BIOMEDICAL INSTRUMENTATION

[16EE766]

SEVENTH SEMESTER

REGULATION - 2016

PREPARED BY

Dr.C.GOWRI SHANKAR

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

K.S.R. COLLEGE OF ENGINEERING

(AN AUTONOMOUS INSTITUTION, AFFILIATED TO ANNA UNIVERSITY CHENNAI)

K.S.R. KALVI NAGAR, TIRUCHENGODE – 637 215

NAMAKKAL (DT), TAMILNADU, INDIA.

Part –A (2 Marks)

K.S.R COLLEGE OF ENGINEERING, TIRUCHENGODE - 637 215

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

LESSON PLAN

B.E Electrical and Electronics Engineering

(Academic Year: 2019- 2020 / Odd Semester)

Subject : 16EE766 –Bio Medical Instrumentation **Year / Sem :** IV / VII

Regulation : 2016 **Staff Name : Dr.C.Gowri Shankar**

LECTURE	TOPIC	HOURS	TEACHING AID	SOURCE	PAGE. NO
UNIT I ELECTRO PHYSIOLOGY					
1	Cell & its structure	1	LCD	R1	1, 3
2	Electrical and chemical activities ,Action and resting potential	1	LCD	R1	19, 22
3	Neurons – Axons – Synapse	1	LCD	R1	81
4	Organization of nervous system , CNS, PNS	1	LCD	R1	79
5	Propagation of electrical impulses along the nerve	1	LCD	R1	14
6	Sodium pump	1	LCD	R1	20
7	Physiology of heart	1	LCD	R1	92
8	Cardio pulmonary system	1	LCD	R1	94
9	Physiology of lung	1	LCD	R1	140
Total		**9**			
UNIT II BIO POTENTIAL ELECTRODES AND TRANSDUCERS					
10	Components of biomedical instrument system	1	BB	R1	02
11	Electrodes: Micro electrodes & Needle electrodes	1	BB	R1	28,31,34
12	Surface electrodes	1	BB	R1	31
13	Piezo–electric transducers	1	BB	R1	42
14	Ultrasonic transducers	1	BB	R1	47
15	Resistive & Capacitive transducers	1	BB	R1	38, 41
16	Inductive transducers	1	BB	R1	40
17	Isolation amplifier & Pre–amplifier	1	BB	R1	60,61
18	Current amplifier & Chopper amplifier	1	BB	R1	62,64
Total		**9**			

UNIT III **INSTRUMENTS USED FOR DIAGNOSIS**					
19	ECG – Einthoven triangle	1	LCD	R1	93,103,105
20	Leads & Electrodes of ECG	1	LCD	R1	102
21	EEG & EMG	1	LCD	R1	87
22	Measurement of cardiac output, heart rate and heart beat	1	BB	R1	113,120
23	Blood flow measurements – Holter monitor	1	BB	R1	122
24	Respiratory rate measurement	1	BB	R1	143,144
25	Oximeter	1	BB	R4	267
26	Blood gas analyzer : pH, pO_2& pCo_2 Measurement	1	BB	R1	147
27	Glucometer	1	BB	R1	148
Total		**9**			
UNIT IV **MEDICAL IMAGING**					
28	Radio graphic and fluoroscopic techniques	1	LCD	R1	198
29	Computer tomography	1	LCD	R1	203
30	MRI	1	LCD	R1	208
31	Ultrasonography	1	LCD	R1	190
32	Endoscopy	1	LCD	R1	237
33	Thermography	1	LCD	R4	367
34	Different types of bio telementary systems	1	LCD	R1	157
35	Patient monitoring	1	LCD	R1	132
36	Sources of electric hazards and safety techniques	1	LCD	R1	175
Total		**9**			
UNIT V **ASSISTING AND THERAPEUTIC EQUIPMENTS**					
37	Pacemaker	1	LCD	R1	240
38	Defibrillators	1	LCD	R1	222
39	Ventilators	1	LCD	R1	253
40	Nerve and muscle stimulators	1	LCD	R1	218
41	Diathermy	1	LCD	R1	229
42	Heart lung machine	1	LCD	R1	247
43	Audio meters	1	LCD	R1	270
44	Dialysers	1	LCD	R1	233
45	Lithotripsy	1	LCD	R7	187
Total		**9**			

Teaching Aid:

1. BB - Black Board.
2. LCD - LCD Projector.
3. OHP - Over Head Projector.
4. Media - Multimedia.
5. Model - Physical Mode**.**

Reference Books:

R1. R. Anandanatarajan, **Biomedical Instrumentation and Measurements**, First edition, PHI learning Private Limited, 2013.

R2. R.S.Khandpur, **Hand Book of Bio–Medical instrumentation**, Tata McGraw Hill Publishing Co Ltd., 2nd edition, 2003.

R3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, **Bio–Medical Instrumentation and Measurements,** 2nd edition, Pearson Education, 2002 / PHI.

R4. M.Arumugam, **Bio–Medical Instrumentation**, 2nd edition, Anuradha publications, 2003.

R5. L.A. Geddes and L.E.Baker, **Principles of Applied Bio–Medical Instrumentation**, John Wiley & Sons, 3rd edition, 1989.

R6. J.Webster, **Medical Instrumentation Application and Design**, John Wiley & Sons, 3rd edition, 2004.

R7. Mandeep Singh, **Introduction to Biomedical Instrumentation,** First edition, PHI learning Private Limited, 2010.

Faculty Signature **HOD/EEE**

1. **Define resting potential (CO1, Remembering)**

   The membrane of excitable cells such as nerve cell, muscles cell readily permit the entry of K and the Cl ions while it effectively block the entry of Na ion. Due to difference in the permeability of different ions the concentration of sodium inside the cell becomes much lower than outside the cell. Since the Na ions are positive, the outside cell is more positive than inside. Due to this ion movement, there will be a potential developed across the membrane is called resting potential and it ranges from -60 mV to -100 mV.

