



SYED AMMAL ENGINEERING COLLEGE

(Approved by the AICTE, New Delhi, Govt. of Tamilnadu and Affiliated to Anna University, Chennai)

Established in 1998 - An ISO 9001:2008 Certified Institution

Dr. E.M.Abdullah Campus, Lanthai, Ramanathapuram – 623 502.

Phone: 304000, 304222, 304101 (04567)

Web: www.syedengg.ac.in, E.mail:saec@syedengg.ac.in

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING



SUBJECT COSE & NAME : EC6001-MEDICAL ELECTRONICS

YEAR : III YEAR

SEMESTER : VI

UNIT-I

ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING

PART – A(2 Marks)

1. What are the objectives of a biomedical instrumentation system?
2. Define the term conduction velocity.
3. Explain the difference between in vivo and in vitro measurements.
4. Name the major physiological systems of the body.
5. What is meant by cell?
6. What are resting and action potential, bioelectric potential?
7. Define the process of sodium pump.
8. Draw an action potential waveform and label the amplitudes and time values.
9. What specific features might be incorporated into an instrument designed for clinical use as opposed to one designed for research purposes?
10. What do you understand by the term "gage factor"?
11. What is the difference between an active and a passive transducer?
12. What are the characteristics of carrier amplifier?
13. What is meant by drift compensation in operational amplifiers?
14. Define an electrometer amplifier. What are its characteristics?
15. What is the purpose is of pre-amplifier isolation circuits in ECG circuit?
16. What is the purpose of auxiliary amplifier in ECG unit?
17. What is input isolation?
18. What is the function of chopper amplifier?
19. Define Lead. Name the types of leads used for ECG.
20. What are micro, needle and surface electrodes?
21. Define electrode, what are the types of electrodes.



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22. What is electrode potential (or) half-cell potential? What are polarisable and non polarisable electrodes?
23. What are the characteristics of resting potential?
24. For a patient, which types of electrode would be the least traumatic?
25. Why microelectrodes are sometimes needed?
26. What are the problems involved in using flat electrodes in terms of interference or high impedance between electrode and skin? How could you help eliminate this problem? / What are the uses of the electrode paste applied during biomedical recording?
27. What do you understand by the term "reference electrode"?
28. What is a glass electrode used for?
29. What is an ear-clip electrode used for?
30. What is the major advantage of floating-type skin surface electrodes?
31. What is the hydrogen ion concentration of blood with a pH of 7.4?
32. What are parts of central nervous system?
33. Name the parts that contain peripheral nervous system.
34. Define circulatory system.
35. Define Einthoven triangle.
36. What is electro encephalography?
37. What is evoked potential?
38. What is meant by brain waves and what are the types of brain waves?
39. Draw the waves of brain.
40. What is electromyography?
41. How would you state the sensitivity characteristics of an electrocardiograph to give a 2-in. deflection on a recorder for a 2-mV peak reading?
42. What is the difference in the information contained in a phonocardiogram and an electrocardiogram?
43. If a person stands up, does his blood pressure increase? Why?



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44. If a person eats a large meal, does his heart rate increase? Why?
45. What part of the cardiovascular system contains the greatest volume of blood?
46. What is meant by 'Depolarization'?
47. What is 'Absolute Refractory Period'?

PART – B

1. Explain the factors that influence the design and application of a medical instruction system / Discuss the different characteristics of a medical instrument system. (8)
2. Explain the man-instrument system with a neat block diagram /Explain with a block diagram the components of the bio-medical instrument system. (8)
3. Discuss the problems encountered in measuring a living system /Discuss the major differences encountered between measurements in a physiological system as distinct from a physical system. (8)
4. Draw the structure of a living cell of our body and explain its constituents. (8)
5. Discuss the different ways of transport of ions through the cell membrane (4)
6. Give an account on the different chemical compositions in the intra and extra cellular fluids and their effects in the case of blood serum. (4)
7. Discuss the development of action potential and muscular contraction. (8)
8. Draw the electrical equivalent circuit of microelectrode and explain its electrical nature. (8)
9. What are biopotentialelectrodes. Distinguish between metallic microelectrode and nonmetallic microelectrode. (4)
10. Draw the micropipette nonmetallic electrode and explain (8)
11. With a neat block diagram, explain the working of ECG recorder (8)
12. Discuss the different lead configuration used in ECG. (8)
13. Explain with a neat diagram the resting potential (8)
14. Explain polarization, depolarization the depolarization (8)



