



Model Answer

SUMMER- 18 EXAMINATION

Subject Code:

17672

Important Instructions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.



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Q. No.	Sub Q.N	Answer	Marking Scheme										
Q.1	(A) a)	<p>Attempt any THREE of the following :</p> <p>Differentiate between fixed and demand pacemaker.</p> <p>Ans :</p> <table border="1"> <thead> <tr> <th>Fixed Mode</th> <th>Demand Mode</th> </tr> </thead> <tbody> <tr> <td>1) Pacing is competitive</td> <td>1) Pacing is non competitive</td> </tr> <tr> <td>2) It functions regardless of patients natural heart rhythm</td> <td>2) It considers patients heart rhythm</td> </tr> <tr> <td>3) It is asynchronous mode</td> <td>3) It is synchronous mode</td> </tr> <tr> <td>4) Number of pulses per minute are fixed</td> <td>4) Number of pulses per minute are not fixed</td> </tr> </tbody> </table>	Fixed Mode	Demand Mode	1) Pacing is competitive	1) Pacing is non competitive	2) It functions regardless of patients natural heart rhythm	2) It considers patients heart rhythm	3) It is asynchronous mode	3) It is synchronous mode	4) Number of pulses per minute are fixed	4) Number of pulses per minute are not fixed	<p>12</p> <p>(any four)</p>
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4) Number of pulses per minute are fixed	4) Number of pulses per minute are not fixed												
	b)	<p>Describe concept of AED.</p> <p>Ans :</p> <p>An important development in the field of defibrillator has been the development and successful use of smart automatic or advisory external defibrillator (AED) which are capable of accurately analyzing the ECG and of making reliable shock decision. They are designed to detect ventricular fibrillation with sensitivity and specificity comparable to that of well trained paramedics then deliver or recommended (advisory) an appropriate high energy defibrillating shock. AED require self adhesive electrode instead of hand held paddles for two reasons. Firstly, the ECG signal acquired from self adhesive electrodes usually contains less noise and has higher quality. Hence, it allows a faster and more accurate analysis of ECG and therefore facilitates better shock decision. Secondly, "Hand-off: defibrillation is safe procedure for the operator .especially if the operator has little or no training. An automatic external defibrillator is the ability of the device to accurately assess the patient's heart and appropriate therapy decision. It is small, light and virtually maintenance free. While it is on standby mode for long periods, the device automatically self tests its electronic circuitry every day and periodically performs an internal discharge and recalibration. The device is powered by long life disposable lithium battery with enough capacity for 75 discharges and one year of self test. It uses a low energy biphasic waveform.</p>	<p>4 marks</p>										
	c)	<p>List various steps for maintenance of ventilator.</p> <p>Ans :</p> <ol style="list-style-type: none"> 1 Check the ON/OFF switch. 2. Check the fuse continuity 3. Check the power cable continuity 4. Check the Gas Supply. 5. Check the Pneumatic lines (including air filters). 6. Check the Gas cylinders (and gauges and regulators, if so equipped). 7. Check the Patient Circuit. 8. Check the Breathing circuit (including filters). 9. Check the Humidifiers. 10. Check Pressure-relief mechanism. 	<p>4 marks</p>										

d) Draw a block diagram of conventional method and closed loop control drug delivery system.

Ans:

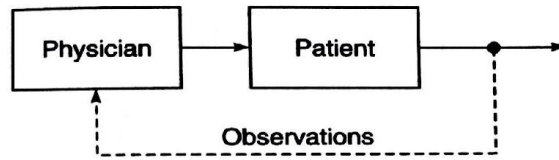


Fig a. Conventional method drug delivery system

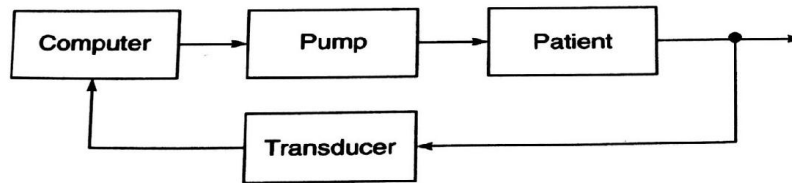


Fig b. Closed loop control drug delivery system

02

02

B) Attempt any ONE of the following.

a) (i) Describe instant and sync modes in defibrillator.

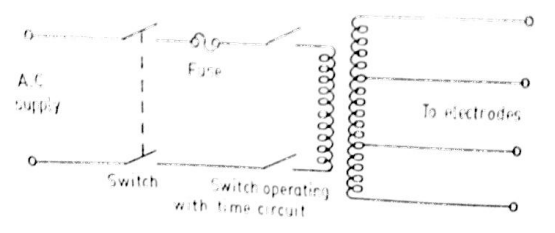
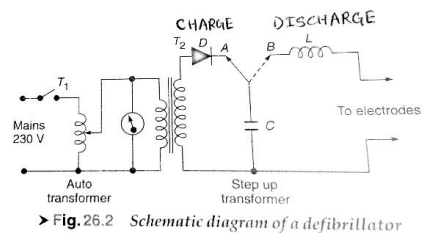
Ans:

Instant mode: In this mode the point at which the energy is delivered, totally depends on the operator. The discharge point is decided at the instant only.