2. **Define Action potential (CO1, Remembering)**

   When a cell membrane is excited by the flow of ionic movement or by some factors of externally applied energy, the permeability of the membrane changes so that the sodium ions are allowed to enter inside the cell. As a result the Na ions rush into the cell and try to balance the ions outside. At the same time k ions are leaving the cell but are unable to move as rapidly as Na ions. Thus the cell has a positive potential inside the cell. The positive potential of the cell membrane during excitation is called action potential and is about 20mv.

3. **Write the characteristics of resting potential. (CO1, Remembering)**

   a) The value of resting potentials maintained as constant until some kind of disturbance upsets the Equilibrium. b) It strongly depends on the temperature. c) Since the permeability of the cells varied, the resting potential varied.

4. **Define all-or -nothing law (CO1, Remembering)**

   Regardless of the method of excitation of cells or the intensity of the stimulus, which is assumed to be greater than the threshold of stimulus, the action potential is always the same for any given cell. This is known as the all-or- nothing law.

5. **Define absolute refractory period (CO1, Remembering)**

   Absolute refractory period is the duration of cell no response to further stimuli. It is about 1 milliseconds.

6. **Define relative refractory period (CO1, Remembering)**

   Relative refractory period, during which another action potential can be triggered but a higher Stimulus is required to reinitiate an action potential and the subsequent contraction of muscles. In the nerve cells, the relative refractory period is several milliseconds.

7. **Define propagation rate or conduction velocity (CO1, Remembering)**

   The rate at which an action potential moves down a fiber of a cell or is propagated from cell to cell is called the propagation rate or conduction velocity.

8. **Define inhibitory post synaptic potential (IPSP). (CO1, Remembering)**

   If the transmitter substance in inhibitory, the membrane potential of the receptor neuron increases in a negative direction. So that it is less likely to discharge, this induced potential change is called inhibitory post synaptic potential.

9. **Define excitory post synaptic potential (EPSP). (CO1, Remembering)**

If the transmitter substance is excitatory, the receptor membrane potential increases in a positive direction. So that the receptor neuron is more likely to discharge and produces a spike potential. This induced change is called excitory post synaptic potential(EPSP).

10. Define Electrode. (CO2, Remembering)

Electrodes are employed to pick up the electrical signals. The types of electrode to be used depend upon the anatomical location of bioelectrical event and the dimensions of the bioelectrical generator.

11. Define half cell potential. (CO2, Remembering)

The voltage developed at an electrode-electrolyte interface is designated as half cell potential or electrical potential.

12. What is the purpose of electrode paste? (CO2, Remembering)

The electrode paste decrease the impedance of the contact and it also reduces the artifacts resulting from movement of the electrode or patient.

13. What are the types of electrodes? (CO2, Remembering)

i. Microelectrodes
ii. Depth and needle electrodes
iii. Surface electrodes

14. **What is ECG? (CO3, Remembering)**

The Electro Cardio Graphy (ECG) deals with study of the electrical activity of the heart muscles. The potentials originated in the individual fibers of heart muscles are added to produce the ECG waveform.

15. **What is ECG lead configuration? (CO3, Remembering)**

i. Bipolar limb lead or standard leads,
ii. Augumented unipolar limb leads,
iii. Chest leads or precodial leads,
iv. Frank lead system or corrected orthogonal leads

16. **What is PCG? (CO3, Remembering)**

The graphic record of the heart sound is called phonogram. Because, the sound is from the heart, it is called phonocardiogram. The instruments used to measure the heart sound are called phonocardiograph.

17. **What are the characteristics of heart sound and murmurs? (CO3, Remembering)**

Heart sounds have transient character and are of short durations. Heart murmurs have a noisy Characteristics and last for a longtime. But in general heart sounds are due to the closing and opening of the valves, whereas the murmurs are due to the turbulent flow of blood in the heart and large vessels.

18. What are the types of the heart sounds? (CO3, Remembering)

i.valve closure sounds, ii.ventricular filling sounds, iii.valve opening sounds, iv.Extra cardiac sounds

19. Mention the medical application of the phonocardiography(CO3, Remembering)

RHEUMATIC VALVULAR LESIONS: The greatest number of valvular lesions results from rheumatic fever. Rheumatic fever is an autoimmune or allergic disease in which the heart valves are likely to be damaged or destroyed .This can be detected by phonocardiography.

20. **Mention the special applications of phonocardiography. (CO3, Remembering)**

FETAL PHONOCARDIOGRAM: A stethoscope microscope with a large chest piece is applied over that part of the maternal abdomen where auscultation reveals fetal heart tones. Simultaneously with the fetal sound tracing maternal ECG is recorded for comparison.

21. What is EEG? (CO3, Remembering)

Electroencephalography deals with the recording and study of electrical activity of brain. By means of electrodes attached to the skull of the patient the brain waves can be picked up and recorded.

22. What is evoked potential? (CO3, Remembering)

Evoked potential are the potential developed in the brain as the response to the external stimuli like light and sound etc. The external stimuli are detected by the sense organs which cause changes in the electrical activity of the brain.

23. What are the types of brain waves? (CO3, Remembering)

i)Alpha waves(8-13Hz), ii)Beta waves(13-30Hz), iii)Theta waves(4-8Hz), iv)Deltawaves(0.5-4Hz)

24. What is EMG? (CO3, Remembering)

Electromyography is the science of recording and interpreting the electrical activities of muscles action potentials. The contraction of the muscles produces the action potentials.

