K.S.R. COLLEGE OF ENGINEERING (AUTONOMOUS), TIRUCHENGODE – 637 215.
COURSE/LESSON PLAN SCHEDULE

STAFF NAME: K.KIRUBA
CLASS/SEM: III YEAR/ V SEM **SUBJECT: 16EC561-Medical Electronics**

A) TEXT BOOK

1. Khandpur,R.S., "Handbook of Biomedical Instrumentation", Tata Mc Graw-Hill,3rd Edition, 2014.
2. Leslie Cromwell, Fred J.Weibel, Erich A.Pfeiffer "Biomedical instrumentation and measurement", Pearson/Prentice Hall India, 2nd edition, 2011.

B) REFERENCES

1. John G.Webster, "Medical Instrumentation Application and Design", John Wiley & Sons Inc, 4th Edition, 2009.
2. Joseph.J.Carr and John M.Brown, "Introduction to Biomedical equipment Technology", John Wiley and Sons, New York, 4th Edition, 2008.
3. Arumugam.M, "Biomedical instrumentation", Anuradha publications, India, 3rd Edition, 2016.
4. Rekha R.L, Ravikumar.C, "Biomedical instrumentation/Medical Electronics", Lakshmi Publications, Inida, 2nd Edition, 2010.

C) LEGEND:

L: Lecture BB: Black Board T: Text Book
R: Reference Book PPT- Power Point Presentation

S.No.	Lecture Hour	Topics to be Covered	Teaching Aid Required	Book No./Page No.
UNIT I - ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING				
1.	L1	The origin of Bio-potentials	BB	T2 49-62,T1 32-35, R3 4-8, R4 1.3-1.7
2.	L2	Bio-potential Electrodes	BB	T2 66-76,T1 39-63, R3 21-33, R4 1.18-1.25
3.	L3	Biological amplifiers- Carrier Amplifiers, Chopper Amplifiers, Isolation Amplifiers	BB	T1 114-124, R3 73-99, R4 2.2-2.13
4.	L4	Transducers for biomedical Applications: Strain Gauge, Piezoelectric, thermocouple, thermistor, biosensors	BB	T1 66-108, T2 42-48
5.	L5	ECG-lead systems and recording methods, typical waveforms and signal characteristics	BB, PPT	T2 55-62, 111-121, T1 154-166, R3 117-133, R4 2.14-2.26
6.	L6	EEG-lead systems and recording methods, typical waveforms and signal characteristics	BB	T2 55-62, 296-300, T1 170-178, R3 144-153, R4 2.26-2.34
7.	L7	EMG,-lead systems and recording methods, typical waveforms and signal characteristics	BB	T2 55-62, 300-303, T1 178-182, R3 153-156, R4 2.34-2.36
8.	L8	PCG-lead systems and recording methods, typical waveforms and signal characteristics	BB	T1 167-170, R3 133-142, R4 2.39-2.43
9.	L9	EOG,ERG-lead systems and recording methods, typical waveforms and signal characteristics	BB	T1 183, R3 158-159, R4 2.37
UNIT II - BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT				
10.	L10	Blood gas analyzers	BB	T2 78-81, T1 420-437, R3 265-267, R4 3.20-3.25
11.	L11	Electrophoresis	BB	R4 3.28-3.30
12.	L12	Colorimeter, Photometer	BB	T2 351-357, T1 397-403, R3 284-290, R4 3.30-3.33
13.	L13	Auto analyzer	BB	T2 417-419, R4 3.34-3.35

14.	L14	Blood flow meter, cardiac output	BB	T2 150-162, T1 325-357, R3 233-253, R4 3.35-3.39, 3.5-3.9
15.	L15, L16	Respiratory measurement, Blood pressure	BB	T2 126-150, T1 332-338, 208-232, R4 3.10-3.16, 3.1-3.5
16.	L17	Temperature, pulse	BB	T2 244-255, T1 232, 204-208, R4 3.39-3.41, 3.45-3.46
17.	L18	Blood cell counters: Coulter Counters	PPT	T2 347-349, T1 444-462, R3 274-277, R4 3.41-3.45
UNIT III – THERAPEUTIC EQUIPMENT				
18.	L19	Cardiac pacemakers	BB	T2 195-206, T1 687-713, R3 164-175, R4 5.1-5.12
19.	L20, L21	DC Defibrillator	BB	T2 206-212, T1 714-727, R3 185-195, R4 5.12-5.19
20.	L22	Dialyzers	BB	T1 pp(789-795), T2 pp(359-402), R3 pp (212 - 215)
21.	L23	Surgical Diathermy	BB	R3pp(219-223),T1pp(728-739)
22.	L24	Physiotherapy equipments	BB,PPT	T1 pp(760-779)
23.	L25	Electrotherapy equipment	BB	
24.	L26	Oxygenators	BB	T2 pp(217-218), R3 pp (205 - 210)
25.	L27	Heart lung machine	BB	R3 pp(202-211)
UNIT IV – MEDICAL IMAGING				
26.	L28,L9	X-Ray	BB	T1 pp(509-526), R3 pp(287-303), T2 pp(364-370)
27.	L30,L31	Computer axial tomography	BB	T1 pp(539-561), R3 pp(360-366), T2 pp(421-426)
28.	L32	Positron Emission Tomography-	BB	T1 pp(587-591), R3 pp(400-401), R1 pp(562-565)
29.	L33,L34	MRI and NMR	BB	T1 pp(592-622), R3 pp(390-400), R1 pp(551-555)
30.	L35,L36	Ultrasonic Imaging systems	BB	T1 pp(623-646), R3 pp(374-389), R1pp(567-573), Tx2 pp (263 – 266)
UNIT V - RECENT TRENDS IN MEDICAL INSTRUMENTATION				
31.	L37, L38	Thermograph	BB	T2 251-255, T1 670-680, R3 367-373, R4 4.19-4.20
32.	L 39	Endoscopy unit	BB	R3 356-359, R4 4.17-4.19
33.	L40	LASER in medicine	PPT	R3 347-355, T1 743-759 , R4 4.33-4.35
34.	L41	Biomedical telemetry	BB	T2 316-337, T1 283-311, R3 310-319, R4 4.20-4.30
35.	L42	Radio-pill	BB	Notes from web
36.	L43	Cardiac Catheterization Laboratory	PPT	T1 238, T2 428
37.	L44, L45	Electrical safety in medical equipment	BB	T2 430-447, T1 486-500, R3 329-341, R4 4.30-4.33

