

SUMMER – 2019 EXAMINATION

Subject Name: Intensive Care Equipment



Model Answer

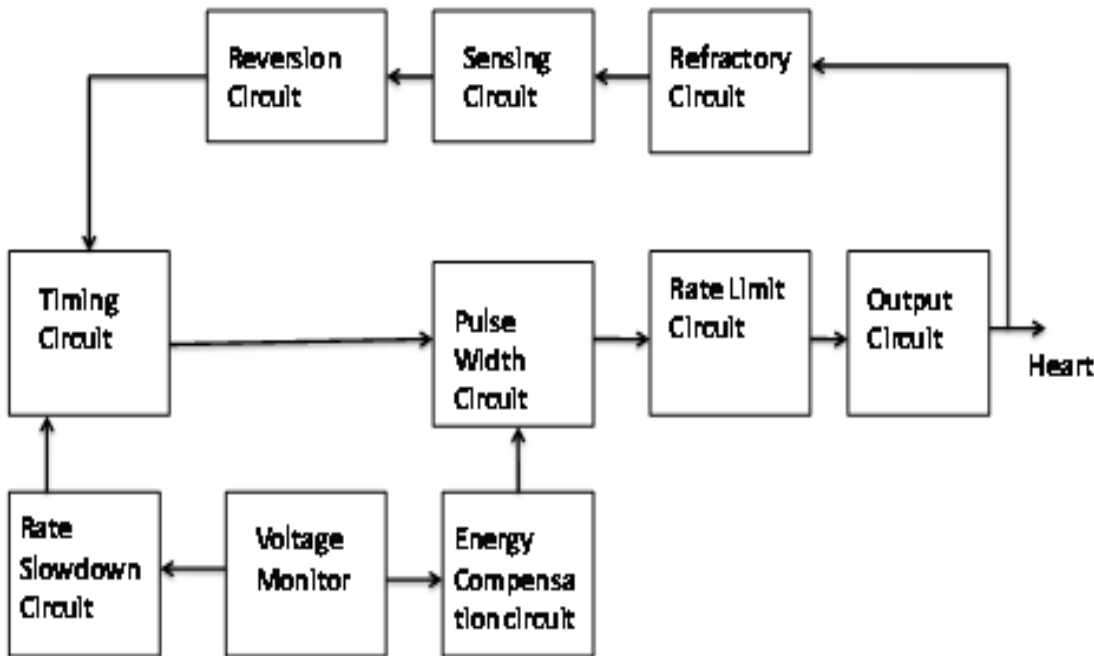
Subject Code:

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.

Q. No.	Sub Q. No.	Answer any THREE :	Marking Scheme
1.	A)	Attempt any THREE :	12 M
	a)	<p>Explain different electrodes used in defibrillator. (any two with diagram)</p> <p>Ans :</p> <p>Paddle electrode:</p>  <p>Fig: Paddle electrodes</p> <p>The most well-known type of electrode is the traditional metal paddle with an insulated handle. This type must be held in place on the patient's skin with a shock or a series of shocks is delivered. Paddles offer a few advantages over self-adhesive pads. Paddles are reusable, being cleaned after use and stored for the next patient. Gel is therefore not pre applied, and must be added before these paddles are used on the patient. Paddles are generally only found on manual external units.</p> <p>Self-adhesive electrode:</p>  <p>Fig: Self-adhesive electrode</p>	<p>01 M</p> <p>01 M</p> <p>01 M</p>