Sync mode: The application of shock during the T wave of the ECG often produces ventricular fibrillation. To avoid this, synchronous mode is used. The discharge point is decided by the synchronizer circuit.

(ii) Differentiate between AC & DC defibrillator (any four points)

Ans:

A.C defibrillator	D.C defibrillator
1. It is not commonly used.	1. It is commonly used.
2. It produce undesirable side effect.	2. It does not produce undesirable side effect.
3. 	3. 
4. Capacitor is not used.	4. Capacitor is used.
5. At transformer secondary side diode is not used.	5. At transformer secondary side diode is used.

02

04

b) Describe heart lung bypass machine with its suitable diagram.

Ans:-

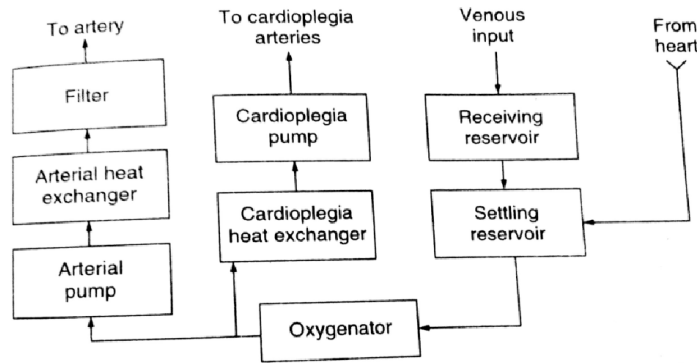


Figure 10.28 Heart lung machine (cardiopulmonary bypass).

OR any relevant diagram

During open heart surgery for installation of a valve prosthesis or correction of a congenital mal formation the heart can not maintain the circulation. It is then necessary to provide extra- corporeal circulation with a special machine called heart lunge machine.

Usually two cannulas are inserted in to the right side of the heart to collect the returning venous blood as shown in fig.Using heart lung machine extracorporeal circulation can be possible and in which the lungs and heart are replaced by the **OXIGENERATOR** and **BLOOD PUMP** respectively.

The collected venous blood is directed in to a receiving reservoir of heart lung machine by gravity drainage.The accumulated blood in the operating field is also collected and passed in to the receiving reservoir by suction devices. From here the blood is passed in to the setting reservoir or dabbling chamber and then it ts passed in to oxygenator. In the oxygenator the blood is exposed to an atmosphere rich in oxygen.

From oxygenator a pump raises the pressure of the blood to the mean arterial pressure from which it flows in to an arterial heat exchanger. arterial heat exchanger. Is necessary during hypothermic or low temperature operation which is followed for two reasons the first is to reduce body metabolism and therefore to reduce oxygen consumption during the operation. And secondly the brain damage due to oxygen starvation is reduced.

In the heat exchanger the blood is maintained at the human body temperature.

From the heat exchanger the blood passes through a filter to prevent the possibility of partials or bubbles returning to the body.

Systematic circulation is maintained by returning the this arterial oxygenated blood to a major artery.

Q2

a) Attempt any Four of the following
Differentiate between endocardial and myocardial leads.

Ans :

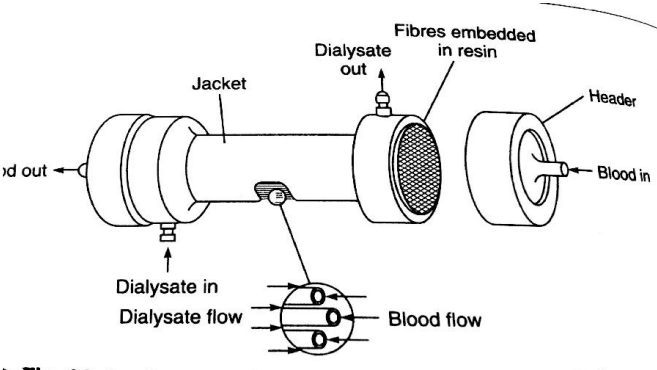
Endocardial pacemaker leads	Myocardial pacemaker leads.
1. This is connected to inner side of heart chamber.	1. This is connected to outer wall of heart muscle.
2. This is used in external pacemaker.	2. This is used in internal pacemaker.
3. The endocardial lead is inserted into the inside of the heart via a vein, usually in the chest area.	3. This type of lead is most often used when other cardiac surgery is being performed and there is already access to the heart.
4.Example : Porous tip electrode	4. Example: Steroid eluting electrode.