UNIT I - ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING (CO1)

PART A - (2 MARKS)

1. **Define resting potential.(R) (May/June 2009,Chennai) (May/June 2015)**

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. (R) (May/June 2007,Chennai) (May/June 2015)**
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. (R)**
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. (R) (April/May-2008,Chennai)**
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. (R) (Nov/Dec 2007,Chennai)**
Absolute refractory period is the duration of cell no response to further stimuli. It is about 1 milliseconds.
6. **Define relative refractory period. (R) (Nov/Dec 2007,Chennai)**
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 nerve conduction velocity. (R) (April/May-2008,Chennai) (May 2018)**
The rate at which an action potential moves down a fiber of a nerve cell or propagated from cell to cell is called the propagation rate or conduction velocity.
8. **Define Electrode. (R)**
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.
9. **Define half cell potential. (R)**
The voltage developed at an electrode-electrolyte interface is designated as half cell potential or electrical potential.
10. **What is the purpose of electrode paste? (R) (May/June 2007,Chennai)**
The electrode paste decrease the impedance of the contact and it also reduces the artifacts resulting from movement of the electrode or patient.
11. **What are the types of electrodes? (R)**
i. Microelectrodes ii. Depth and needle electrodes iii. Surface electrodes
12. **What is ECG? (R) (May/June-2009,Chennai)**
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.
13. **What is ECG lead configuration? (R)**
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
14. **What is PCG? (R) (Nov/Dec-2007,Chennai)**
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.
15. **What are the characteristics of heart sound and murmurs? (R)**
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.
16. **What are the types of the heart sounds? (R)**
i.valve closure sounds, ii.ventricular filling sounds, iii.valve opening sounds, iv.Extra cardiac sounds
17. **Mention the medical application of the phonocardiography.(U)**
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.

18. Mention the special applications of phonocardiography.(U)

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.

19. What is EEG? (R)

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.

20. What is evoked potential? (R)

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.

21. What are the types of brain waves? (R)

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

22. What is EMG? (R)

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

23. Define latency and conduction velocity. (R)

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

24. What is EOG? (R)

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.

25. What are the advantages of EOG? (R)

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.

26. What is graded potential? (R)

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).

27. What are the frequency range of ECG, EEG and EMG waves? (R) (April/May 2011)

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

28. What do you mean by Bio electric potential? (R) (Dec/Jan 2017)

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.

29. Define Epilepsy? Mention its types also. (R)

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

30. What do you mean by Montage? (R)

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

31. Define Ectopic Beat? (R)

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.

32. Define Nernst Equation? (R) (April/May 2011)

$V_R = -KT/Q \ln([K^+]_i / [K^+]_o)$, V_R = Resting Potential, K = Boltzman constant, T=Absolute temperature in Kelvin, Q=Charge of an electron

33. What are the vital parameters measured in ICU? (U)

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

34. List the conditions satisfied by a bio-signal amplifier. (U) (May/June 2013,2016)

- 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.

35. For what purpose isolation amplifier is used? (R) (May 2018)

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

36. **Define noise figure. (R)**
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.

37. **For what purpose line driving amplifier is used? (R)**
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.

38. **Define CMRR. (R)**
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.

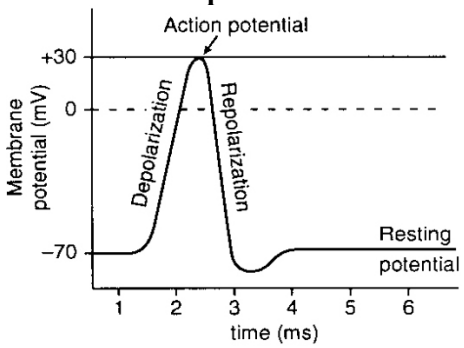
39. **Define inhibitory post synaptic potential (IPSP). (R)**
If the transmitter substance in inhibitory, the membrane potential of the receptor neuron increases in a negative direction. So that it is less likely to discharge, this induced potential change is called inhibitory post synaptic potential.

40. **Define excitory post synaptic potential (EPSP). (R)**
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).

41. **Recall motion artifacts in recording electrodes.(R) (May/June 2015)**
Movement artifact or Motion artifact is a noise voltage or variable half cell voltage originated from movement of the patient or electrode. The use opf electrodes with equal half cell potentials and of a recording apparatus having high input input impedance will minimize this type of artifact. One can use floating electrodes for minimizing motion artifacts.

42. **List the electrodes used for recording ECG, EMG, EEG, ERG & EOG.(An) (May/June 2016) (Dec/Jan 2017)**
EEG, EMG, ECG - Surface, Needle electrodes, **ERG**-Corneal electrodes, **EOG**-Miniature surface electrodes.

