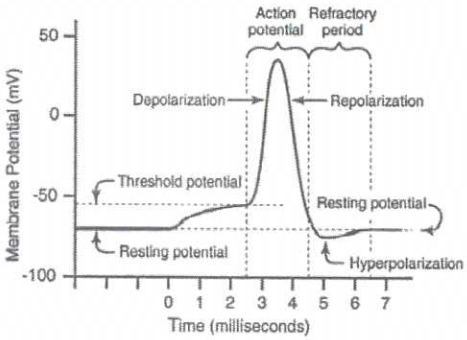
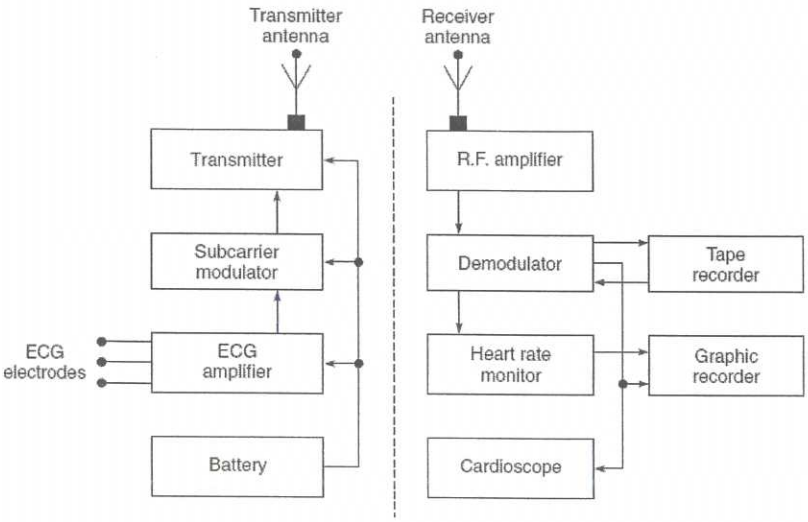
SCHEME OF VALUATION
(Scoring indicators)

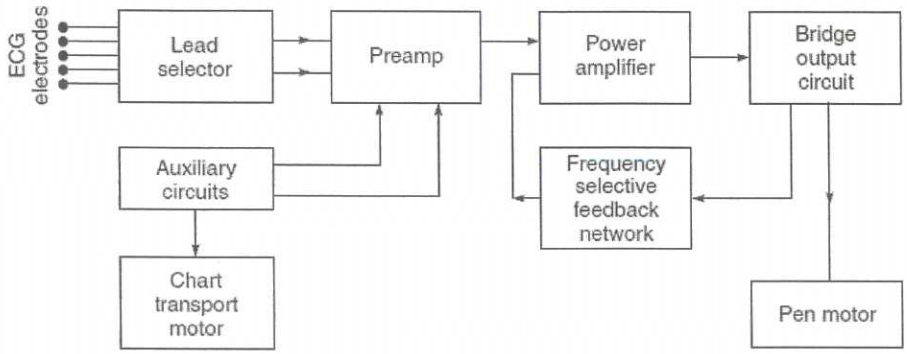
A	Revision : 2015 Course Code: 5044 Course Title : MEDICAL ELECTRONICS			
Qst. No.	**Scoring Indicator**	**Split up score**	**Sub Total**	**Total**
	PART A			
1	ECG, EEG, EMG (any two)	2		
2	120/80 mmHg	2		
3	to prevent exposure to air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, and thus to prevent occupational illness.	2		
4	Radiography-Magnetic Resonance Imaging (MRI)-Nuclear medicine-Ultrasound-Elastography-Photoacoustic imaging (any two)	2		
5	patient care such as telemetry of ECGs from comprehensive coronary concern patients, telemetry of ECG dimensions during use- Collection of therapeutic information from a house or office- Biotelemetry for space living science study- etc	2 (any two)		
	PART B			
1	SA node initiate the heart activity - generates impulses at the normal rate of the heart • The action potential contracts the atrial muscle and the impulse spreads through the atrial wall • Bundle of His carries the action potential to the ventricles • The AV node delay ensures that the atria complete their contraction • Purkinje fibres, after a short distance split into two branches to initiate action potentials simultaneously in the two ventricles	6	6	
2	The membrane- excitable cells permits potassium and chloride ions - blocks sodium ions. • Concentration imbalance of potassium ions - potential difference across the membrane- This membrane potential is called the **resting potential**.			