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15. Draw the circuit diagram of an ECG isolation amplifier and explain its action. (8)
16. What are chopper amplifiers and explain. (8)
17. Explain with a diagram medical preamplifier and explain its action (8)
18. Explain a bridge voltage amplifier and explain (8)
19. Explain buffer amplifier and explain (8)
20. Explain a current amplifier circuit and explain its working. (8)
21. Draw the curves of ECG and diagnose any form of disturbance in heart rhythm (8)
22. Draw the block diagram of an EEG unit and explain the different parts in it. (8)
23. Give the origin of brain waves and describe the 10-20 electrode system used in EEG. (8)
24. Describe the recording setup used in EMG (8)
25. Write a note on ERG and EOG (8)
26. Explain the origin of different heart sounds (8)
27. Explain with diagram the salient features of Phonocardiography (PCG) (8)
28. Draw the frequency response of
 - a. An electromyogram. (2)
 - b. Blood flow measurements. (2)
 - c. Phonocardiogram. (2)
 - d. Plethysmogram (2)
29. (a) Write down the 'Nernst Equation' and 'Goldman Equation' and explain about the constants used. (8)
(b) Explain 'Bio Electric Potentials from the brain' and 'Resting Rhythms of the Brain'. (8)



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UNIT II - BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENTS

Part A

- 1. What are the typical values of blood pressure and pulse rate of an adult? (Nov/Dec.2012)**

Systolic (maximum) blood pressure in the normal adult is in the range of 95 to 145 mm Hg, with 120 mm Hg being average. Diastolic (lowest pressure between beats) blood pressure ranges from 60 to 90 mm Hg, 80 mm Hg being average.

- 2. What are systolic and diastolic pressures? (Nov/Dec 2011)**

The heart's pumping cycle is divided into two major parts systole and diastole. Systole is defined as the period of contraction of the heart muscles specifically the ventricular muscle at which time blood is pumped into the pulmonary artery and the aorta. Systolic pressure is 120 mm Hg (average value). Diastole is the period of dilation of the heart cavities as they fill with blood. Diastolic pressure is 80 mm Hg (average value).

- 3. What is the reason for decrease of cardiac output?**

The reason for decrease of cardiac output may be due to low blood pressure, reduced tissue oxygenation, poor renal function, shock and acidosis.

- 4. Define – Cardiac Output**

Cardiac output is defined as the amount of blood delivered by the heart to the aorta per minute. In case of adults during each beat, the amount of blood pumped ranges from 70 to 100 ml. for normal adults the cardiac output is about 4- 6 liters/ minute.

- 5. State the principle behind the indicator dilution method.**

The indicator dilution method is based on the principle that a known amount of dye or radio isotope as an indicator is introduced with respect to time at the measurement site, so the volume flow of blood can be estimated.

- 6. What is residual volume? (May /June 2007)**

Residual volume is the volume of gas remaining in the lungs at the end of maximum expiration.

- 7. Define – Tidal Volume**

Tidal volume is also called as normal depth volume of breathing or is the volume of gas inspired or expired during each normal quiet respiration cycle.



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8. What is total lung capacity?

The total lung capacity is the amount of gas contained in the lungs at the end of maximal inspiration.

9. Define – Vital Capacity

The vital capacity (VC) is the maximum volume of gas that can be expelled from the lungs after a maximal inspiration.

10. What is electrophoresis?

(April / May 2010)

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.

11. How is cardiac output is used?

Using implanted electromagnetic fine probe on the aorta, find the cardiac output per minute directly can be found by multiplying the stroke volume with the heart beat rate per minute.

12. What are the uses of gas analyzers?

Gas analyzers are used to determine the quantitative composition of inspired and expired gas to assess the lung function.

13. What are the uses of blood flow meters?

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

14. What are the applications of flame photometer?

(Nov/Dec2009)

Flame photometer is used to analyze urine or blood in order to determine the concentration of potassium (K), sodium (Na), calcium (Ca) and lithium (Li).