43. **Illustrate an action potential waveform and label the amplitudes and time values.**



44. **Explain about Limb electrodes. (U) (June 2017)**

PART B - (16 MARKS)

1. Discuss in detail about the origin of bioelectric potentials with neat diagram.(U) **(Nov/Dec-2009, May/June 2016)**
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. (An)
3. Discuss the development of action potential and muscular contraction and resting potential. (U)
4. What are bio-potential electrodes? Discuss the different types of electrode used in bio-potential measurement.(R) **(May/June 2013, 2017), (Dec16/Jan 2017)**
5. Draw the micropipette nonmetallic electrode and explain (R)
6. With a neat block diagram, explain the working of ECG recorder (U) **(Nov/Dec-2009)**
7. Discuss the different lead configuration used in ECG.(U)**(April/May-2009) (May/June 2013,2014)**
8. Explain polarization, depolarization the repolarization (R) **(April/May-2009)**
9. Draw the circuit diagram of an ECG isolation amplifier and explain its action. (R)
10. Explain the following electrodes with neat diagram (i) Hydrogen , (ii) pH , (iii) Pco2 , (iv)Po2(R)
11. Classify microelectrodes and explain any one with sketch(6) (R) **(April/May 2011)**
12. Explain EEG and 10-20 electrode system used in EEG recording system(U)**(Apr/May2011) (May/Jun 2015, 2016, 2017) (May 2018)**
13. (i)Explain the different types of electrode used in bio medical recording.

(ii) Explain the measurement of EMG. (R) **(May/June 2012) (May 2018)**

14. (i)Draw the 10-20 electrode placement system and explain
    (ii) Draw the typical waveforms of EEG and give its significances. (R) **(May/June 2012)**
15. What are chopper amplifiers and explain. (R) **(June 2017)**
16. Explain with a diagram medical carrier amplifier and explain its action (R)
17. Explain ECG isolation amplifier (R) **(June 2017)**
18. Draw the curves of ECG and diagnose any form of disturbance in heart rhythm (A)**(8) (Dec16/Jan 2017)**
19. Draw the block diagram of an EEG unit and explain the different parts in it. (R) **(May/June 2016)**
20. Describe the recording setup used in EMG and ERG (R) **(May/June 2013) (May/June 2015)**
21. Write a note on PCG and EOG (R) **(May/June 2014) (May/June 2015) (Dec16/Jan 2017) (May 2018)**
22. Explain with diagram the salient features of Phonocardiography (PCG) (U)
23. (a) Write down the 'Nernst Equation' and 'Goldman Equation' and explain about the constants used. (U)
24. (b) Explain 'Bio Electric Potentials from the brain' and 'Resting Rhythms of the Brain'. (U)
25. With neat diagram, explain strain gauge, piezoelectric, thermocouple, thermistor, and biosensors. (R)
26. Distinguish a biological amplifier from a conventional amplifier with suitable equations and circuits. (An) **(May/June 2014)**
27. What are peak amplitude and frequency response for ECG, EEG and EMG. (R) **(Dec16/Jan 2017)**
28. Heart generates a sound of frequency 20Hz to 1000Hz. Demonstrate with a block diagram as how this signal can be picked up and given to the medical practitioner as a audio output and also as a recorded output.(U) **(Dec16/Jan 2017)**

UNIT II - BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT (CO2)

PART A - (2 MARKS)

1. **What is blood flow meter?** (R)
   Blood flow meters are used to monitor the blood flow in various blood vessels and to measure cardiac output.
2. **What is a electromagnetic blood flow meter?** (R) **(May/June 2007,chennai) (May/June 2014)**
   The electromagnetic blood flow meter is suitable for determining the instantaneous flow rates in intact vessels and it consists of certain useful features like good linearity, direction sensitivity and capability of monitoring pulsatile flow.
3. **What is the principle used in blood flow meter?** (R) (**May/June 2016)**
   It is the based on the principle of Faraday's law of Induced e.m.f. When a magnetic field is applied to a blood vessel, the blood flow in the vessel causes an electrical field to be induced in a direction perpendicular to the direction of the applied magnetic field and blood velocity.
4. **Mention the applications of electromaganetic blood flow meters?(Ap)**
   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
5. **What is ultrasonic blood flow meter?** (R)
   Ultrasonic blood flow meters 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 blood flow meters were based on the transmit time principle.
6. **Define Doppler Effect?** (R)
   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.
7. **What is cardiac output?** (R) **(Nov/Dec 2007, Apr/May 2011, May/June 2016)**
   Cardiac output is the amount of blood delivered 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.
8. **What are the methods used in cardiac output measurements?** (R)
   1. Fick's method, 2. Indicator dilution method 3. Measurement of cardiac output by impedance change
9. **Mention the advantages of cardiac output measurements?** (R)
   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.
10. **What is the use of Blood gas analyzers?** (R) **(Dec16/Jan 2017)**
    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.
11. **How to calculate potential difference in electro-magnetic blood flow meter?** (R)
    Potential difference is the sum of flow signal and transformer e.m.f.

12. **What is source impedance in electromagnetic blood flow meter?** (R)
    Source impedance of an electromagnetic flow meter 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.
13. **Which wave is replaced by square wave in electromagnetic blood flow meter?** (R)
    Due to practical difficulties involved in generation of a square wave, trapezoidal current waveform has been used as alternative.
14. **In which principle ultrasonic blood flowmeter works?** (R) It works on transmit time principle.
15. **At which frequency the reflection of Doppler is shifted?** (R)
    The frequency is about 267 Hz on reflection from the moving body.
16. **Give the different diagnostic sound in Doppler blood flowmeter?(U)**
    - 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.
17. **Give the advantage of Pulsed Doppler blood flow meter?(Ap)**
    Blood vessel diameter and blood velocity are measured accurately.
18. **What is Fick's method?** (R)
    It is based on the determination of cardiac output by the analysis of gas-keeping of the organism.
19. **What is Indicator dilution method?** (R)
    It is based on the principle that if we introduce a known amount of dye or radioisotope as an indicator in the blood circulation.
20. **By which method, electronically cardiac output is measured?**(R)
    Impedance method is used to calculate cardiac output electronically.
21. **What is Electrophoresis?** (R) **(May/June 2012) (May/June 2015) (May 2018)**
    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.
22. **What are the factors affecting migration of ions?** (R)
    1. Magnitude of charge 2. Ionic strength of buffer 3. Temperature 4. Time
23. **Write the types of Electrophoresis?** (R)
    1. Cellulose acetate Electrophoresis 2. Immuno Electrophoresis
24. **Define PH. How it is related with blood?** (R)
    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.