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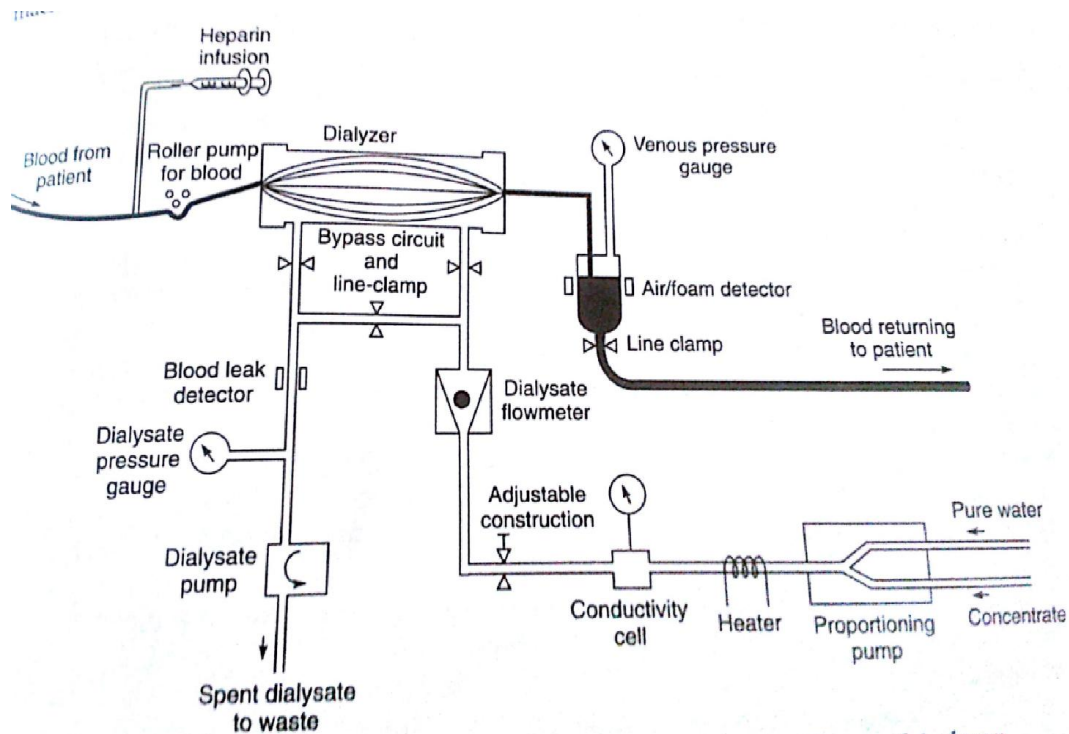
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16

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<p>b)</p>	<p>Describe hollow fiber dialyzer with suitable diagram. Ans:</p>  <p>The Hollow Fiber Hemodialyser is the most commonly used hemodialyzer. It consists of about 10000 hollow de-acetylated cellulose diacetate capillaries. The capillaries are jacketed in a plastic cylinder 18 cm in length and 7 cm in diameter. The capillaries are sealed on each end into a tube sheet with an elastomer. The capillaries range from 200-300 mm internal diameter and a wall thickness of 25-30 micro meter. The dialyzing area is approximately 9000 cm square unit. The primary volume with blood manifolds exclusive of tubing is approximately 130 ml. The blood is introduced and removed from hemodialyser through manifold headers. The dialysate is drawn through the jacket under a negative pressure around the outside of the capillaries counter-current to the blood flow, the dialyzer is disposable.</p>	<p>02</p> <p>02</p>
<p>c)</p>	<p>List the possible faults and its solution in ventilator (any four). Ans: (Consider any relevant faults)</p> <ol style="list-style-type: none"> 1. Equipment is not working Solution: Check power switch is on. Replace fuse with correct voltage and current if blown. Check mains power is present at socket using equipment known to be working. 2. Electrical shocks or fuse keeps blowing. Solution: Replace with correct rating 3. No oxygen flow Solution: Check tubing and connectors are fitted tightly Remove tubing, flush through and dry out before replacing 4. Alarms not working Solution: Check alarm circuit. 	<p>4</p>
<p>d)</p>	<p>List technical specification of Central Monitor (any four). Ans:</p> <ol style="list-style-type: none"> 1) Power supply requirement: 1ø, 230 V 50 Hz AC 2) Sampling Speed of ECG: at every 2 mS 3) Display: 300 X 260 picture element bit map for alphanumeric and graphics 4) Number of channels: up to 8 5) Storage time for patient data: 24 Hrs. 6) Alarm indications: visible and/or audio 	<p>4</p>

e) Describe principle of operation of hemodialysis machine with suitable diagram.
Ans:



02

Haemodialysis machine is used to purify the blood in case if kidney is partially or completely not working. Proportionating pump prepare the dialysate solution by using dry chemicals and water with the ratio of 1:35 respectively. The Haemodilysis procedure is done at the room temperature. The heater is used to maintain the temperature of the dialysate. The rate of filtration depends upon the concentration in the dialysate. To measure the concentration in the dialysate a conductivity cell is placed at the path of the dialysate before it reaches to the dialyzer. Dialyzer is an artificial kidney. It is actual site where the filtration takes place. Depending upon the construction of the dialyzer the blood and dialyzer are made to come in contact to each other through a semipermeable membrane. The impurities in the blood are sucked out through this semipermeable membrane in to the dialysate. During the process of dialysis two more detectors are used.

02

- 1) Blood leak detector: it is used to detect if there are any leakage in the blood tubing or blood path. If detected any leakage then the blood is bypassed to the body.
- 2) Air Bubble Detector: during the whole procedure if some air bubble found in the blood tubing it must be removed before it reaches to heart. Because air bubble in the blood circulation can cause serious problems. This detector uses photoelectric method. If some air found in the path the blood is bypassed to the body.