25. Define latency and conduction velocity. (CO3, Remembering)

Latency is defined as the elapsed time between the stimulating impulse and the muscles action potential. Conduction velocity = (l1-l2)/(t1-t2)

26. What is EOG? (CO3, Remembering)

A record of corneal-retinal potentials associated with eye movement is called electrooculogram. One pair of skin electrode on either side of eye for recording horizontal movement of eyes and another pair of electrodes on the forehead and cheeks for recording vertical movement of eye.

27. What are the advantages of EOG? (CO3, Remembering)

i. Diagnosis of the neurological disorder.
ii. The level of anesthesia can be indicated by the characteristic eye movement
iii. The effect of certain drugs on the eye movement system can be determined.
iv. The state of the semicircular canals is analyzed by EOG.

28. What is graded potential? (CO3, Remembering)

Average value of the resting potential in the brain surface. The potential to be recorded all the way through the skull the large number of neurons must exit electric current

simultaneously. Synchronously discharge (action potential) and partially discharge (resting potential).

29. **What are the frequency range of ECG, EEG and EMG waves? (CO3, Remembering)**

ECG/EEG: 0.3-50 Hz. EMG: 50-500 Hz

30. **What do you mean by Bio electric potential? (CO3, Remembering)**

Bio Electric potential generated at cellular level.Each cell is minute voltage regulator because +ve and –ve ions concentrate unequally inside and outside the cell wall,a potential difference is generated called resting potential and then cell becomes a tiny biological battery. Eg: ECG,EEG,EMG,EOG and ERG.

31. Define Epilepsy? Mention its types also. (CO3, Remembering)

Brain damage results in Epilepsy. The types are Grandmal and Peritmal.

32. What do you mean by Montage? (CO3, Remembering)

Electrodes are attached to the channel selector in groups of eight called Montage.

33. Define Ectopic Beat? (CO3, Remembering)

It is the beat starts in a abnormal location of heart and is often premature.It is also called premature ventricular contraction.It occur sooner than the next expected beat.

34. Define Nernst Equation? (CO3, Remembering)

$V_R = -KT /Q \ln([K^{+}]_i /[K^{+}]_o)$,

V_R = Resting Potential, K = Boltzman constant,

T=Absolute temperature in Kelvin, Q=Charge of an electron

35. What are the vital parameters measured in ICU? (CO3, Remembering)

Heart Rate, ECG, Blood Pressure, Temperature, Respiration, Pulse Rate.

36. List the conditions satisfied by a bio-signal amplifier. (CO2, Remembering)

- The gain and the frequency response should be more than 100 db. So as to amplify the bio-signal property to drive the recorder.
- It should have 10 W frequency response from d.c. to required frequency of the particular bio-signal.
- The gain and the frequency response should be uniform throughout the required bandwidth.
- The output impedance of the amplifier should be very small.
- The common mode rejection ratio (CMRR) should be at least a differential amplifier.

37. For what purpose isolation amplifier is used? . (CO2, Remembering)

Isolation amplifier is used to increase the input impedance of the monitoring system in order to isolate the patient from the biomedical instrument.

38. Define noise figure. . (CO2, Remembering)

The amount of degradation of the signal can be defined in terms of the noise figure. (nj) as defined as Noise figure = signal to noise ratio at the input signal to the output signal.

39. For what purpose line driving amplifier is used? . (CO2, Remembering)

Whenever a transducer has high impedance and its output voltage is so low and if want to couple this transducer output to a load having low impedance, we can use line driving amplifier.

40. Define CMRR. . (CO2, Remembering)

The ability of the differential amplifier circuit to ignore common mode inputs like 50 HZ interference from mains is known as common mode rejection ratio (CMRR). Thus CMRR = amplification of the differential voltage amplification of the common mode voltage.

41. What is a blood flowmeter? . (CO3, Remembering)

Blood flow meters are used to monitor the blood flow in various blood vessels and to measure cardiac output.

42. **What is a electromagnetic blood flow meter? (CO3, Remembering)**

The electromagnetic blood flowmeter is suitable for determining the instantaneous flowrates in intact vessels and consist of certain useful features like good linearity, direction sensitivity and capability of monitoring pulsatile flow.

43. What is the principle used in blood flowmeter? (CO3, Remembering)

It is the based on the principle of Faraday's law of Induced e.m.f.

44. Mention the applications of electromaganetic blood flowmeters? (CO3, Remembering)

1. Blood flow measurements in cardiac surgery, 2. Blood flow measurements in peripheral arterial surgery, 3. Blood flow measurements in shunt operations, 4. Blood flow measurements in the carotid artery 5. Blood flow measurement in renal arteries, 6. Blood flow measurements in organ transplantation

45. **What is ultrasonic blood flow meter? (CO3, Remembering)**

Ultrasonic blood flow meter are used to measure the velocity of a stream of blood, a moving heart valve or the motion of artery in response to a pressure pulse.Early ultrasonic bloodmeters were based on the transmit time principle.

46. Define Doppler Effect? (CO3, Remembering)

Doppler Effect refers to the apparent change in frequency of the sound wave emitted by the source when there is a relative motion between the source and observer.

47. **What is cardiac output? (CO3, Remembering)**

Cardiac output is the amount of blood deliverd by the heart to the aorta per minute.A decrease in cardiac output may be due to low blood pressure, reduced tissue oxygenation, poor renal function, shock and acidosis.

48. What are the methods used in cardiac output measurements? (CO3, Remembering)

1. Fick's method, 2. Indicator dilution method 3. Measurement of cardiac output by impedance change

49. Mention the advantages of cardiac output measurements? (CO3, Remembering)

Indicator dilution is more useful when there are no severe heart defects such as congenital mal formations where the blood recirculates more rapidly due to presence of shunts between the right and left halves of the heart. The impedance method is a non-invasive one, by which one can monitor the cardiac output during each stroke volume.