25. **Discuss about blood cells. / What are the components of blood?** (R) **(May/June 2013) (May 2018)**
    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 platelets are involved in the clotting of blood.
26. **For what purpose colorimeters and photometers are used?** (R)
    Colorimeters and photometers are used to measure he transmitted and absorbed light as it passes through sample.
27. **What is flame photometer?** (R)
    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.
28. **Define systole.** (R)
    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.
29. **Define diastole.** (R) Diastole is defined as the period of dilation of the heart cavities as they fill with blood.
30. **Where are pressures present in different areas of the heart?** (U)

	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

31. **What is stroke volume?** (R) **(May/June 2013)**
    Stroke volume is the amount of blood pumped by the left ventricle of the heart in one contraction.
32. **Find the cardiac output of a person if his heart rate is 72 bpm and stroke volume is 70 ml. (May/June 2016)**
    Cardiac output=stroke volume x heart rate per min =70ml x 72bpm = 5040ml/min
33. **Discuss about Leucocytes.** (R) **(May/June 2017)**
    White blood cells (WBCs), also called leukocytes or leucocytes, are the cells of the immune system that are involved in protecting the body against both infectious disease and foreign invaders. All white blood cells are produced and derived from multipotent cells in the bone marrow known as hematopoietic stem cells. Leukocytes are found throughout the body, including the blood and lymphatic system.
34. **If the systolic and diastolic blood pressures are given as 110 mmHg and 82 mmHg, Solve to determine the mean arterial pressure (MAP). (E) (Dec16/Jan 2017)**
    MAP = [(2 x diastolic) + systolic] / 3 = 91.3 mmHg.

PART B - (16 MARKS)

1. Discuss the principle and working of electromagnetic blood flow meters. (U)
2. Describe an ultrasonic blood flow meter used in the measurement of velocity of blood flowing in the blood vessels. (R) **(April/May 2011) (May/June 2013, 2016) (Dec16/Jan 2017)**
3. Describe ultrasonic Doppler blood flow meters. (R)
4. Explain with a block diagram the laser based blood flow meter. (R)
5. Explain the Fick's method for the determination of cardiac output. (R) **(April/May-2009 Chennai) (May/June 2013,2016)**
6. Explain the Indicator dilution method of cardiac output measurement. (R)
7. Explain the thermal dilution method of cardiac output measurement. (R) **(May/June 2017) (May 2018)**
8. Write down the application of Electrophoresis and explain basic principle involved (R)
9. Draw the complete block diagram of blood gas analyzer and explain its function. (U) **(May/June 2015, 2017)**
10. How partial pressure of oxygen in the blood can be measured and explain the measurement techniques. **(U)(April/May 2011)**
11. Explain the blood flow measurement using following techniques(R).
    (i)Electromagnetic principle (ii) Thermo dilution (**May/June 2012)**
12. Explain the photometers with suitable diagrams.a.Filter photometer (8) b. Flame photometer (8) (R)
13. Explain the colorimeter with principle and suitable diagrams.(8) (R)
13. Explain the working principle of spectrophotometer and colorimeter. (U) **(May/June 2014)**
14. Draw the block diagram of an automatic blood cell counter and explain its functioning. Write the principle of blood cell counters. (R) **(Dec16/Jan 2017)**
15. Explain in detail any one of the methods used for measuring blood pressure (8) (U) **(May 2018)**
16. Explain in detail any one of the methods used for measuring temperature (8) (U)
17. Explain the various respiratory measurement methods. (R) (**May/June 2016, 2017)**
18. Explain how pulse rate is measured. (U)
19. Discuss about auto analyzers. (R) **(May/June 2014)**
20. Explain i) Sphygmomanometer and ii) Measurement of $PHCO_3$(R) **(May/June 2013)**
21. From the basic principles discuss the working of a pulmonary function analyzer. (U) **(May/June2014)**
22. Explain how to measure the respiratory rate using apnoea detectors in detectors. (U) **(May/June 2015)**
23. Analyze the construction and working of Rheographic method and Differential Auscultatory technique in blood pressure measurement. (An) **(May/June 2015)**
24. Describe in detail the working of Coulter type Blood cell counter. **(May/June 2016) (Dec16/Jan 2017)**
25. Justify as whether blood is alkaline or saline. Mention the equipment that is capable of measuring the pH, $PaCO_2$, PaO_2 of blood. (E) **(Dec16/Jan 2017)**

UNIT III – THERAPEUTIC EQUIPMENT (CO3)

PART A - (2 MARKS)

1. **Define pacemackers?** (R) **(May/June 2013, 2017)**
   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.
2. **What is a pluse of energy applied on heart muscles?** (R)

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.