Heparin is added to the blood to avoid the blood clotting.

f) Differentiate between internal and external pacemaker (any four points).

Ans:

Internal pacemaker	External pacemaker
1. Internal pacemakers are used in long-term pacing cases.	External pacemakers used in short time pacing cases.
2. These types of pacemakers are used when there is permanent damage to the heart.	These types of pacemakers are used when the heart block presents as an emergency.
3. Internal pacemakers are implanted beneath the skin along with its electros.	External pacemaker is applied externally on the surface of body by using metal electrodes.
4. Internal pacemakers are small in size.	External pacemakers are large in size.

4

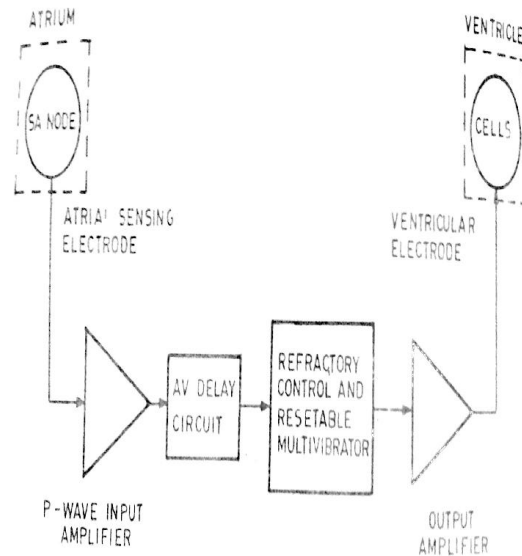
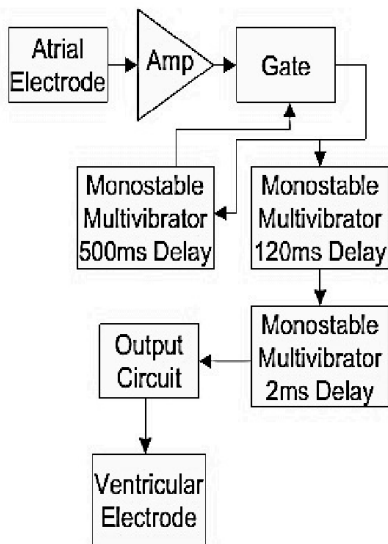
Q.3

Attempt any Four of the following.

16

a) Describe atrial synchronous pacemaker with suitable diagram.

Ans :



OR

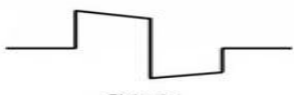

As SA node fires, it triggers the pacemaker. Gate is used to trigger the circuit and amplifier for amplification purpose. Delays are used to simulate natural delay from SA to AV node (120ms) and to create a refractory period (500ms). Output circuit controls ventricular contraction. 2ms delay is given to the output circuit. Combining the demand pacemaker with this design allows the device to let natural SA node firing to control the cardiac activity.

02

02

b) Differentiate between biphasic and monophasic defibrillator.

Ans :

Biphasic defibrillator	Monophasic defibrillator
1. In a biphasic shock, initially direction of shock is reversed by changing the polarity of the electrodes in the latter part of the shock being delivered.	1. In monophasic shock, the shock is given in only one direction from one electrode to the other
2. Biphasic shocks are more effective than monophasic shocks and need lesser energy.	2. Monophasic shocks are not effective than Biphasic shocks and need high energy.
3. Typically when 2.0 Joules are delivered for defibrillation in a Biphasic defibrillator	3. Typically when 360 Joules are delivered for defibrillation in a monophasic defibrillator
4. Output of Biphasic defibrillator	4. Output of Monophasic defibrillator
 <p style="text-align: center;">Biphasic</p>	 <p style="text-align: center;">Monphasic</p>

04

c) List any four technical specifications of ventilator.

Ans:

Power Source: - 220/230 V Ac 50 Hz supply.

Ventilation parameters: -

1. Tidal volume - 200 – 2000 ML (Adult patient). 50 to 300 ML (Paediatric PC mode).
2. Respiratory rate - 5 – 100 BPH.
3. Pressure - 0 – 100 cm H₂O.
4. Inspiratory Peak Flow - 4 – 100 l/min.
5. Minute volume - 1 – 30 l/min.
6. Oxygen Concentration - 21 – 100 %
7. Inspiratory pause - 0.1 – 5.5 sec.
8. PEEP/CPAP - 30 cm H₂O.

Ventilation modes

1. Pediatric mode.
2. Controlled mode.
3. Asst. Controlled mode.
4. Pressure Controlled Ventilation.
5. SIMV/V and SIMV/P.
6. Bipressure Ventilation.
7. CPAP and PEEP.
8. Facility for Non-Invasive ventilation