		<p>Adhesive pad includes either solid or wet gel. These are peeled off their backing and applied to the patient's chest when deemed necessary, much the same as any other sticker. The electrodes are then connected to a defibrillator. If defibrillation is required, the machine is charged, and the shock is delivered, without any need to apply any additional gel or to retrieve and place any paddles. Pads do not require extra leads to be attached for monitoring, and they do not require any force to be applied as the shock is delivered. Thus, adhesive electrodes minimize the risk of the operator coming into physical (and thus electrical) contact with the patient as the shock is delivered by allowing the operator to be up to several feet away.</p>	01 M
	b)	<p>State the need of respirator. Ans : Need of respirator: Respirator is device which helps in the respiration. It helps in the respiration. In some cases when patient fails to initiate this process, or unable to perform its own respiration To initiate the procedure of respiration certain amount of force is required by the body to move the chest upward and in front during inspiration while backward and downward during expiration. This creates the partial pressure difference between the atmosphere and the body which helps the air to go in and out, thus carried respiration. In some cases when patient fails to initiate this process, or unable to perform its own respiration, respirator is used which trigger and helps in complete respiratory cycle of the patient.</p>	04 M
	c)	<p>Draw the block diagram of internal pacemaker. Ans :</p>  <p style="text-align: center;">Fig: Block diagram of internal pacemaker</p>	04 M
	d)	<p>State the concept of balloon pump. Ans : Balloon Pump: The balloon pumps save your breath & energy. This balloon pump gives you the lungpower to inflate latex balloons at record pace. The balloon pump looks & operates like a standard bicycle pump, except for the specially designed needle nozzle that grips</p>	04 M



the balloon by the neck. Slide the balloon onto the nozzle, pump it up, remove, & tie. Then repeat process again & again, if you bought the 100 count bag of assorted balloons. For ages 3 & up.

Balloon pump product details:

1. Works like a bicycle pump.
2. Needle nozzle for easy fills.
3. Plastic case, metal pump rod.

B) Attempt any ONE :

06 M

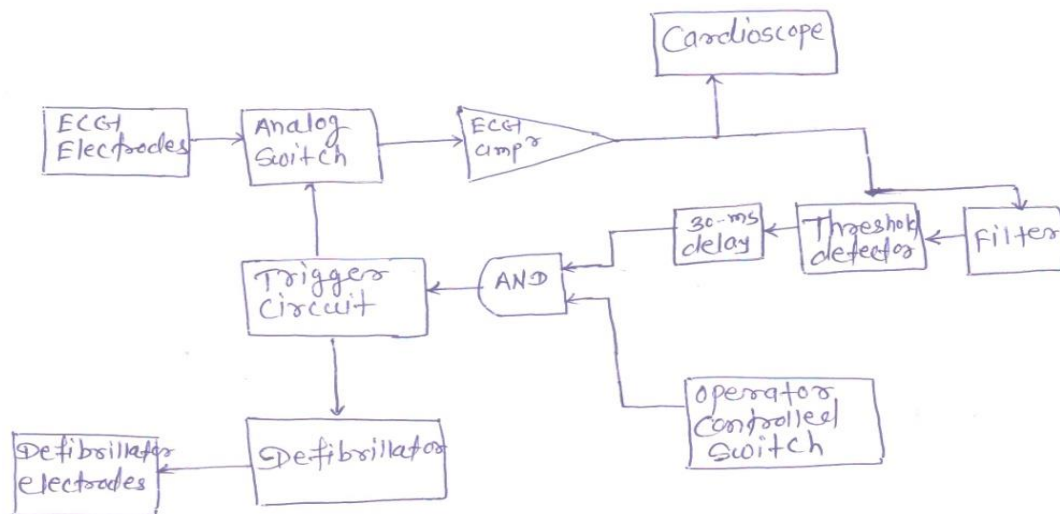
a) Explain cardioverter with neat diagram.

Ans:

A block diagram of such defibrillator which is known as a cardioverter. Basically the device is a combination of the cardiac monitor & the defibrillator. ECG electrodes are placed on the patient in the location that provides the highest R wave with respect to the T wave. The signal from these electrodes passes through a switch that is normally closed connecting the electrodes to an appropriate amplifier. The output of the amplifier is displayed on a cardio scope so that the operator can observe the patients ECG to see among other things whether the cardio version was successful or in extreme cases whether it produced more serious arrhythmias. The output from the amplifier is also filtered & passed through a threshold detector that detects the R wave. This activates a delay circuit that delays the signal by 30ms & then activates a trigger circuit that opens the switch connecting the ECG electrodes to the amplifier to protect the amplifier from the ensuing defibrillation pulse. At the same time it closes a switch that discharges the defibrillator capacitor through the defibrillator electrodes to the patient.