3. **What are the methods of simulation?** (R) i) External simulation ii) Internal simulation.
4. **Define External Stimulation**(R)
   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.
5. **Define Internal Simulation**(R)
   Internal simulation employed in cases requiring long term pacing because of permanent damage that prevents normal self triggering of the heart.
6. **Define asynchronous pacing?** (R)
   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.
7. **What are the types of pacemakers?** (R)
   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.
8. **What is a Demand pacemaker?** (R)
   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.
9. **Define defibrillators?** (R) **(Nov/Dec-2007,Chennai)**
   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.
10. **Types of defibrillators?** (R)
    There are two types of defibrillators based on the electrode placement .
    1. Internal defibrillator. 2. External defibrillator .
11. **Types of external defibrillators?** (R)
    1.A.C.defibrillator 2. D.C.defibrillator, 3. synchronized D.C.defibrillator 4. square pluse defibrillator
    5. Double square pluse defibrillator 6. Biphasic D.C.defibrillator.
12. **Disadvantages of ventricullar asynchronous pacemackers?(U)**
    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.
13. **Advantages of ventricular synchronous pacemackers?(U)**
    a) To arrest the ventricular fibrillation, this circuit can be used. b) 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.
14. **Function of dual peak defibrillators?** (R)
    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.
15. **What is diathermy? List its types.** (R)
    Diathermy is the treatment process by which cutting, coagulation of tissues are obtained. Its various types are: Shortwave diathermy, Microwave diathermy, Ultrasonic diathermy.
16. **What is oxygenator?** (R) **(May/June 2017)**
    An oxygenator is a medical device that is capable of exchanging oxygen and carbon dioxide in the blood of human patient during surgical procedures that may necessitate the interruption or cessation of blood flow in the body, a critical organ or great blood vessel.
17. **Ideal conditions for oxygenerators?** (U)
    a)lower priming volume, b)minimum trauma to blood, c) simple,safe&reliable operation
    d)ensured sterilization, e)no microembolus formation and f)short preparation time.
18. **What are the electrosurgery techniques using in diathermy unit?** (R)
    1)fulguration, 2)desiccation, 3)electrotomy, 4)coagulation, 5)blending.
19. **Define heart-lung machine?/ Why do we require heart lung machine?**(R)**(April/May 2011) (May 2018)**

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.

20. Types of oxygenerators? (R)

a) Buddle oxygenators, b) Film oxygenators, c) Membrane oxygenators, d) liquid-liquid oxygenators

20. Compare internal and external pacemakers. (An) **(May/June 2015) (Dec16/Jan 2017)**

S.No.	External Pacemakers	Internal Pacemakers
1.	The pacemaker is placed outside the body, may be in the form of wrist watch or in pocket, from that one wire will go into the heart through the vein.	The pacemaker is miniaturized and is surgically implanted beneath the skin near the chest or abdomen with its output leads are connected directly to the heart muscle.
2.	The electrodes are called endocardiac electrodes	The electrodes are called myocardiac electrodes
3.	It doesnot necessitate open chest surgery	It requires an open chest minor surgery to place the circuit
4.	Here there is no safety for the pacemaker particularly in the case of children carrying the pacemaker	Here there is cent percent safety for the circuit from the external disturbances.
5.	Used for temporary heart irregularities	Used for permanent heart damages

21. Identify the types of dialyzers used in clinic. (Ap) **(May/June 2015) (May 2018)**

Extracorporeal dialysis (Hemodialysis) and Intracorporeal dialysis(Peritoneal dialysis)

22. List the typical ranges of pacemaker parameters. (R) **(May/June 2016)**

Pulse rate: 25-155 pulses per minute, Pulse width: 0.1-2.3ms, Pulse amplitude: 2.3-10V, battery capacity: 0.44-3.2 amp-hours, longevity: 3.5-18 years, weight: 33-98 gms

23. What are the types of blood pumps? (R) **(May/June 2016)**

Pulsatile pumps, nonpulsatile pumps.

24. Evaluate the energy stored in 16 µF capacitor of a DC defibrillator that is charged to a potential of 5000Vdc. (E) (Dec16/Jan 2017)

$E=1/2\ CV^2 = 1/2 * 16*10^{-6} * 25*10^6=200$ joules

PART B - (16 MARKS)

1. Describe the cardiac pacemaker waveforms and explain their importance. Compare external and implanted pacemakers. (R)
2. Explain with diagram the ventricular asynchronous pacemaker(fixed rate pacemaker).(R)(**May/June 2016**)
3. Explain demand pacemaker/R wave inhibited pacemaker with a diagram**.** (R) **(May/June 2013)**
4. Explain the function and characteristics of the various types of on-demand cardiac pacemakers. (R) **(May/June 2014) (May 2018)**
5. Explain the atrial synchronous pacemaker. (R)
6. Explain with a neat diagram, the working of Synchronized D.C. defibrillator.(U) **(April/May-2009 Chennai, May/June 2016)**
7. What is the need for a Defibrillator? Explain the working of DC Defibrillator. (U) **(April/May 2011) (May/June 2013, 2017)**
8. What are the techniques involved in electro surgery techniques using diathermy units? (R) **(Dec16/Jan 2017) (May/June 2017)**
9. Explain the following(i)Surgical diathermy,(ii)R-wave synchronized pacemaker(R) **(May/June 2012,2013)**
10. What are the techniques involved in electro surgery techniques using diathermy units? (8)
11. Draw the block diagram of short wave diathermy unit and explain. (R) (8)
12. Draw the block diagram of ultrasonic diathermy and explain. (R) (8)
13. Explain in brief the salient features of microwave diathermy. (R) (4) **(May 2018)**
14. Discuss the range and area of irritation of different heating techniques in diathermy. (U)(4)
15. Write a brief note on the functioning of microwave diathermy unit. (R) **(May/June 2014)**
16. Dissect the working of solid-state surgical diathermy machine and explain about electro-surgery techniques. (R) **(May/June 2015)**
17. Construct the block diagram of microwave diathermy and explain its function.(AP) **(May/June 2015)**
18. Explain about heart lung machine and oxygenators with diagram.(R) **(May/June 2016)**
19. What are the precautions to be followed in hospitals while using defibrillators? (R) **(Dec16/Jan 2017)**