4

	<p>d) State the maintenance steps carried out for bedside monitor. Ans:</p> <ol style="list-style-type: none"> 1. Check that battery charge indicator, power indicator and patient cable connector indicators are working. 2. Check all cables are not bent, knotted or damaged. 3. Check all knobs, switches and indicators are tightly fitted. 4. Check battery power can operate the equipment. 5. Check all the parameters are displayed on the screen. 6. Check alarm setting. 	4
	<p>e) Describe the need of hemodialysis machine. Ans :</p> <p>It is also known as dialysis machine (dialyzer). It is used to partially or completely replace the functions of the kidney. When patient natural kidney fails to purify the blood by sucking out the toxic substances from it and eventually drained it, dialysis or artificial kidney is used. It is used to purify the blood when natural kidney fails to do so. It is used to support the filtration.</p>	4
<p>Q4</p>	<p>(A) a) Describe Rate Responsive pacemaker with suitable diagram. Ans</p> <div data-bbox="391 957 1179 1188" data-label="Diagram"> </div> <p>In some patient, due to diseased condition of the sinus, the heart's natural pacemaker is not able to increase its rate in response to metabolic demands. Fig shows block diagram of rate responsive pacemaker. A sensor is used to convert a physiological variable in the patient to an electrical signal that serves as an input to the controller circuit, which can determine whether any artificial pacing is required or not. Today, the majority of pacemakers are rate responsive pacemaker, incorporating one or more sensor. The most common sensor which uses piezoelectric materials to detect vibration caused by the body movement. The sensor can be placed within the pacemaker itself or located at some other place in the body. It may be noted that each of physiological variables requires a different control algorithm for the control circuit.</p>	12 02 02
	<p>b) Draw block diagram of Suction Apparatus and describe its working. Ans :</p> <div data-bbox="440 1671 1146 1944" data-label="Diagram"> </div>	02

Suction pump typically consists of an inlet where the fluid enters the pump and an outlet where the fluid comes out.
 Also there is a plastic container which will contain a fluid from the patient's body.
 The inlet location is said to be at the suction side of the pump. The outlet location is said to be at the discharge side of the pump.
 At inlet side there is a connecting tube which is made up of plastic and called as catheter.
 At outlet side there is a pressure gauge which shows that how much pressure is applied.
 Operation of the pump creates suction (a lower pressure) at the inlet/suction side so that fluid can enter the pump through the inlet.
 Pump operation causes higher pressure at the outlet/discharge side by forcing the fluid out at the outlet. The whole apparatus is connected to the wall suction.

02

c) List any four possible faults and their solutions in Bedside monitor.

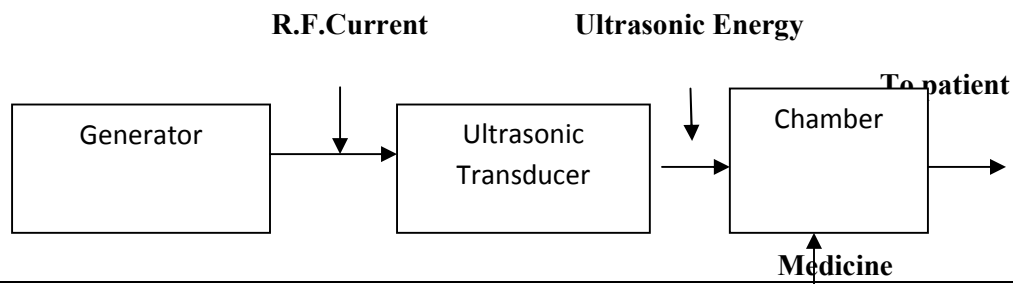
Ans: (Consider any related faults)

Problem	Solutions
1.Nothing is displayed	Mains switch gets ON. Replace the fuse.
2.Parameters are absent	Check and replace the faulty modules.
3.Cannot store data in memory	Correct the connection between memory and processor.
4.Alarm does not ring	Replace the SpO ₂ module. Replace the sensor.
5. Temperature varies frequently	Replace Temperature probe.

4

d) Draw a labelled block diagram of Nebulizer.

Ans :

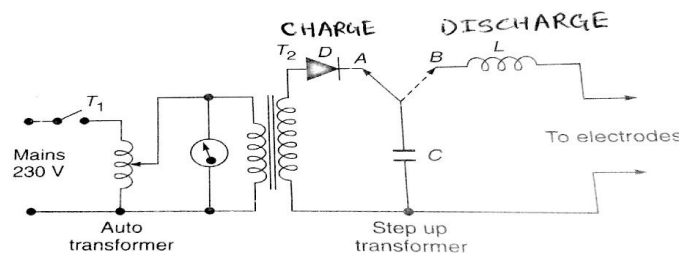


4

Q.4 (B) Attempt any ONE of the following :

a) Draw circuit diagram of charging and discharging section of DC Defibrillator and explain it.

Ans:



> Fig. 26.2 Schematic diagram of a defibrillator

03

CHARGING CIRCUIT:

A variable auto transformer T1 forms the primary of a high voltage transformer T2. The output voltage of the transformer is rectified by a diode rectifier and is connected to a vacuum type high voltage change over switch.