15. What are blood cells?

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 is involved in the clotting of blood.



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16. What is the purpose PO₂ electrode is used?

PO₂ electrode is used to determine the oxygen tension in the blood. It is a piece of platinum wire embedded in an insulating glass holder with the end of wire exposed to the electrolyte into which the oxygen from the solution under measurement is allowed to diffuse through the membrane.

17. How is auto analyzer useful in medical field?(April /May 2010)

Auto analyzer is used to measure blood chemistry and display that on a graphic recorder.

18. What are korotkoff sounds?(Nov/Dec 2008)

In the Blood pressure (BP) measurement, when the systolic pressure exceeds the cuff pressure, then the doctor can hear some crashing, snapping sounds through the stethoscope. These sounds are called as korotkoff sounds.

19. What is cardiac output? What are the methods of measurement of cardiac output? (Nov/ Dec 2004).

Cardiac output is the amount of blood delivered by the heart to the aorta per minute. For normal adult, the cardiac output is 4- 6 litres/min. The cardiac output is measured by using three methods. They are Fick's Method, Indicator dilation method, Measurement of cardiac output by impedance change.

20. What are the two methods of pulse measurement?

The methods used for measuring pulse are transmittance and reflectance methods.

PART B

1. Explain the various BP measurement techniques.

- a) Introduction
- b) Indirect method of BP measurement
- c) Direct method of BP measurement



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2. Explain respiratory rate measurement techniques.

- a) Introduction
- b) Types of Respiration rate measurement
 - i) Displacement method
 - ii) Thermistor method
 - iii) Impedance pneumography
 - iv) CO₂ method
 - v) Apnoea method

3. What are the various cardiac output measurement techniques?

- a) Introduction
- b) Three methods:
 - i) Fick's method
 - ii) Indicator dilution method
 - iii) Thermo dilution method
 - iv) Impedance change method

4. Write short notes on: a) Auto analyser (8)

b) pulse measurement (8)

- a) Auto analyzer definition
- b) Components used in auto analyzer
- c) Explanation of each component.
- d) pulse measurement definition
- e) Transmittance method
- f) Reflectance method.



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5. Describe a procedure for the measurement of pH in blood. (8)

- a) Definition
- b) Construction and working.

6. Draw the block diagram of ultrasonic blood flow meter. Explain the method of measuring the velocity of blood flow using a) transit time principle b) Doppler effect.

- a) Definition of blood flow meter
- b) Block diagram of ultrasonic blood flow meter
- c) transit time principle
- d) block diagram and explanation of transit time method
- e) Doppler effect method
- f) Block diagram and explanation of Doppler effect.

7. Explain the principle of sphygmomanometer. (8)

- a) Construction and components of sphygmomanometer
- b) Measurement using sphygmomanometer

8. Explain the principle of operation of coulter counter. What is its application?

- a) Definition and basic cells in the blood
- b) The coulter principle
- c) Block diagram of coulter counter
- d) Components and Explanation about measurement techniques.



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UNIT –III ASSIST DEVICES

1 Give two important factors that demand internal pace maker's usage. [A/M2005]

The two important factors that demand internal pace maker's usage are

- (i) Type and nature of the electrode used
- (ii) Nature of the cardiac problems.
- (iii) Mode of operation of the pacemaker system.

2 Classify Pacing modes[N/D 2007]

Based on the modes of operation of the pacemakers, they can be classified into five types. They are:

- i) Ventricular asynchronous pacemaker(fixed rate pacemaker)
- ii) Ventricular synchronous pacemaker
- iii) Ventri defibrillator inhibited pacemaker (demand pacemaker)
- iv) Atrial synchronous pacemaker
- v) Atrial sequential ventricular inhibited pacemaker

3 Distinguish between Internal and External pacemakers. [M/J 2007]

S.No	Internal Pacemakers	External Pacemakers
1.	The pacemaker is a surgically implanted when if the skin near chest or abdomen, with its output's leads is connected directly to the heart muscle.	The pacemaker is placed outside the the body. It may be in the form of watch or in the pocket, from that one terminal will go in the heart through the vein
2.	It requires open chest minor surgery to place the pacemaker	It does not require open chest surgery
3.	It is used for temporary heart regularity	It is used for permanent heart regularity
4.	There is no safety for the pacemaker, particularly in case of child carrying the pacemaker	There is 100% safety for circuit from the external disturbances.