20. Recognize a machine that can increase the oxygen content in the blood and hence describe its design. (Ap) **(Dec16/Jan 2017)**
21. Illustrate the basic circuit diagram of capacitive discharge type of cardiac defibrillator and explain the working principle. (U) **(Dec16/Jan 2017)**

UNIT-IV MEDICAL IMAGING (CO4)

PART A - (2 MARKS)

1. **What is meant by computer tomography?** (R)
   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).
2. **What is back projection reconstruction?** (R)
   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.
3. **Give the types of artifacts?** (R)

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

4. **What is CT stereotaxy?** (R)
   It is an innovation for diagnostic and therapeutic procedures in brain without open surgery.
5. **What are the degenerative diseases?** (R)
   Cerebral atrophy, helminthic infestations of brain and chronic inflammatory diseases like tuberculomas.
6. **Mention any four uses of CT scan in thorax?(U)**
   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.
7. **Define ultrasound.** (R)
   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.
8. **What is known as damping?** (R)
   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”.
9. **What are two conditions that have to be fulfilled by damping?** (R)
   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.
10. **Write about convex array of ultrasonic imaging systems?** (R)
    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.
    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.
11. **Define ultrasonography.** (R)
    Ultrasonography is a technique by which ultrasonic energy is used to detect the state of the internal body organs.
12. **What is Acoustic impedence?** (R)
    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.

13. **Define Specular reflection**(R)
    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.

14. **Define non-specular reflection.** (R)
    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.

15. **What is called Resolution and what are the types of resolution?** (R)

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

16. What are the types of modes of Display? (R)

The reflected echoes are now displayed on the screen as a useful image. The various modes of display are: A-mode, B-mode, M-mode or T-M mode.

17. Define Doppler mode. (R)

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.

18. What are the various types of recording devices? (R)

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

19. Write the classifications of artifacts. (R)

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

20. What is as "angiodynography"? (R)

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".

21. What are the advantages of MRI? (R)

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.

22. What is known as Free Induction decay (FID)? (R)

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.

23. What are the three principles of MRI parameters? (R)

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

24. Explain Magnetic field strength and gradients? (R)

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.

25. What is meant by free induction decay? (R) **(April/May 2011)**

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

26. Mammograms are used for what purpose? (U) (April/May 2014)

It is used to detect breast cancer or tumor.

27. Construct the difference between hard X-ray and soft X-ray. (A) (May/June 2015, 2016) (Dec/Jan 2017)

Hard X-rays are produced when the anode voltage is increased and it is used for therapeutic purposes.
Soft x-rays are produced when the anode voltage is decreased and it is used for diagnostic purposes.

28. Interpret the working principle of PET. (U) (May/June 2015, 2017)(May 2018)

It is the imaging modality for obtaining in vivo cross sectional images of positron emitting isotopes that demonstrate biological function, physiology or pathology. Chemical compound is labeled with radioactive isotope that decays by emitting a positron or positive electron. Emitted positron combines with electron and emit 2 gamma rays. The 2 gamma rays penetrate the surrounding tissue and are recorded outside the subject by a circular array of detectors.

29. List the applications of CT scanner. (R) (May/June 2016)

Central nervous system, orthopedics and bone tumors, thorax, abdomen and pelvis, neck, radiotherapy planning.

30. Expand PET and MRI. (Dec16/Jan 2017) (R)
PET-Positron Emission Tomography, **MRI-**Magnetic Resonance Imaging

31. Identify the ultra sound frequency range for various imaging modes and their applications. (Ap) (June 2017) (May 2018)
Medical Ultrasound produces sound with frequencies in the range of 2 to 15MHz for A mode, B mode and TM (M) mode. A mode is used in echoencephalograph and M mode in Echocardiograph.

PART B - (16 MARKS)

1. List out the properties of X-Rays? (R)
2. Explain with suitable diagram the diagnostic X –Ray machine. What are the applications of X-Ray examination? (R) **(Nov/Dec 2007) (May/June 2014,2016, 2017) (Dec/Jan 2017) (May 2018)**
3. Explain with block diagram the infrared thermograph technique and its merits and demerits. (R)
4. What are the medical applications of thermography(R)
5. Draw the block diagram of a CT and explain the different blocks in it. (U) **(Nov/Dec 2007, Chennai) (May/June 2015) (May 2018)**
6. Briefly explain the different modes of ultrasonic scanning with suitable diagram(R)
7. Describe ultrasonic imaging system with suitable diagram(R) (**May/June 2016)**
8. Draw the block diagram of a MRI system and explain the image reconstruction using it (R) **(Nov/Dec 2007), (May/June 2016,2017), (Dec16/Jan 2017)**
9. Explain PET(U)
10. Explain the basic components of a Nuclear Magnetic Resonance imaging system(U) **(April/May 2011) (May/June 2015) (May 2018)**
11. Explain the need of i)Collimator ii)Bucky grid iii) Image intensifier (R) **(May/June 2013)**
12. Explain the principle of nuclear imaging with neat diagram. (R) **(May/June 2013)**
13. Interpret the types of x-ray tubes and the basic components used in the tube(U) **(May/June 2015)**

UNIT V - RECENT TRENDS IN MEDICAL INSTRUMENTATION (CO5)

PART – A (2 Marks)