	• Cell membrane is excited by the flow of ionic current - begins to allow some of the sodium ions to enter- Then the cell has a slightly positive potential on the inside - This potential is known as **action potential**.  	3 3	6	
3	• Proposed by Korotkoff - sounds produced by flow changes is the one normally used in the conventional sphygmomanometers. • The sounds first appear when the cuff pressure falls to just below the systolic pressure. • They are produced by the brief turbulent flow terminated by a sharp collapse of the vessel and persist as the cuff pressure continues to fall. • The sounds disappear or change in character at just below diastolic pressure when the flow is no longer interrupted. • These sounds are picked up by using a microphone placed over an artery distal to the cuff.	6	6	
4	1. Collimation/Non-Divergence A laser beam is collimated, meaning it consists of waves traveling parallel to each other in a single direction with very little divergence 2. Monochromatic Because the wavelength of laser light determines its effect on tissue, the monochromatic property of laser light allows energy to be delivered to specific tissues in specific ways. 3. Coherence Laser light is coherent, which means all the light waves move in phase together in both time and space. A laser has a very tight beam that is strong and concentrated.	2 2 2	6	

5	• Asynchronous contraction of the heart muscles • Coronary occlusion • Electric shock • Abnormalities of body chemistry. • By Defibrillators heart muscle fibres are continuously stimulated by adjacent cells so that there is no synchronized succession of events that follow the heart action. Consequently, control over the normal sequence of cell action cannot be captured by ordinary stimuli.	6	6	
6		6	6	
7	Electrical Medical Technology security is considered: –physiological effects of electricity –possibility (risk) of failures and their consequences –methods of patients and staff protection –standards describing electrical safety –electrical safety testing modes Understanding the possible dangers and risks Implementation in achieving security	6	6	

PART C

III a



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- The potentials picked up by the patient electrodes
- The preamplifier is usually a three or four stage differential amplifier
- The amplified output signal is picked up single-ended and is given to the power amplifier.

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- The power amplifier is generally of the push-pull differential type.
- The output of the power amplifier is single-ended and is fed to the pen motor, which deflects the writing arm on the paper.
- A direct writing recorder is usually adequate since the ECG signal of interest has limited bandwidth.
- The auxiliary circuits provide a 1 mV calibration signal and automatic blocking of the amplifier during a change in the position of the lead switch.

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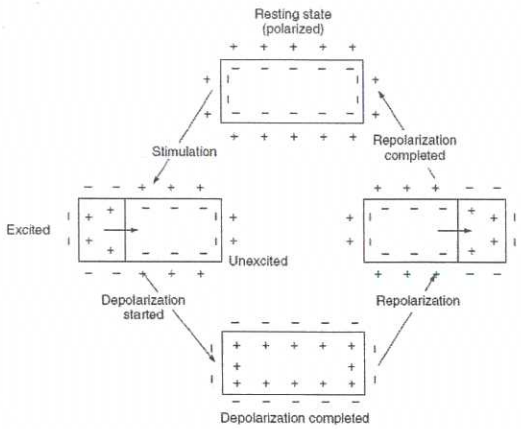
III b



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- Every contraction of a muscle results in the production of an electric voltage.
- This voltage occurs in the muscle in such a way that the moving muscle section is always negative with respect to its surroundings.
- These voltages are called action potentials because they are generated by the action of the muscles.

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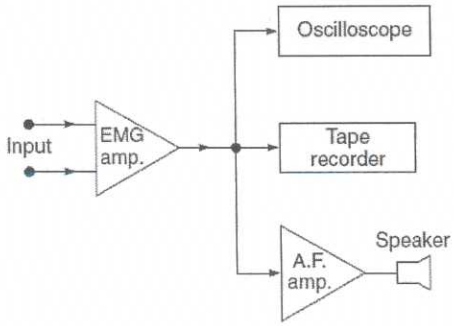
IV a



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- The oscilloscope displays EMG waveforms.
- The tape recorder facilitate playback and study of the EMG sound
- The waveform can also be photographed from the CRT screen by using a synchronized camera.
- EMG is usually recorded by using surface electrodes or more often by using needle electrodes, which are inserted directly into the muscle. The signal can then be amplified and displayed on the screen of a cathode ray tube.