03 M

Block diagram of cardioverter :-



03 M

Fig: - A Cardioverter

Fig: Cardioverter

b) State the preventive maintenance steps of ventilator.

Ans :

1. Check the ON/OFF switch
2. Check the fuse continuity
3. Check the power cable continuity
4. Check the Gas Supply.

06 M
(Any Six)



		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. Pressure-relief mechanism											
2.		Attempt any FOUR :	16 M										
	a)	Differentiate Internal and External pacemaker on the basis of size, cost, need and battery life. Ans : <table><tr><th>Internal pacemaker</th><th>External pacemaker</th></tr><tr><td>1. Internal pacemakers are used in long-term pacing cases.</td><td>1. External pacemakers used in short time pacing cases.</td></tr><tr><td>2. These types of pacemakers are used when there is permanent damage to the heart.</td><td>2. These types of pacemakers are used when the heart block presents as an emergency.</td></tr><tr><td>3. Internal pacemakers are implanted beneath the skin along with its electros.</td><td>3. External pacemaker is applied externally on the surface of body by using metal electrodes.</td></tr><tr><td>4. Internal pacemakers are small in size.</td><td>4. External pacemakers are large in size.</td></tr></table> Table: Difference between Internal and External pacemaker	Internal pacemaker	External pacemaker	1. Internal pacemakers are used in long-term pacing cases.	1. External pacemakers used in short time pacing cases.	2. These types of pacemakers are used when there is permanent damage to the heart.	2. 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.	3. External pacemaker is applied externally on the surface of body by using metal electrodes.	4. Internal pacemakers are small in size.	4. External pacemakers are large in size.	04 M
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	b)	Justify Heart-lung machine is called “By-pass Machine.” Ans : <p>Heart is the organ of the body which continuously supplies blood for the nutrition of the whole body. Any changes in the rhythmicity of the heart because of its nonfunctioning could be dangerous and results in to serious problems and even death. During surgery sometimes Heart is bypassed. Heart is unable to maintain circulation during surgery. So there must be provision of something that can replace the working of the heart till the duration of surgery. In such type of surgical procedures perfusion of the body tissues with the blood is maintained by an extracorporeal (ie. Outside the body) pump called the Heart lung machine.</p> <p>Heart lung machine is used to partially or completely replace the functions of heart and the lungs. This machine is used to provide the oxygenated blood to the whole body and also to the heart. Heart lung machine works on the same principle of supplying the blood to the body and heart as in systemic and pulmonary circulation takes place. It is mainly used in case of the open heart surgery where the heart is exposed. It is used in bypass surgery where we need to replace the function of the heart while it is being operated.</p>	04M										
	c)	Give the significance of Boils apparatus in O.T. (Operation Theatre) and list it’s any four technical specifications. Ans : Significance of Boils apparatus in O.T. : <p>Boils apparatus in O.T. / An anaesthetic machine is a medical device used to generate and mix a fresh gas flow of medical gases and inhalational anaesthetic agents for the purpose of inducing and maintaining anaesthesia. The machine is commonly used together with a mechanical ventilator, breathing system, suction equipment, and patient monitoring devices. The continuous-flow anaesthetic machine or "Boyle's machine" is designed to provide an accurate supply of medical gases mixed with an accurate concentration of anaesthetic vapour, and to deliver this continuously to the</p>	02 M										