1. **What are the characteristics of good thermo graphic equipment?** (R)
   i) Short frame time(less than 4seconds), ii) high resolution (more than 100,000 picture elements)
   ii) A small size and light weight optical head, iv) A wide spectrum band detector near the wavelength of 10 microns, v)Absolute temperature can be measurable.
2. **What is meant by thermography?** (R) **(Dec16/Jan 2017)**
   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.
3. **What are the types of thermography?** (R)
   Infrared thermography, Liquid crystal thermography, Microwave thermography
4. **What are the medical applications of thermography?** (R) **(Dec16/Jan 2017)**
   Tumors, Uncontrolled multiplications of cells, Inflamation, Brain diseases, Burns, Orthopedic diseases
5. **What is the need for grounding of medical instruments?** (R) **(May/June 2017)**
   Grounding is needed in medical equipments to avoid the macro and micro shocks. The leakage current is also reduced by proper grounding.
6. **Define let-go current.** (R)
   Let-go current is the minimum current to produce muscular contraction. For men it is about 16mA. For women its about 10.5mA.
7. **Define leakage current.** (R)
   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.
8. **What are the devices used to protect against electrical hazards?** (R)
   Ground fault interrupter, Isolation transformer
9. **Name the types of LASER used in medicine.** (R)
   Pulsed Nd-YaG laser, Continuous wave CO2 laser, continuous wave argon ion laser
10. **What are the advantages of LASER surgery?** (R)
    1. Highly sterile, 2. Highly localized and precise, 3. Non contact and bloodless surgery, 4. Short period of surgical time and painless surgery
11. **What is endoscopy?** (R) **(May/June 2015) (May 2018)**
    Endoscope is a tubular optical instrument to inspect or view the body cavities that are not visible to the naked eye normally.
12. **What are the components of endoscopy?** (R) **(May/June 2013, 2016)**

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.

14. **What are the types of endoscopes?** (R) **(May/June 2015)**
Bronchoscope, Cardioscope, Cytoscope, Gastroscope, Laproscope, Opthalmoscope, Otoscope, Proctoscope, Sigmoidoscope, Thoracoscope
15. **Define Biotelemetry.** (R) **(April/May-2008,Chennai, April/May 2011) (May/June2013)**
Biotelemetry (or Medical Telemetry) involves the application of telemetry in the medical field to remotely monitor various vital signs of ambulatory patients.
16. **What are the uses of biotelemetry?** (R)
The use of telemetry to monitor, measure and record physiological data of an organism
17. **Briefly mention the components involved in the biotelemetry.** (U)
1) Sensors appropriate for the particular signals to be monitored, 2) Battery-powered, Patient worn transmitters, 3) A Radio Antenna and Receiver, 4) A display unit capable of concurrently presenting information from multiple patients
18. **What is meant by single channel telemetry system?** (R)
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.
19. **What is multiplexing?** (R)
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.
20. **Write any one problem in implant telemetry.** (R)
For implant telemetry the size and weight limitations are much more serious and the reliability requirement is more critical.
21. **What is meant by radio pill?** (R)**(April/May 2011) (May/June 2012) (May/June 2015) (May 2018)**
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.).
22. **Write any one use of biotelemetry.** (R) **(May/June 2007,chennai)**
Biotelemetry helps use to record the bio signals over long periods and while the
patient is engaged in his normal activities
23. **What are the physiological parameters adaptable to biotelemetry*?*** (R)
a) Temperature by rectal or oral thermistor.
b) Respiration by impedance pneumograph.
c) Electrocardiograms by surface electrodes.
d) Indirect blood pressure by contact microphone and cuff.
e) Bioelectrical signals such as ECG, EMG & EEG.
24. **What are the characteristics of good thermo graphic equipment?** (R)
i) short frame time(less than 4seconds)
ii) high resolution (more than 100,000 picture elements)
ii) A small size and light weight optical head
iv) A wide spectrum band detector near the wavelength of 10 microns
v)Absolute temperature can be measurable.
25. **What is meant by thermography?** (R) **(Dec16/Jan 2017)**
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.
26. **Distinguish between microshock and macroshock.** (U) **(May/June 2013)**
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.
27. **Mention the situations which account for hazards from electric shock.** (An) (**May/June 2016)**
Microshock and macroshock
28. **List out the characteristics or properties of laser that differentiate it from ordinary light (An) (Dec16/Jan 2017)**
Coherence, Directionality, Monochromatic, High intensity

PART B - (16 MARKS)

1. Explain with block diagram the infrared thermograph technique and its merits and demerits. (8) (R) **(May/June2013) (May/June 2015) (May 2018)**
2. List out the types of Laser with their classification and interpret the functions of Helium-Neon laser and Nd-YAG laser. (R) **(May/June 2015,2016) (May 2018)**
3. What are the medical applications of thermography (8) (R)
4. Mention the details of laser instrumentation for biomedical applications. (8) (R) (**May/June 2016**)
5. Discuss the laser principle and mention the different laser interactions on our body. (8) (U)
6. Write short notes on HE-NE and Argon laser and the general applications of laser in medicine (8) **(May/June 2013,2014)(U)**
7. What are the uses of endoscopes in medicine? Explain the endoscopy unit. (8) (R)**(May/June 2013,2014)**
8. What are the different types of commonly available endoscopes and their Diagnostic applications? Design any one of the therapeutic instrument using an endoscope. (16) (R) (**May/June 2017**)
9. Explain the liquid crystal thermograph in brief. (4) (R)
10. Give an account on biological effects of radiation exposure and safe dose equivalent limits. (8)(An)
11. Describe the construction and working of any one of the personnel radiation monitoring equipment (8)(U)
12. Write a note on area monitoring in the case of radiation safety. (8) (R)
13. Explain the physiological effects of current at commercial frequencies on human body (8) (R) **(Dec16/Jan 2017)**
14. Describe the possibilities of occurrence of micro and macro shock hazards in a hospital.(16) (R) (**May/June 2016**) **(Dec16/Jan 2017)**
15. Explain the following with respect to 'electrical safety': (U)
    (a) Ground fault interrupter (3)
    (b) Isolation transformer (3)
    (c) Line isolation monitors (3)
    (d). Grounding (3)
    (e) Important aspects of hospital architecture. (4)
16. Bring out the salient points of instrumentation in (a) Endoscopy unit (8) (b) Bio Medical Laser (8) (R) **(Dec16/Jan 2017)**
17. Explain the block diagram of a bio-telemetry system. Discuss its design.(U) **(April/May-2009)** (**May/June 2017**)
18. Explain the single channel telemetry system with neat diagram. (R) **(May/June 2012) (May 2018)**
19. Draw and explain the telemetry circuit for the transmission of EMG, ECG, EEG and respiration rate. (U)
20. What are the problems associated with the implant telemetry circuits? Explain the uses of biotelemetry. (R)
21. 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. (R)
22. What is radio pill? Explain its construction and working. (R) (**May/June 2016**)
23. In detail discuss about multiple channel biotelemetry systems. (R) **(April/May 2011) (May/June 2013)**
24. Explain in detail about the cardiac catheterization laboratory with neat diagram. (R)
25. Recall single channel telemetry system with the basic requirements and explain how the ECG Telemetry transmitter is working. (R) **(May/June 2015)**
26. Propose any two testing methods in electrical safety analyzer.(C) **(May/June 2015)**
27. Identify an alternative method for identifying breast cancer using the heat variation on the breast. Explain as how this method is more effective than the traditional mammogram imaging technique. (Ap) **(Dec16/Jan 2017)**