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4 What are the batteries used for implantable pacemaker?[N/D 2012]

The batteries used for implantable pacemakers are (i)Mercury cell (ii) Lithium cells (iii)Nuclear

5 What types of electrodes are used in a defibrillator? [A/M 2005]

The electrodes used in a defibrillator are

- (i)Internal electrodes - Spoon shaped
- (ii)External electrodes -Paddle shaped

6 What are the three types of exchangers used in HEMODIALYSIS system? [M/J 2005]

The three types of exchangers used in HEMODIALYSIS systems are i)Parallel Flow dialyzer

(ii)Coil Hemodialyser

(iii)Hollow Fiber modialyser

7 What is meant by fibrillation?[M/J 2009][A/M 2010]

The condition at which the necessary synchronizing action of the heart is lost is known as fibrillation. During fibrillation the normal rhythmic contractions of either atria or the ventricles are replaced by rapid irregular twitching of the muscular wall.

8 Calculate the energy stored in 16 μ F capacitor of a DC defibrillator that is charged to a potential of 5000 Vdc.

Given Data:

$$C = 16\mu\text{F}$$

$$V = 5000$$

$$E = (1/2) CV^2$$

$$= (1/2) \times 16 \times 10^{-6} \times 25 \times 10^6$$

$$= 200 \text{ Joules}$$

9. What is heart lung machine?

The machine can provide extra corporal circulation to the patient is known as heart lung machine.



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10. What is Dialysis?

Dialysis is a process by which the waste products in the blood are removed and restoration of normal pH value of the blood is obtained.

11. What is the use of proportioning pump?

It is used to mix the pure water with dialysate. Usual ratio of water and concentrate is 34:1.

13. Write the principle of hemodialysis.

Blood is purified by an artificial kidney machine in which blood is taken out from the body and waste products diffuse through a semi-permeable membrane which is continuously rinsed by a dialysing solution.

14. Distinguish a defibrillator from a pacemaker.

Defibrillator	pacemaker
It is an electronic device that creates a sustained myocardial depolarization of a patient heart in order to stop the fibrillation	It is an device capable of generating artificial pacing impulses and delivering them to the heart.

15. what are pacemakers?

Pacemakers means electrical pulse generator for starting and/or maintaining the normal heart beat. The output of pacemaker is applied either externally to the chest or internally to the heart.

PART B

1. Explain the different types of pacemakers?, Explain with relevant diagrams, the principles of an demand pacemaker. (A/M 2010)

- Definition of pacemakers
- Internal Pacemakers
- External pacemakers.
- Primary and secondary pacemakers
- Artificial pacemakers



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2. **Explain the different types of pacing modes?(A/M 2011)**
 - a) Fixed rate pacemaker
 - b) Standby pacemaker
 - c) Demand pacemaker
 - d) Atrial synchronous pacemaker
 - e) Atrial synchronous ventricular inhibited pacemaker.

3. **Explain D.C defibrillator with neat diagram. (A/M 2011), (N/D 2011)**
 - a) Introduction
 - b) Fibrillation
 - c) Atrial and ventricular fibrillation
 - d) Electrodes used in defibrillators
 - e) How to treat fibrillation problems
 - f) Circuit diagram of D.C defibrillator
 - g) Explanation of block diagram

4. **Draw and explain heart lung machine model. (N/D 2006)**
 - a) Heart-lung machine model block diagram
 - b) Working
 - c) Heat exchanger
 - d) Filter block
 - e) Blood pumps(Pulsatile and Nonpulsatile pumps)
 - h) Oxygenators
 - i) Types(Membrane, Liquid-liquid, Film Oxygenators)

5. **Explain the two types of Dialysis.(N/D 2006)**
 - a) Functions of kidney
 - b) Artificial kidney
 - c) Dialysis
 - d) Heamo dialysis
 - e) Peritoneal dialysis



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UNIT IV PHYSICAL MEDICINE and BIO-TELEMETRY

1. What is meant by diathermy? [A/M 2010]

Diathermy is the treatment process by which, cutting coagulation of tissues are obtained.