50. What is the use of Blood gas analyzers? (CO3, Remembering)

Blood gas analyzers are mainly used to measure the partial pressure of hydrogen (pH), carbon dioxide (pCo2) and oxygen (pO2) present in the human blood.It I used for determining the acid base balance in the body.

51. How to calculate potential difference in electro magnetic blood flow meter? (CO3, Remembering)

Potential difference is the sum of flow signal and transformer e.m.f.

52. What is source impedance in electromagnetic blood flow meter? (CO3, Remembering)

Source impedance of an electromagnetic flowmeter is the sum of the electrode impedance and the impedance of the fluid. If the source impedance varies then the baseline stability, noise level and measured flow values will vary.

53. Which wave is replaced by square wave in electro magnetic blood flow meter? (CO3, Remembering)

Due to practical difficulties involved in generation of a square wave, trapezoidal current waveform has been used as alternative.

54. In which principle ultrasonic blood flowmeter works? (CO3, Remembering)

It works on transmit time principle.

55. At which frequency the reflection of Doppler is shifted? (CO3, Remembering)

The frequency is about 267 Hz on reflection from the moving body.

56. Give the different diagnostic sound in Doppler blood flowmeter? (CO3, Remembering)

Thump, Thump- low frequency note, rapid rhythm-fetal heart movement.
Swish, Swish-high frequency note, rapid rhythm-umbilical cord sound.
Thuummp, Thuummp - low frequency note, slow rhythm-mother's body movement due to vibrations transmitted from the heart.
Wooooch. Wooooch- mid frequency note, slow rhythm-mother's arteries.

57. Give the advantage of Pulsed Doppler blood flow meter? (CO3, Remembering)

Blood vessel diameter and blood velocity are measured accurately.

58. What is Fick's method? (CO3, Remembering)

It is based on the determination of cardiac output by the analysis of gas-keeping of the organism.

59. What is Indicator dilution method? (CO3, Remembering)

It is based on the principle that if we introduce a known amount of dye or radioisotope as an indicator in the blood circulation.

60. By which electronically cardiac output is measured? (CO3, Remembering)

Impedance method is used to calculate cardiac output electronically.

61. What is Electrophoresis? (CO3, Remembering)

Electrophoresis is a method for separating and analyzing macromolecular substances such as plasma proteins. The method is based on the fact that, the molecules carry electric charges and therefore migrate in a electric field.

62. What are the factors affecting migration of ions? (CO3, Remembering)

1. Magnitude of charge 2. Ionic strength of buffer 3. Temperature 4. Time

63. **Write the types of Electrophoresis? (CO3, Remembering)**

1. Cellulose acetate Electrophoresis 2. Immuno Electrophoresis

64. Define PH. How it is related with blood? (CO3, Remembering)

The PH is defined as the logarithm of the reciprocal of W ion concentration. i.e. PH = log10 (1/W) = - log10 (W), the chemical balance of the body is identified by the measurement of PH of blood and other body fluids.

65. Discuss about blood cells. / What are the components of blood? (CO3, Remembering)

The blood cells have important functions in our body. The red blood cell is used for the transport of oxygen and carbon dioxide. The white blood cells are part of the body's defense against infections and foreign substances. The platelet are involved in the clotting of blood.

66. For what purpose colorimeters and photometers are used? (CO3, Remembering)

Colorimeters and photometers are used to measure he transmitted and absorbed light as it passes through a sample.

67. What is flame photometer? (CO3, Remembering)

By measuring optical density or absorbance A, the concentration of given substance in the sample can be determined. Colorimeters can be in the filter photometer or spectrophotometer. When an interference filter is used to select a given wavelength, it is called filter photometer.

68. Define systole. (CO3, Remembering)

Systole is defined as the period of contraction of the heart muscles, specifically the ventricular muscle at which time blood is pumped into pulmonary artery and the aorta.

69. Define diastole. (CO3, Remembering)

Diastole is defined as the period of dilation of the heart cavities as they fill with blood.

70. Where are pressures present in different areas of the heart? (CO3, Remembering)

Parts of Heart	Systolic pressure/diastolic

	pressure
a.Aorta	130/75
b.left ventricle	130/5
c.right ventricle	25/0
d.left atrium	9/5
e.right atrium	3/0
f.pulmonary artery	25/12

71. What is stroke volume? (CO3, Remembering)

Stroke volume is the amount of blood pumped by the left ventricle of the heart in one contraction.

72. **Define pacemackers? (CO5, Remembering)**

73. Pacemaker is an electrical pulse generator for starting and/or maintaining the normal heart beat. The o/p of the pacemaker is applied either externally to the chest or internally to the heart muscle.

74. What is a pluse of energy applied on heart muscles? (CO5, Remembering)

The minimum energy required to excite the heart muscle is about 10μJ.For better simulation &safety purposes, a pulse of energy 100μJ is applied on the heart muscle.

75. What are the methods of simulation? (CO5, Remembering)

i) External simulation ii) Internal simulation.

76. Define External Stimulation(CO5, Remembering)

External simulation is employed to restart the normal rhythm of the heart in the case of cardiac stand still. Stand still can occur during open-heart surgery or wherever there is a sudden physical shock stand still.

77. Define Internal Simulation(CO5, Remembering)

Internal simulation employed in cases requiring long term pacing because of permanent damage that prevents normal self triggering of the heart.

78. Define asynchronous pacing? (CO5, Remembering)

Asynchronous pacing is called competitive pacing because the fixed rate impulses may occur along with natural pacing impulse and would therefore in competition with them in controlling the heart beat. The noncompetitive pacemakers are generally programmed either in demand or synchronized mode.