In position A, the switch is connected to one end of an oil filled 16 micro fared capacitor. In this position the capacitor charges to voltage set by positioning of the auto transformer,

DISCHARGING CIRCUIT :

When the shock is to be delivered to the patient, a foot switch or a push button mounted on a handle of the electrode is operated

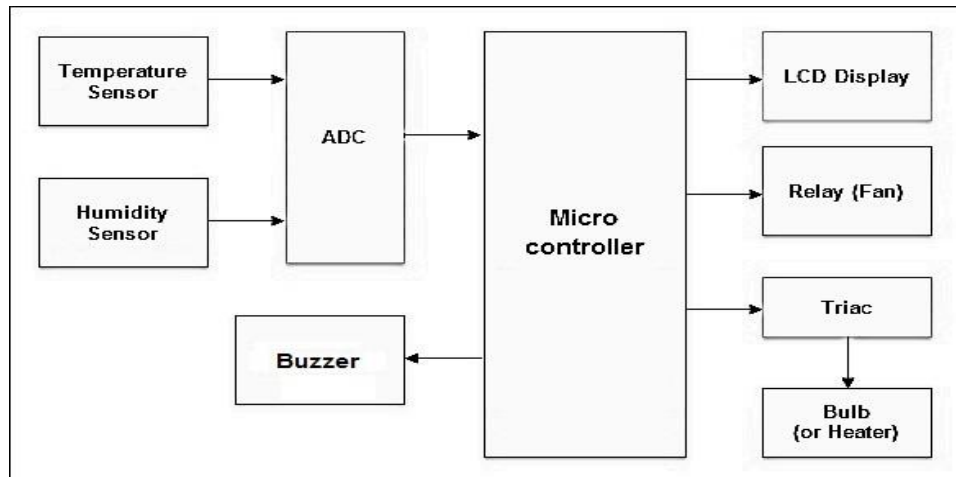
The high voltage switch changes over to position B and the capacitor is discharged across the heart through the electrodes.

In a defibrillator .an enormous voltage approximately 4000 V is initially applied to the patient.

03

b) Describe block diagram of baby incubator and also give any four technical specification of it.

Ans :



Above figure shows the block diagram of baby incubator.

It consists of a temperature sensor and a humidity sensor to sense temperature and humidity. The signals are then given to the ADC which will convert analog signals to digital form. Then these are given to the microcontroller. LCD display is used for display purpose which will display the temperature and humidity. Whenever Temperature rises above a threshold level at that time a Relay is turned on. There is a 12 volt DC fan at the output of Relay. Whenever Humidity rises above a threshold level, at that time microcontroller gives firing angle pulses to a Triac. Then this is connected to a heater or bulb. The intensity of bulb varies with the increase in Humidity value. The buzzer is connected which can be used in an emergency case.

Technical specification

- 1) Air temperature control range: 25°C -38°C (>37°C temperature setting.)
- 2) Skin temperature control range:35°C - 37°C
- 3) Power supply: 230v AC 50 Hz.
- 4) Humidity control range:40-95%RH
- 5) Water tank capacity: 1.0000ml
- 6) Weight 89 kgs Approx

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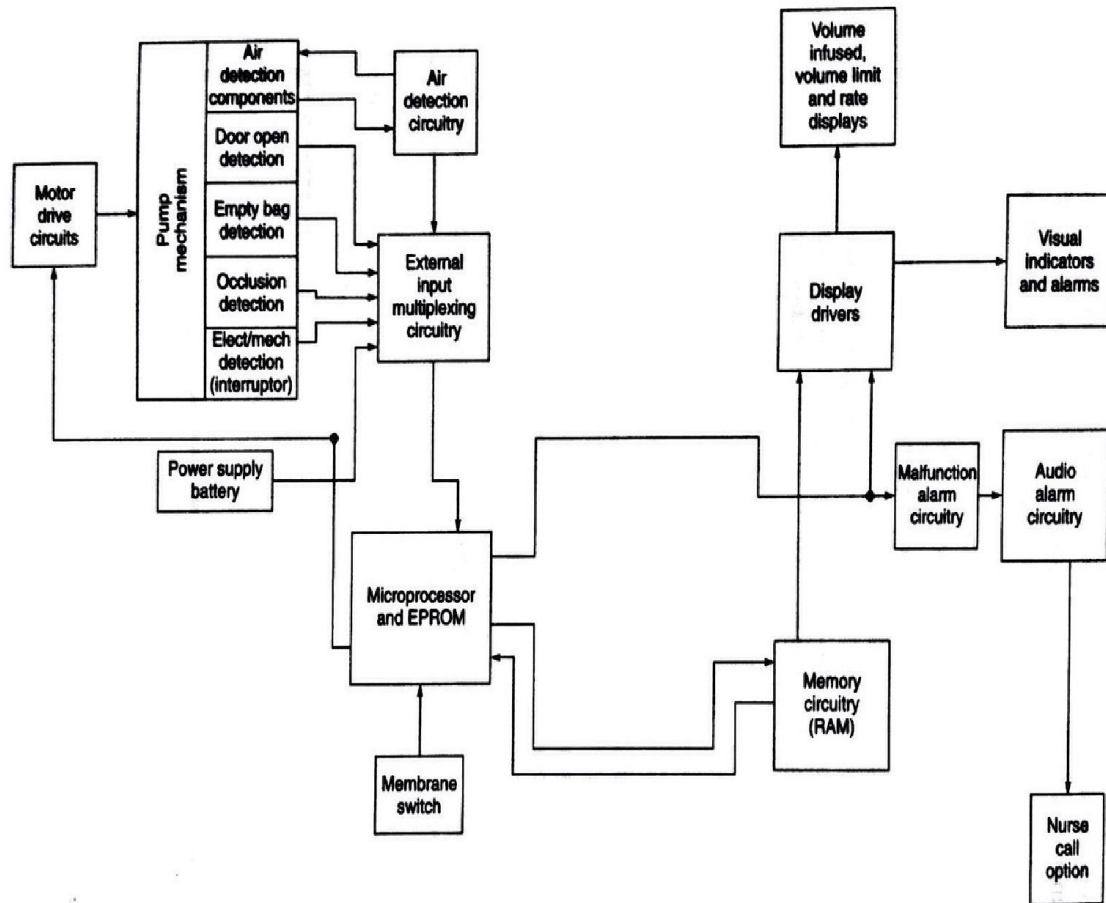
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02