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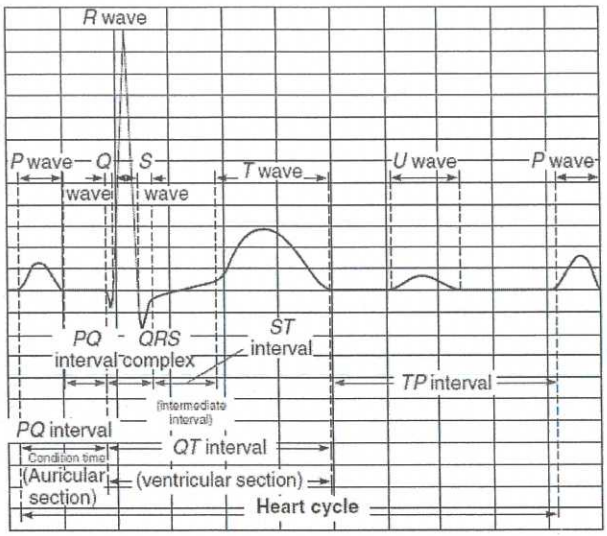
IV b



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- PR andPQ interval-time which an impulse leaving the SA node takes to reach the ventricles.
- PR interval normally lies between 0.12 to 0.2 s.
- QRS interval- represents the time taken by the heart impulse to travel first through the interventricular system and then through the free walls of the ventricles, normally varies from 0.05 to 0.10s.
- T wave represents repolarization of both ventricles.
- QT interval, is the period for one complete ventricular contraction.

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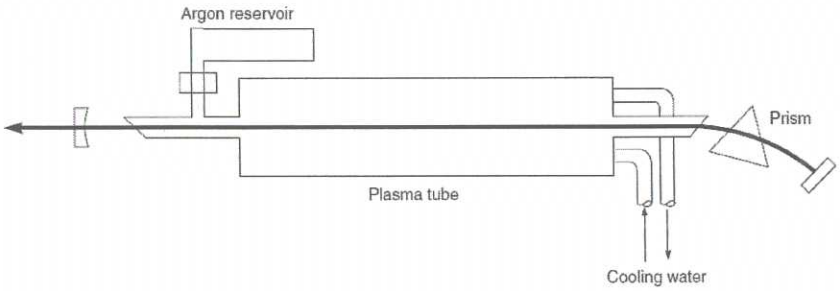
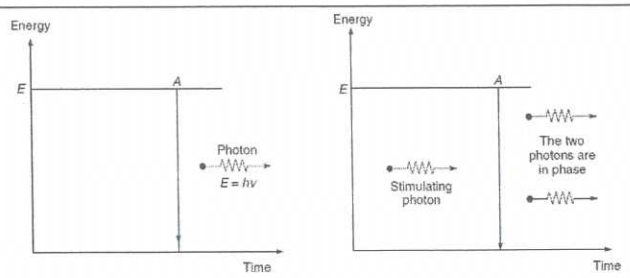
V a	• Erythrocytes (Red Blood Cells): bi-concave disc - diameter 7.5 mm- thickness 1.7 mm- mean surface area of 134mm^2- 120 days- no nucleus- carrying oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs	2		
	• Leucocytes (White Blood Cells): have nucleus- normally 5000–10,000 white cells per cubic mm of blood – live for seven to fourteen days - form the defence mechanism of the body against infection- types: the neutrophils and the lymphocytes	2	6	
	• Thrombocytes (Platelets): tiny, round, oblong or irregularly shaped cells of the blood - diameter of approximately 2 mm- important role in the blood coagulation process- usually 250,000–750,000 platelets in every cubic mm of blood	2		15
V b		5		
	• Plasma tube- a very high current discharge passes down the barrel of the tube through argon gas. • The discharge ionizes the argon gas and also populates the excited ion states which are involved in the lasing. • A strong electrical current is forced to flow through argon gas within the tube, each end of which has a mirror. • The current excites the argon atoms to a higher energy level and some of them begin to emit light spontaneously. • As this light is reflected back and forth between the mirrors, it stimulates additional argon atoms to emit light by forcing them to lower energy levels.	4	9	
VI a	Absorption - Spontanesous emission - Population inversion/pumping	3		



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Applications: Treatment of detached retina- Coagulation in diabetic retinopathy (coagulation of lesions in the retina)- Neuro-surgery (treatment of tissue in the skull and spine)- Gastro-entrology (treatment by coagulation of the lower gastrointestinal tract)- Dermatology (removal of skin imperfections by laser irradiation)- Ear, nose and throat surgery. 3

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VI b **Microscopic Method**: the diluted sample is visually examined and the cells counted- inherent error of the system about 10%- subjective error of ±10% entailing poor reproducibility of the results- poor time and labour utilisation.