79. What are the Types of pacemakers? (CO5, Remembering)

Based on the modes of operation of the pacemakers, they can be divided into five types:

1.Ventricular asynchronous pacemaker(fixed rate pacemaker),

2.Ventricular synchronous pacemaker

3.ventricular inhibited pacemaker(demand pacemaker),

4.atrial synchronous pacemaker

5.atrial sequential ventricular inhibited pacemaker.

80. What is a Demand pacemaker? (CO5, Remembering)

If the R wave is missing for a preset period of time, the pacer will supply a stimulus. therefore if the heart rate falls below a predetermined minimum ,the pacemaker will turn on and provide the heart a stimulus. For this reason it is called a demand pacemaker.

81. Define defibrillators? (CO5, Remembering)

A defibrillator is an electronic device that creates a sustained myocardial depolarization of a patient's heart in order to stop ventricular fibrillation or atrial fibrillation .ventricular fibrillation is a serious cardiac emergency resulting from asynchronous contraction of the heart muscles.

82. Types of defibrillators? (CO5, Remembering)

There are two types of defibrillators based on the electrode placement .

i. Internal defibrillator.
ii. External defibrillator .

83. Types of external defibrillators? (CO5, Remembering)

1.A.C.defibrillator 2. D.C.defibrillator, 3. synchronized D.C.defibrillator 4. square pluse defibrillatorDouble square pluse defibrillator 6. Biphasic D.C.defibrillator.

84. Disadvantages of ventricullar asynchronous pacemackers? (CO5, Remembering)

a) Using the fixed rate pacemaker, the heart rate cannot be increased to match greater physical effort.

b) Stimulation whit a fixed pulse frequency results in the ventricles and atria beating at different rates. This varies the stoke volume of the heart which causes some loss in the cardiac output.

c)possibility for ventricular fibrillation will be more, when we use it for patients with unstable block due to interference b/w the ventricular contractions evoked by the pacemaker and the atria.

85. Advantages of ventricular synchronous pacemackers? (CO5, Remembering)

To arrest the ventricular fibrillation, this circuit can be used. If the R-wave occurs with its normal value in amplitude and frequency then it would not work. Therefore the power consumption is reduced and there is no change of getting side effects due to competition b/w natural and artificial pacemaker pluses.

86. Function of dual peak defibrillators? (CO5, Remembering)

The passage of high current may damage the myocardium & the chest wall. To reduce this risk, some defibrillators produce dual peak waveform. This keeps the stimulus at peak voltage for longer duration. Same energy can be applied to the heart with low current level. Such defibrillators are called dual peak defibrillators.

87. What is diathermy? List its types. (CO5, Remembering)

Diathermy is the treatment process by which cutting, coagulation of tissues are obtained. Its various types are: Shortwave diathermy, Microwave diathermy, Ultrasonic diathermy.

88. Ideal conditions for oxygenerators? (CO5, Remembering)

i. Lower priming volume

ii. Minimum trauma to blood
iii. Simple,safe&reliable operation
iv. Ensured sterilization
v. No microembolus formation and
vi. Short preparation time.

89. What are the electrosurgery techniques using in diathermy unit? (CO5, Remembering)

i. Fulguration
ii. Desiccation
iii. Electrotomy
iv. Coagulation
v. Blending.

90. **Define heart-lung machine?/ Why do we require heart lung machine? (CO5, Remembering)**During open heart surgery for installation of a valve prosthesis or correction of a congenital mal formation, the heart cannot maintain the circulation. It is then necessary to provide extra-corporeal circulation with a special machine called heart lung machine.

91. Types of oxygenerators? (CO5, Remembering)

i. Buddle oxygenators,
ii. Film oxygenators,
iii. Membrane oxygenators
iv. liquid-liquid oxygenators

92. What is meant by computer tomography? (CO4, Remembering)

A new method of forming images from X-rays is called computer tomography. It is referred as computerized axial tomography or computer transmission tomography or computer tomography (CT).

93. What is back projection reconstruction? (CO4, Remembering)

It is simple calculation. It can illustrate how the attenuation values along the surface of a transverse slice can be computed from the externally measured attenuation factors.

94. Give the types of artifacts? (CO4, Remembering)

i) Noise ii) Motion artifacts
iii) Artifacts due to high differential absorption in adjacent tissues iv)Technical errors and computer artifacts.

95. What is CT stereotaxy? (CO4, Remembering)

It is an innovation for diagnostic and therapeutic procedures in brain without open surgery.

96. What are the degenerative diseases? (CO4, Remembering)

Cerebral atrophy, helminthic infestations of brain and chronic inflammatory diseases like tuberculomas.

97. Mention any four uses of CT scan in thorax? (CO4, Remembering)

i) In the screening of high risk group (e.g., chronic smokers) for early detection of lung cancer.

ii) When conventional chest X-rays do not reveal a lesion but sputum examination shows malignant cells.

iii) In differential diagnosis of solitary pulmonary noduly (SPN) whether it is malignant (CT density below 150) or non-malignant (CT density above 150)

iv) CT guided FNAC for lung lesions and mediastinal tumors.

98. Define ultrasound. (CO4, Remembering)

Ultrasound is a form of energy which consists of mechanical vibrations and the frequencies of which consist mechanical vibrations and the frequencies of which are so high that are above the range of human hearing.

99. What is known as damping? (CO4, Remembering)

The vibrations of the piezo-electric crystal produces the ultrasound waves in the pulsed type of ultrasound which is correctly used for imaging, the vibrations have to be controlled effectively. This is achieved by a process called “damping”.

100. What are two conditions that have to be fulfill by damping? (CO4, Remembering)

i) The impedance of the material and crystal must be the same. This will reduce the reflection at the boundary, between crystal and the material.

ii) The sound waves going into backing material must be totally absorbed. This helps in transmission of short pulses of sound waves into the medium.