<p>Q5</p>	<p>a) Describe Programmable pacemaker with suitable diagram. Ans:</p> <div data-bbox="370 310 1198 661" data-label="Diagram"> </div> <p>A programmable pacemaker consists of two parts: the external unit which generates programmed stimuli which is transferred to an internal unit by one the several communication techniques. Fig shows a functional block diagram of the programming interface, The commonly used methods of transmitting information are: (i) magnetic- an electromagnet placed on the surface of the body establishes a magnetic field which penetrates the skin and operate the pacemaker's reed switch (ii) radio frequency waves – the information can be transmitted over high frequency electromagnetic waves which are received inside the body by antenna. The antenna is usually in the shape of coil housed within the pacemaker, (iii) acoustic-ultrasonic pressure waves from a suitable transducer placed over the skin ,can operate the human body. They are received by a suitable receiver in the pacemaker which carries out the desired function.</p>	<p>16</p> <p>02</p> <p>02</p>
<p>b)</p>	<p>Describe following modes of ventilator.</p> <p>(i) Assist (ii) Assist/control</p> <p>Ans :</p> <p>(i) Assist: A ventilator which augments the inspiration of the patient's inspiratory effort. A pressure sensor detects the slight negative pressure that occurs each time the patient attempts to inhale and triggers the process of inflating the lungs. Thus the ventilator helps the patient to inspire when needed. A sensitivity adjustment provided on the equipment helps to select the amount of effort required on the patient's part to trigger the inspiration process. The assist mode is required for those patients who are able to breathe but is unable to inhale a sufficient amount of air or for whom breathing requires a great deal of effort.</p> <p>(ii) Assist/control: A ventilator which combines both the controller and assistor functions. In these devices, if the patient fails to breathe within a pre-determined time, a timer automatically triggers inspiration process to inflate the lungs. Therefore, the breathing is controlled by the patient as long as it is possible, but in case the patient should fail to do so, the machine is able to take over the function. Such devices are most frequently used in critical care units.</p>	<p>02</p> <p>02</p>

c) Draw a neat labelled block diagram of programmable microprocessor infusion pump.

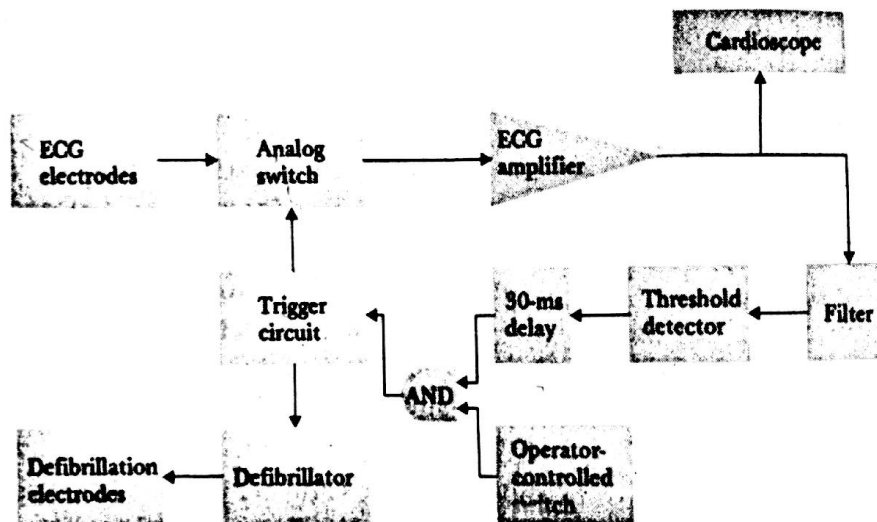
Ans :



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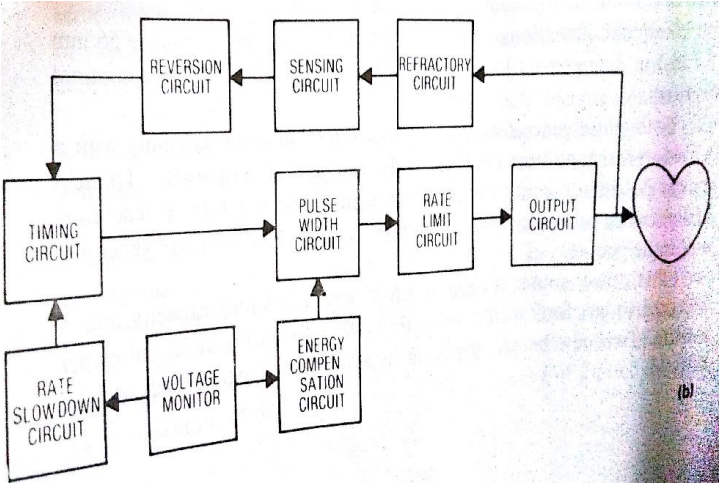
d) Draw block diagram of cardioverter.