2. List the types of diathermy.

The types of diathermy are

- i) Short wave diathermy
- ii) Microwave diathermy
- iii) Ultrasonic diathermy
- iv) Surgical diathermy

3. What are the types of thermography?

The types of thermography are

- i). Infrared thermography
- ii) Liquid crystal thermography
- iii). Microwave thermography

4. What are the different types of current that are used for medical applications?

The different types of current are Threshold current, pain current, let-go current, paralysis current, fibrillation and defibrillation current.

5. Define - Endoscopes and mention some of its types.

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

Types of endoscopes are cardioscope, bronchoscope, laparoscope, otoscope, gastroscope etc.

6. What are the devices used to protect against electrical hazards?

- i). Ground fault interrupt ii). Isolation transformer



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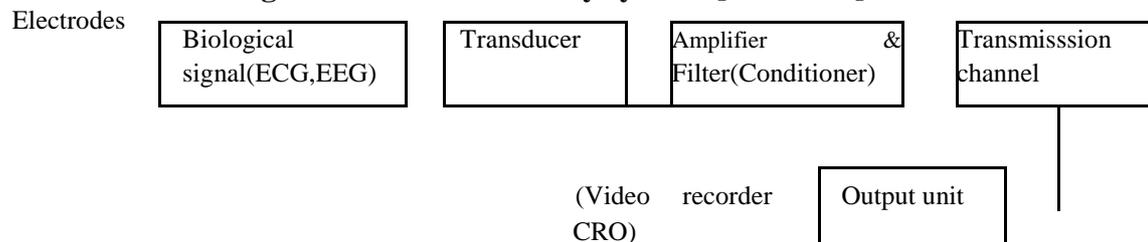
7. What are the two methods of shortwave diathermy?

The two methods of shortwave diathermy are i)Capacitive method
ii) Inductive method

8. What is the modulation techniques used for biotelemetry? Mention the reason for adopting that modulation scheme.[N/D 2004]

The two different modulation techniques used for biotelemetry are i)Double Modulation
ii)Pulse Width Modulation

9. Draw the block diagram of a Bio-Telemetry system. [N/D 2008]



10. What are the advantages of biotelemetry system? [M/J 2007] [M/J 2009]

The advantages of biotelemetry systems are

- (i) It is used to record the bio signals over long periods
- (ii) The medical attendant or computer can easily diagnose the nature of Disease by seeing the telemeter biosignals without attending patient Room
- (iii) Patient is not disturbed during recording
- (iv) For recording on animals, particularly for research, the biotelemetry is greatly used

11. Specify the frequencies used for biotelemetry.[N/D 2012]

Wireless telemetry system uses modulating systems for transmitting biomedical signals. Two modulators are used here. A lower frequency sub-carrier is employed in addition to very-high frequency (VHF). This transmits the signal from the transmitter

RADIO-PILL AND TELE-STIMULATION

12. What is a radio-pill? [N/D 2009][A/M 2010][M/J 2012]

The radio pill is capable of measuring various parameters that are available in the tract. With the help of radio pill type devices, it is possible for us to measure or sense temperature, pH, enzyme activity and oxygen tension values. These measurements can be made in association with transducers. Pressure can be sensed by using variable inductance and temperature can be measured by using temperature-sensitive transducer.



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13. What is the principle of telestimulation? [A/M 2008]

Telestimulation is the measurement of biological signals over long distance.

PART B

1. Explain the working principle of a diathermy unit with a neat block diagram.(A/M 2008), Explain the function of surgical diathermy and various modes of operations. (A/M 2010)

- a) Diathermy definition
- b) Types of diathermy unit
 - i) Short wave diathermy
 - ii) Microwave diathermy
 - iii) Ultrasonic diathermy
 - iv) Surgical diathermy

2. Explain in detail the components of a bio-telemetry system (A/M 2008) (N/D 2011)

- a) Introduction
- b) Elements of bio telemetry
- c) Block diagram of bio-telemetry system
- d) Design of bio-telemetry system
- e) Radio telemetry system
- f) Single channel bio-telemetry system
- g) Multi channel bio-telemetry system

3. List out the physiological effect of electric current on humans (A/M 2008), Explain how electrical hazards can be rectified in hospitals. (A/m 2010)

- a) Mechanism of electrical shock
- b) Macro shock
- c) Micro shock
- d) Leakage current
- e) Shock hazards from electrical equipment
- f) Macro shock hazards



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Dr. E.M.Abdullah Campus, Lanthai, Ramanathapuram – 623 502.