Automatic Optical Method: A sample optical system provides a dark field illuminated zone on the stream and the light scattered in the forward direction is collected on the cathode of a photomultiplier tube. Pulses are produced in the photomultiplier tube corresponding to each cell. These signals are amplified in a high input impedance amplifier and fed to an adjustable amplitude discriminator. 6

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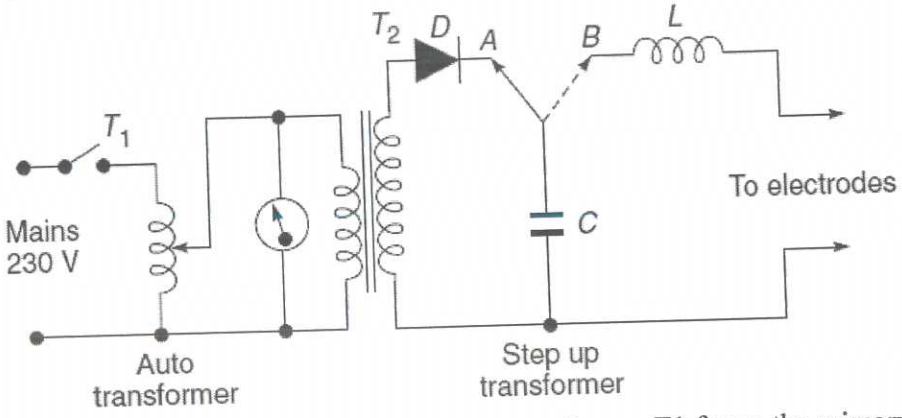
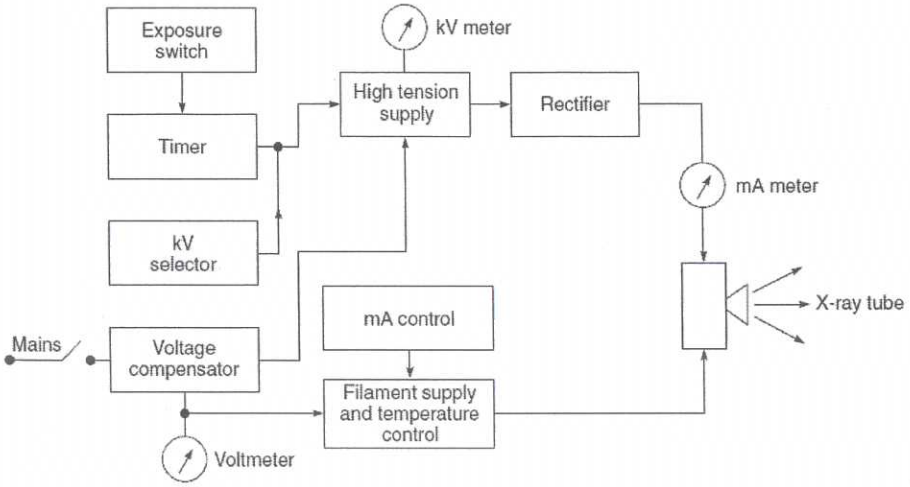
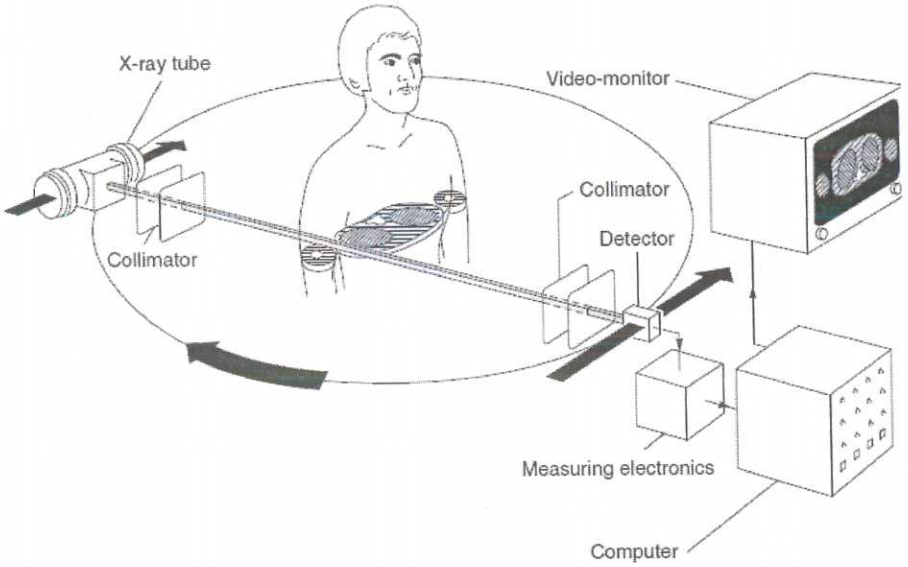
Electrical Conductivity Method: Operating on the principle of conductivity change, which occurs each time a cell passes through an orifice, are generally known as Coulter Counters- useful for determining the number and size of the particles suspended in an electrically conductive liquid.