101. Write about convex array of ultrasonic imaging systems? (CO4, Remembering)

i. The convex array transducer has a number of elements like the linear array but these elements are arranged in a curvilinear fashion .this transducer produces a trapezoid shaped image format.

ii. The advantages of this type of transducer are that one can have a very wide far field view. Transducers are of various frequencies .higher the frequency, better the resolution, poorer the penetration.

102. Define ultrasonography. (CO4, Remembering)

Ultrasonography is a technique by which ultrasonic energy is used to detect the state of the internal body organs.

103. What is Acoustic impedence? (CO4, Remembering)

Various tissues offer varying degrees of resistance to the passage of sound and this is called Acoustic impedance. This determined by the formula. Z=dxc.

Here Z is the Acoustic impedance, d is the density of the medium and c is the velocity.

104. Define Specular reflection(CO4, Remembering)

It occurs when the interface is larger than the sound beam. Here the angle of reflection is equals to angle of incidence.

E.g., capsule of liver and kidney ,aorta, gallbladder.

105. Define non-specular reflection. (CO4, Remembering)

It occurs when the interface is smaller than the sound beam.

E.g., parenchymal tissue echoes such as those arising between cells and small vessels.

106. What is called Resolution and what are the types of resolution? (CO4, Remembering)

It is the ability to show two closely spaced interfaces as separate echoes on the screen. Resolution should be considered in two axes, that are

i) Axial resolution - Longitudinal axis
ii) Lateral resolution – Horizontal axis

107. What are the types of modes of Display? (CO4, Remembering)

The reflected echoes are now displayed on the screen as a useful image. The various modes of display are:

i. A-mode,
ii. B-mode,
iii. M-mode or T-M mode.

108. Define Doppler mode(CO4, Remembering)

This mode is used for the study of blood flow in various vessels and across the valves in the heart. It has the applications in echo-cardiography, peripheral vascular diseases and in obstetrics.

109. What are the various types of recording devices? (CO4, Remembering)

i) The Polaroid camera	ii) 35mm camera	iii) Multiformat camera
iv)Strip chart recorder	v)Video printer	vi)Video recording

110. Write the classifications of artifacts. (CO4, Remembering)

ii) Those related to instrument problems
iii) Artifacts due to improper operator technique
iv) Unavoidable artifacts-because of the interaction of sound with the tissues.

111. What is as “angiodynography”? (CO4, Remembering)

Real-time color Doppler is now available for actual visualization of blood flow. This shows flow away from the probe in red color and flow towards the probe in blue color.

Color Doppler is very useful in the evaluation of congenital anomalies of the heart. It is also used in peripheral vascular blood flow evolution like carotid arteries and other peripheral vessels – which is called “angiodynography”.

112. What are the advantages of MRI? (CO4, Remembering)

i. Superior contrast resolution
ii. Direct multiplanar imaging, slices in the sagitial , coronal and oblique directions can be obtained directly.
iii. There is a total absence of harmful radiations like X-rays, γ-rays, positrons,etc.Hence making it as a noninvasive imaging technique.

113. What is known as Free Induction decay (FID)? (CO4, Remembering)

The loss of transverse magnetization as consequence of frequency or a time domain signal of a NMR line results that is known as Free Induction decay.

114. What are the three principles of MRI parameters? (CO4, Remembering)

i) spin Density
ii) spin-latice (longitundinal) relaxation time,T1
iii) spin-spin or transverse relaxation time, T2

115. Explain Magnetic field strength and gradients? (CO4, Remembering)

MRI systems are generally characterized by the strength of magnetic field. Most imaging procedure are performed with field strengths in the range of 0.3 to 1.5 telsa, although imaging outside this range is possible. The strength of the magnetic field determines the tissue resonant frequency. This is the frequency that is receptive to the RF pulses applied to the tissue and is also the frequency of the RF signals during the imaging process.

116. What is meant by free induction decay? (CO4, Remembering)

In NMR, at room temperature there are more photons in a low energy state than in the high energy state. The excited photon tends to return or relax to its low energy states with spontaneous decay and re-emissions of energy at a later time T in the form of radio wave photons. This is Free Induction Decay

117. Mammograms are used for what purpose? (CO4, Remembering)

It is used to detect breast cancer or tumor.

118. What are the characteristics of a good thermo graphic equipment? (CO4, Remembering)

- Short frame time(less than 4seconds),
- High resolution (more than 100,000 picture elements)
- A small size and light weight optical head,
- A wide spectrum band detector near the wavelength of 10 microns,
- Absolute temperature can be measurable.

119. What is meant by thermography? (CO4, Remembering)

Thermography is the process of recording true thermal images of the surfaces of objects. In medicine, thermography displays images representing the thermal radiation of skin areas.

120. What are the types of thermography? (CO4, Remembering)

- Infrared thermography,
- Liquid crystal thermography,
- Microwave thermography

121. What are the medical applications of thermography? (CO4, Remembering)

Tumors, Uncontrolled multiplications of cells, Inflamation, Brain diseases, Burns, Orthopedic diseases

122. What is the need for earthing of medical instruments? (CO4, Remembering)

Grounding is needed in medical equipments to avoid the macro and micro shocks. The leakage current is also reduced by proper grounding.

123. Define let-go current. (CO4, Remembering)

Let-go current is the minimum current to produce muscular contraction. For men it is about 16mA. For women its about 10.5mA.

124. Define leakage current. (CO4, Remembering)

Leakage current is an extraneous current flowing along a path other than those intended. It is due to ungrounded equipment, broken ground wire, unequal ground potentials.