Phone: 304000, 304222, 304101 (04567)

Web: www.syedengg.ac.in, E.mail:saec@syedengg.ac.in



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4. Write short notes on radio-pill.

- a) Block diagram of radio-pill
- b) Components of radio-pill
- c) Transducer
- d) Transmitter
- e) Receiving antenna
- f) Demodulator circuit
- g) Tape recorder

5. Describe the frequency selection of Bio-telemetry principle.

- a) Introduction
- b) Elements of bio telemetry
- c) Block diagram of bio-telemetry system
- d) Design of bio-telemetry system
- e) Radio telemetry system
- f) Single channel bio-telemetry system
- g) Multi channel bio-telemetry system



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UNIT-V RECENT TRENDS IN MEDICAL INSTRUMENTATION

1. What is medical thermography? Mention its applications. [N/D 2004] [N/D 2005]

Thermography is the process of recording true thermal image of the surfaces of objects under study. It displays images representing the thermal radiation of skin areas. Thermogram contain both qualitative and quantitative information relevant to the image itself and to temperature.

Medical applications of thermography i) Tumors

ii) Inflammation

iii) Diseases of peripheral vessels

iv) Orthopedic diseases

2. List the types of lasers used in medical field [N/D 2004]

The types of lasers used in medical fields are i). Pulsed Nd-YaG laser

ii). Continuous laser. Co₂ laser

iii). Continuous wave organ ion laser

3. Define - Let-go current [M/J 2006] [A/M 2008]

Let – go current is the minimum current to produce muscular contraction. For men—about 16mA

For Women—about 10.5 mA

4. Define – Micro Shock[M/J 2007]

A physiological response to a current alied to the surface of the heart that results in unnecessary stimulation like muscle contractions or tissue injury is called as microshock.

5. What are the advantages of performing surgery using LASER? [A/M 2008][N/D 2009]

The advantages of performing surgery using LASER are i)Highly sterile

ii) Non-contact

surgery iii)Highly

localized and precise

iv)prompt surgery

v)short period of surgical time



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6. Define – Macro Shock [N/D 2009]

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.

7. What are the applications of laser in medicine?

Laser is used in ophthalmology (eye problem), Gynecology (fertility), Plastic surgery, skin cancer etc.

8. What is the purpose of using resuscitation unit?

Resuscitation unit is generally used in intensive care unit (ICU). In modern hospitals the resuscitation units are in the form of a mobile trolley.

9. List the applications of Endoscope.

Endoscopes are used in hospitals for examination, treatment of disease and surgery.

10. What is the use of laparoscope?

The laparoscope is used for analyzing abdominal related diseases and to perform operations in the abdominal region.

PART B

1. Explain the principle involved in endoscopy unit with relevant diagrams.(A/M 2010)

- Introduction
- Block diagram of endoscopy laser coagulator
- Structure of laser optic coagulator
- Gamma ray endoscope camera

2. Write short notes on thermograph (A/M2011) ,(N/D2011)

- Introduction
- Block diagram of thermograph
- Three methods
- Infrared thermograph
- Liquid crystal thermograph
- Microwave thermograph
- Advantages & applications of thermograph



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3. Explain the application of different type of laser in medicine (M/J2014)

- a) Definition
- b) Basic principle of laser
- c) Components of laser
- d) Laser working
- e) Applications of laser in surgery
- f) Photochemical applications
- g) Applications of laser in medicine

4. Write short notes on cryogenic applications in medical field.

- a) Definition of cryogenic
- b) Types of cryogenic treatment
- c) Cryosurgery
- d) Neuron therapy
- e) Cryosurgery
- f) Benefits of cryosurgery.

5. List out the applications of telemedicine in medical field.

- a) Basic concept of a telemedicine system
- b) Essential parameter for telemedicine
- c) Delivery modes in telemedicine
- d) Telemedicine system (block diagram)
- e) Telemedicine using mobile communication.