Ans :



4



	<p>e) Explain the role of oxygenators used in Heart- Lung Machine. Ans : Oxygenator is a device that is capable of exchange in oxygen and carbon dioxide in the blood of human body during surgical procedure. The oxygenators repeatedly draw of the blood from the veins, reoxygenates and pumps it into the arterial system. The oxygenator serves as the lung during the open heart surgery as the lung.</p>	4
	<p>f) Describe the fail-safe system of Anesthesia machine. Ans: From the supply, the gas flows into the inlet of the anesthesia machine and is directed through the pressure safety system (fail-safe system) towards the flow delivery unit. The pressure safety system will not allow nitrous oxide to flow unless an oxygen supply pressure exists in the machine. The fail-safe system consists of a master pressure regulator valve located in the oxygen supply line. From master regulator, a reference pressure is provided to the slave regulator valve controlling the pressure and flow of the nitrous oxide line. When sufficient oxygen pressure of 275 kPa is present in the master regulator, the reference pressure enables the slave regulator valve to open and for nitrous oxide to flow. Regulations require oxygen –nitrous oxide ratio safeguards, which need a minimum continuous low flow of oxygen varying from 200 to 300 mL/min, as indicated by the low-flow rotameter. In newly designed machines, ingenious mechanical devices prevent the delivery of gas mixtures with an oxygen concentration below a low limit. Oxygen-nitrous oxide ratios vary from 25:75 to 30:70, depending on the manufacturer.</p>	4
Q6)	<p>a) Describe the concept of Apnea. Ans : Apnea – Apnea is the cessation of breathing which may precede the arrest of the heart and circulation in several clinical situations such as head injury, drug over dose, anesthetic complication and obstructive respiratory diseases.</p>	16 4
	<p>b) A patient requires artificial pacing for long period of time. Suggest the type of pacemaker required for the patient. Draw block diagram of it. Ans : (Consider any type of Internal or Implantable pacemaker) Suggestion : Internal pacemaker is required for the patient.</p>  <p>The block diagram illustrates the internal pacemaker system. It features a central loop of four blocks: REVERSION CIRCUIT, SENSING CIRCUIT, REFRACTORY CIRCUIT, and TIMING CIRCUIT, connected in a clockwise cycle. The SENSING CIRCUIT is also connected to an external heart symbol. Below this loop, there are three blocks: RATE SLOWDOWN CIRCUIT, VOLTAGE MONITOR, and ENERGY COMPENSATION CIRCUIT. The RATE SLOWDOWN CIRCUIT feeds into the TIMING CIRCUIT. The VOLTAGE MONITOR and ENERGY COMPENSATION CIRCUIT both feed into the PULSE WIDTH CIRCUIT. The PULSE WIDTH CIRCUIT feeds into the RATE LIMIT CIRCUIT, which then feeds into the OUTPUT CIRCUIT. The OUTPUT CIRCUIT is connected to the heart symbol. The REVERSION CIRCUIT also feeds into the TIMING CIRCUIT.</p>	4

Block diagram of Internal pacemaker

c)	<p>Draw block diagram of Bedside Monitor.</p> <p>Ans :</p> <p style="text-align: center;">Figure 5.42 Block diagram of a typical bed side monitoring system.</p>	4
d)	<p>Describe the need of following machines:</p> <p style="margin-left: 20px;"> (i) Baby Incubator (ii) Heart- Lung Bypass Machine. </p> <p>Ans :</p> <p style="margin-left: 20px;">(i) Baby Incubator:</p> <ol style="list-style-type: none"> To provide controlled environment for new born or premature babies, who needs special care. To monitor different aspects of children's environment in order to create ideal conditions for survival. To regulate oxygen temperature and humidity level to protect infant from pollutants and infections. <p style="margin-left: 20px;">(i) Heart- Lung Bypass Machine.</p> <p>The heart-lung machine is a system which takes over the function of the heart and the lungs with sufficient safety to maintain life while the heart is stopped or opened to allow surgery on the coronary arteries or the heart valves, or to allow repair of congenital abnormalities</p>	02 02
e)	<p>Describe Unipolar and Bipolar leads of pacemaker.</p> <p>Ans :</p> <p>1. Unipolar: In unipolar system one electrode is inside or on the heart & is the stimulating electrode, & the second electrode is usually a large metal plate attached to the pulse generator. The current in this case flows between the pacing electrode in the heart & the indifferent electrode via the body tissue.</p> <p>2. Bipolar leads: Bipolar leads which have two electrodes positioned in the heart are designed with a coaxial connector requiring only a single receptacle resulting in improvement in the size of bipolar pacemaker connector. In the bipolar electrode system both electrodes are approximately of the same size and both are placed inside or on the heart so that current flows between the two electrodes.</p>	02 02