MEDICAL ELECTRONICS cycle test-1

PART-A 5*2=10

1. List the practical reference electrodes. (R,CO1)
2. What is EOG? (R,CO1)
3. Draw the recording setup of EMG. (U,CO1)
4. Define action potential. (R,CO1)
5. What is evoked potential? (R,CO1)

PART-B 2*10=20

6. Draw the ECG recording setup and lead configurations.(A,CO1)
7. Draw and explain the EEG recording setup. (U,CO1)

cycle test-2

PART-A 5*2=10

1. Draw the block diagram of auto analyzer. (U)(CO2)
2. Explain the principle behind colorimeters.(E)(CO2)
3. List the factors affecting the migration in electrophoresis. (An)(CO2)
4. What is the use of blood gas analyzers? (U) (CO2)
5. List the types of blood flow meters. (R) (CO2)

PART-B 2*7.5=15

6. Illustrate the working of cellulose acetate electrophoresis. (U)(CO2)

7. Demonstrate the ultrasonic blood flow meter. (U)(CO2)

Cycle Test-3

1. Differentiate internal and external pacemakers. (2)
2. Identify the electrosurgery techniques used in diathermy (2)
3. Compare intracorporeal and extracorporeal dialysis. (2)
4. Discuss about the effect of heat in pain relief (2)
5. List the types of oxygenators (2)
6. Explain in detail about standby pacemaker with neat diagram (7.5)
7. Outline the working of DC defibrillator (7.5)

Assignment-1

1. Write the principle of PET. (2)
2. Compare hard and soft x-rays. (2)
3. Give the applications of CT scan. (2)

4. Write about the different modes to display the reflected echos in Ultrasonic imaging. (2)
5. Discuss about various artifacts in CT scan. (2)
6. With a neat diagram explain about x-rays (7.5)
7. With the neat block diagram explain about computer tomography and Back Projection Reconstruction. (7.5)

Assignment-2

1. What is meant by thermography? (2)
2. Define let-go current. (2)
3. What is endoscopy? (2)
4. What is meant by radio pill? (2)
5. Distinguish between microshock and macroshock. (2)
6. Mention the details of laser instrumentation for biomedical applications. (7.5)
7. Explain the block diagram of a bio-telemetry system. Discuss its design. (7.5)

Reg. No. : 1 9 1 5 0 4 5 6

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

(AUTONOMOUS)

Question Paper Code : 172265

B. E. / B.Tech. DEGREE END SEMESTER EXAMINATION, JUNE 2018

Sixth Semester

B.E. - ELECTRONICS AND COMMUNICATION ENGINEERING

12EC4603 – Medical Electronics

(Regulations 2012)

Time : Three hours Maximum Marks : 100

Answer ALL Questions

PART A — (10 x 2 = 20 Marks)

1. Illustrate the term nerve conduction velocity.
2. Explain the purpose of pre-amplifier isolation circuits in ECG circuit.
3. Interpret about Electrophoresis.
4. Discuss about types of blood cells.
5. What is heart lung machine?
6. List the types of Dialyzers used in clinic.
7. Recall the working principle of Positron Emission Tomography.
8. Identify the ultrasound frequency range for various imaging modes and their applications
9. What is Radio – Pill?
10. Discuss the concept behind endoscope.

PART B — (5 x 16 = 80 Marks)

11. (a) Identify the various types of electrodes used in EEG and explain the function of EEG with neat block diagram. (16)

(Or)

(b) (i) Describe EMG Recording system with neat sketch (8)

(ii) Explain with diagram the salient features of Phonocardiography. (8)

12. (a) Explain how Thermal Dilution method is useful in cardiac output measurement (16)

(Or)

(b) Analyze the construction and working of Rheographic method and Differential Auscultatory Technique in Blood Pressure Measurement (16)

13. (a) Explain about the need for pacemaker and the working principle of Programmable Pacemaker with neat block diagram (16)

(Or)

(b) Construct the block diagram of Microwave Diathermy and explain its function (16)

14. (a) (i) Explain X-Ray machine and the basic components used in the machine. (8)

(ii) With the neat block diagram explain Processing system in X-ray Computer axial Tomography. (8)

(Or)

(b) Sketch the block diagram of typical NMR imaging system and explain the detection system in detail. (16)

15. (a) (i) Discuss briefly about Infrared Detectors used in Thermograph. (8)

(ii) List out the types of Laser with their classification and interpret the functions of Helium -- Neon Laser and ND – YAG Laser. (8)

(Or)

(b) Draw and explain the single channel ECG telemetry system (16)

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