125. What are the devices used to protect against electrical hazards? (CO4, Remembering)

Ground fault interrupter, Isolation transformer

126. Name the types of LASER used in medicine. (CO4, Remembering)

Pulsed Nd-YaG laser, Continuous wave CO2 laser, continuous wave argon ion laser

127. What are the advantages of LASER surgery? (CO4, Remembering)

1. Highly sterile, 2. Highly localized and precise, 3. Non contact and bloodless surgery, 4. Short period of surgical time and painless surgery

128. What is endoscopy? (CO4, Remembering)

Endoscope is a tubular optical instrument to inspect or view the body cavities that are not visible to the naked eye normally.

129. What are the components of endoscopy? (CO4, Remembering)

Two fibre bundles, Power supply, Argon laser, Beam splitter, Power meter and heat sink, Lens system, micropositional circuit, firing control and timing unit, synchronous filter shutter, endoscope, knife.

130. What are the types of endoscopes? (CO4, Remembering)

Bronchoscope, Cardioscope, Cytoscope, Gastroscope, Laproscope, Opthalmoscope, Otoscope, Proctoscope, Sigmoidoscope, Thoracoscope

131. **Define Biotelemetry. (CO4, Remembering)**

Biotelemetry (or Medical Telemetry) involves the application of telemetry in the medical field to remotely monitor various vital signs of ambulatory patients.

132. What are the uses of biotelemetry? (CO4, Remembering)

The use of telemetry to monitor, measure and record physiological data of an organism

133. Briefly mention the components involved in the biotelemetry. (CO4, Remembering)

- Sensors appropriate for the particular signals to be monitored,
- Battery-powered, Patient worn transmitters,
- A Radio Antenna and Receiver,
- A display unit capable of concurrently presenting information from multiple patients

134. What is meant by single channel telemetry system? (CO4, Remembering)

The Universal Single Channel Telemetry System is compact in size and light weight which allows for quick and easy installations in areas where space is at a premium

without affecting the dynamic properties of the shaft. The universal receiving electronics allows the user to power and condition strain gage, thermocouple, or voltage sensors from a single module. Power transmission to the rotor electronics and return signal transmission to the stator is accomplished via a transmission band wrapped around the shaft. Alternatively, power can be derived from an on-shaft battery.

135. What is multiplexing? (CO4, Remembering)

For multi-channel radio telemetry, various channels of information are combined into a single signal. This technique is called multiplexing. There are two basic methods of multiplexing – Frequency division multiplexing and time division multiplexing.

136. Write any one problem in implant telemetry. (CO4, Remembering)

For implant telemetry the size and weight limitations are much more serious and the reliability requirement is more critical.

137. What is meant by radio pill? (CO4, Remembering)

Radio pill is a capsule containing a miniature radio transmitter that can be swallowed by a patient. During its passage through the digestive tract a radio pill transmits information about internal conditions (acidity, etc.).

138. Write any one use of biotelemetry. (CO4, Remembering)

Biotelemetry helps use to record the bio signals over long periods and while the patient is engaged in hisnormal activities

139. What are the physiological parameters adaptable to biotelemetry? (CO4, Remembering)

- Temperature by rectal or oral thermistor.
- Respiration by impedance pneumograph.
- Electrocardiograms by surface electrodes.
- Indirect blood pressure by contact microphone and cuff.
- Bioelectrical signals such as ECG, EMG & EEG.

140. What are the characteristics of a good thermo graphic equipment? (CO4, Remembering)

- Short frame time(less than 4seconds)
- High resolution (more than 100,000 picture elements)
- A small size and light weight optical head
- A wide spectrum band detector near the wavelength of 10 microns
- Absolute temperature can be measurable.

141. What is meant by thermography? (CO4, Remembering)

Thermography is the process of recording true thermal images of the surfaces of objects. In medicine, thermography displays images representing the thermal radiation of skin areas.

142. Distinguish between microshock and macroshock. (CO4, Remembering)

A physiological response to a current applied to the surface of the body that produces unwanted stimulation like tissue injury or muscle contractions is called as macro shock. A physiological response to a current applied to the surface of the heart that results in unnecessary stimulation like muscle contractions or tissue injury is called as microshock.

PART B - (16 MARKS)

UNIT – I ELECTRO PHYSIOLOGY

1. Discuss in detail about the origin of bioelectric potentials with neat diagram. (Nov/Dec-2009 Chennai)
2. Give an account on the different chemical compositions in the intra and extra cellular fluids and their effects in the case of blood serum.
3. Discuss the development of action potential and muscular contraction and resting potential.
4. Explain polarization, depolarization the repolarization(April/May-2009Chennai)
5. Write down the 'Nernst Equation' and 'Goldman Equation' and explainabout the constants used.
6. Explain 'Bio Electric Potentials from the brain' and 'Resting Rhythms of the Brain'.

UNIT – II BIO POTENTIAL ELECTRODES AND TRANSDUCERS

1. What are biopotential electrodes? Discuss the different types of electrode used in biopotential measurement. (May/June 2013)
2. Draw the micropipette nonmetallic electrode and explain
3. Draw the circuit diagram of an ECG isolation amplifier and explain its action.
4. Explain the following electrodes with neat diagram (i) Hydrogen , (ii) pH , (iii) Pco2 , (iv)Po2
5. Classify microelectrodes and explain any one with sketch (April/May 2011)
6. What are chopper amplifiers and explain.
7. Explain with a diagram medical carrier amplifier and explain its action.
8. Explain a isolation amplifier and explain.
9. With neat diagram, explain strain gauge, piezoelectric, thermocouple, thermistor, and biosensors.
10. Distinguish a biological amplifier from a conventional amplifier with suitable equations and circuits.(May/June 2014)