Coulter counters: A platinum electrode is placed inside the orifice tube and a second electrode is submerged into the beaker containing the cell dilution, creating an electrical circuit between the two electrodes. Current will flow from one electrode to the other through the orifice. When the cell suspension is drawn through the orifice, cells will displace their own volume of electrolyte and cause a resistance change, which is converted to a voltage change, and is amplified and displayed.

VII a		5	9	15
	The basic circuit diagram: A variable auto-transformer T1 forms the primary of a high voltage transformer T2. The output voltage of the transformer is rectified by a diode rectifier and is connected to a vacuum type high voltage change-over switch. In position A, the switch is connected to one end of an oil-filled 16 micro-farad capacitor. In this position, the capacitor charges to a voltage set by the positioning of the auto-transformer. When the shock is to be delivered to the patient, a foot switch or a push button mounted on the handle of the electrode is operated.	4		
VII b	**Shortwave Diathermy** Shortwave diathermy involves the therapeutic application of high-radiofrequency (usually 27.12 MHz [λ = 11.06 m]) electrical currents. Hyperemia, sedation, and analgesia are the basic physiologic effects.	2	6	
	Microwave Diathermy Microwave diathermy, which employs electromagnetic radiation delivered at frequencies substantially higher than those seen with shortwave diathermy, is another deep heat modality that selectively heats tissues with high water concentration	2		
	Ultrasound Diathermy Ultrasound diathermy is a deep heating modality that uses high-frequency acoustic vibrations. The frequencies employed are above the human audible spectrum (ie, higher than 17 kHz), typically in the range of 0.8-1.0 MHz. Energy is generated via the piezoelectric effect;	2		
VIII a	**A machine used in dialysis** that filters a patient's blood to remove excess water and waste products when the kidneys are damaged,dysfunctional, or missing. 1)mixes the dialysate- 2)monitors the dialysate- 3)pumps the blood and controls administration of anti-coagulants- 4)monitors the blood for the presence of air and drip chamber pressure- 5)monitors the ultra-filtration	2 5	7	15

VIII b	**Pressure-cycled ventilators**: Gas is allowed to flow into the lungs until a present airway pressure limit is reached, at which time a valve opens allowing exhalation to ensue. The volume delivered by the ventilator varies with changes in airway resistance, lung compliance, and integrity of the ventilatory circuit.	4	8	
	Volume-cycled ventilators are those in which both the tidal volume and the breathing rate are set in advance and are controlled by the machine. Pressure-cycled ventilators are those in which the inspiration phase is interrupted when the pressure in the lungs reaches a preset value.	4		
IX a		5	9	
	X-rays can be generated by an X-ray tube, a vacuum tube that uses a high voltage to accelerate the electrons released by a hot cathode to a high velocity. This beam travels through the air, comes into contact with our body tissues, and produces an image on a metal film. Soft tissue, such as skin and organs, cannot absorb the high-energy rays, and the beam passes through them. Dense materials inside our bodies, like bones, absorb the radiation.	4		15
IX b	A magnet, which provides a strong uniform, steady, magnet field- An RF transmitter, which delivers radio-frequency magnetic field to the sample- A gradient system, which produces time-varying magnetic fields of controlled spatial nonuniformity- A detection system, which yields the output signal- and- An imager system, including the computer, which reconstructs and displays the images.	6	6	

X a



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CT is based on the fundamental principle that the density of the tissue passed by the x-ray beam can be measured from the calculation of the attenuation coefficient. ... Unlike x-ray radiography, the detectors of the CT scanner do not produce an image.

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X b

1. The ultrasound machine transmits high-frequency (1 to 5 megahertz) sound pulses into your body using a probe.
2. The sound waves travel into your body and hit a boundary between tissues (e.g. between fluid and soft tissue, soft tissue and bone).
3. Some of the sound waves get reflected back to the probe, while some travel on further until they reach another boundary and get reflected.
4. The reflected waves are picked up by the probe and relayed to the machine.
5. The machine calculates the distance from the probe to the tissue or organ (boundaries) using the speed of sound in tissue (5,005 ft/s or1,540 m/s) and the time of the each echo's return (usually on the order of millionths of a second).
6. The machine displays the distances and intensities of the echoes on the screen, forming a two dimensional image like the one shown below.

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