UNIT – III INSTRUMENTS USED FOR DIAGNOSIS

1. With a neat block diagram, explain the working of ECG recorder (Nov/Dec-2009 Chennai)
2. Discuss the different lead configuration used in ECG.(April/May-2009 Chennai) (May/June 2013,2014)
3. Explain EEG and 10-20 electrode system used in EEG recording system. (April/May 2011)
4. Explain the different types of electrode used in bio medical recording.
5. Explain the measurement of EMG.(May/June 2012)
6. Draw the 10-20 electrode placement system and explain
7. Draw the typical waveforms of EEG and give its significances. (May/June 2012)
8. Draw the curves of ECG and diagnose any form of disturbance in heart rhythm.
9. Draw the block diagram of an EEG unit and explain the different parts in it.
10. Describe the recording setup used in EMG and ERG. (May/June 2013)
11. Write a note on PCG and EOG.(May/June 2014)
12. Explain with diagram the salient features of Phonocardiography (PCG).
13. Discuss the principle and working of electromagnetic blood flow meters.
14. Describe an ultrasonic blood flow meter used in the measurement of velocity of blood flowing in the blood vessels. (April/May 2011) (May/June 2013)
15. Describe ultrasonic Doppler blood flow meters.
16. Explain with a block diagram the laser based blood flow meter.
17. Explain the Fick's method for the determination of cardiac output. (April/May-2009 Chennai) (May/June 2013)
18. Explain the Indicator dilution method of cardiac output measurement.
19. Explain the thermo dilution method of cardiac output measurement.
20. Write down the application of Electrophoresis and explain basic principle involved
21. Explain blood gas analyzer?
22. How partial pressure of oxygen in the blood can be measured and explain the measurement techniques. (April/May 2011)
23. Explain the blood flow measurement using following techniques.
    (i)Electromagnetic principle (ii) Thermo dilution (May/June 2012)
24. Explain the various respiratory measurement methods.
25. Explain how pulse rate is measured.
26. Discuss about auto analyzers. (May/June2014)
27. Explain i) Sphygmomanometer and ii)Measurement of $PHCO_3$ (May/June 2013)
28. From the basic principles discuss the working of a pulmonary function analyzer. (May/June2014)

UNIT-IV MEDICAL IMAGING

1. List out the properties of X-Rays?
2. Explain with suitable diagram the diagnostic X –Ray machine. What are the applications of X-Ray examination? (Nov/Dec 2007, Chennai) (May/June 2014)
3. Explain with block diagram the infrared thermograph technique and its merits and demerits.
4. What are the medical applications of thermography
5. Draw the block diagram of a CT and explain the different blocks in it. (Nov/Dec 2007, Chennai)
6. Briefly explain the different modes of ultrasonic scanning with suitable diagram
7. Describe ultrasonic imaging system with suitable diagram
8. Draw the block diagram of a MRI system and explain the image reconstruction using it. (Nov/Dec 2007, Chennai)
9. Explain PET
10. Explain the basic components of a Nuclear Magnetic Resonance imaging system (April/May 2011)
11. Explain the need of i)Collimator ii)Bucky grid iii) Image intensifier (May/June 2013)
12. Explain the principle of nuclear imaging with neat diagram. (May/June 2013)
13. Explain with block diagram the infrared thermograph technique and its merits and demerits. (May/June2013)
14. What are the medical applications of thermography.
15. What are the uses of endoscopes in medicine? Explain the endoscopy unit. (May/June 2013, 2014)
16. What are the different types of commonly available endoscopes and their Diagnostic applications?
17. Explain the liquid crystal thermograph in brief.
18. Give an account on biological effects of radiation exposure and safe dose equivalent limits.
19. Describe the construction and working of any one of the personnel radiation monitoring equipment.
20. Describe the possibilities of occurrence of micro shock hazards in a hospital.
21. Explain the following with respect to ‘electrical safety’:
    i. Ground fault interrupter (3)
    ii. Isolation transformer (3)
    iii. Line isolation monitors (3)
    iv. Grounding (3)
    v. Important aspects of hospital architecture. (4)

22. Explain the block diagram of a bio-telemetry system. Discuss its design. (April/May-2009 Chennai)
23. Explain the single channel telemetry system with neat diagram. (May/June 2012)
24. Draw and explain the telemetry circuit for the transmission of EMG, ECG, EEG and respiration rate.
25. What are the problems associated with the implant telemetry circuits? Explain the uses of biotelemetry.
26. Explain the various modulation techniques used for transmitting a bio signal in a telemetry system and write about how frequency is selected in telemetry systems.
27. What is radio pill? Explain.
28. In detail discuss about multiple channel biotelemetry systems. (April/May 2011)

UNIT – V ASSISTING AND THERAPEUTIC EQUIPMENTS

1. Describe the cardiac pacemaker waveforms and explain their importance. Compare external and implanted pacemakers.
2. Explain with a diagram the ventricular asynchronous pacemaker (fixed rate pacemaker).
3. Explain demand pacemaker/R wave inhibited pacemaker with a diagram. (May/June 2013)
4. Explain the function and characteristics of the various types of on-demand cardiac pacemakers. (May/June 2014)
5. Explain the atrial synchronous pacemaker.
6. Explain with a neat diagram, the working principle of D.C. defibrillator. (April/May-2009 Chennai)
7. What is the need for a Defibrillator? Explain the working of DC Defibrillator(April/May 2011) (May/June 2013)
8. What are the techniques involved in electro surgery techniques using diathermy units?
9. Draw the block diagram of short wave diathermy unit and explain.
10. Draw the block diagram of ultrasonic diathermy.
11. Explain the following (i)Surgical diathermy, (ii)R-wave synchronized pacemaker (May/June 2012,2013)
12. What are the techniques involved in electro surgery techniques using diathermy units?
13. Draw the block diagram of short wave diathermy unit and explain.
14. Draw the block diagram of ultrasonic diathermy.
15. Explain in brief the salient features of microwave diathermy.
16. Discuss the range and area of irritation of different heating techniques in diathermy.
17. Write a brief note on the functioning of microwave diathermy unit. (May/June 2014)