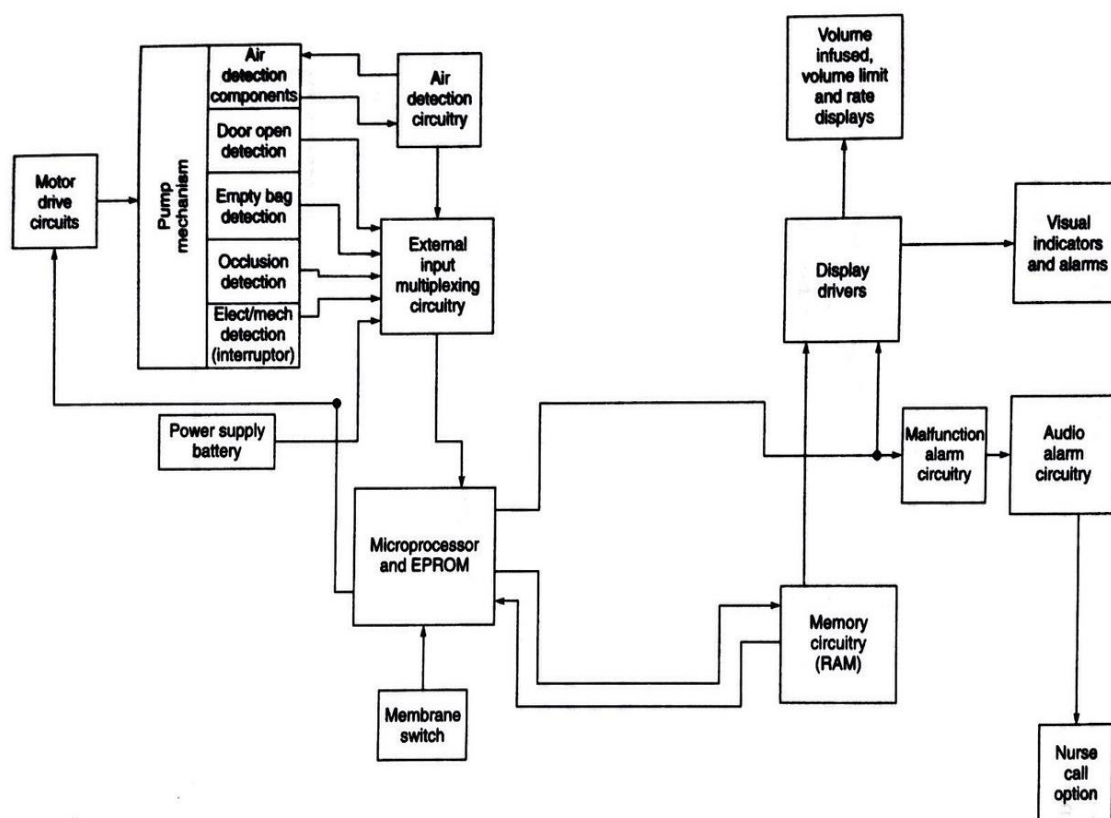
patient at a safe pressure and flow. The machine Provides O₂, Accurately mixes anaesthetic gases and vapours, Enables patient ventilation and Minimises anaesthesia related risks to patients and staff.

Technical specification:

1. Should be portable stainless steel, with large antistatic sturdy castor wheels fitted with brakes.
2. Gas cylinder (pin indexed) yokes with sliding stainless steel/sturdy clamping bars for easy handling.
3. Two Pin index yokes for connecting cylinders each for O₂, N₂O.
4. Should have pressure gauge for all gas inlets including central lines mounted on the front panel for easy visibility.
5. Should have audible alarm for O₂ failure.
6. N₂O supply should cut off if O₂ supply fails (Anti-hypoxic guard).
7. Oxygen and Nitrous oxide should be linked either mechanically or pneumatically to ensure a minimum of 25% oxygen delivery at all times to avoid delivery of hypoxic mixture.
8. Should have dual cascade type flow meter for O₂ and N₂O calibrated in multiple scale. Provision to mount any two selectable vaporizers with interlocking facility to allow use of only one vaporizer at a time.
9. Non-return cum pressure relief valve when pressure exceeds 120cm of H₂O.
10. Should have changed over from open circuit to closed circuit and vice versa.
11. Should provide with oxygen flush switch.
12. Should have low flow anesthesia technique.
13. Should have safety certificate from a competent authority.


02 M

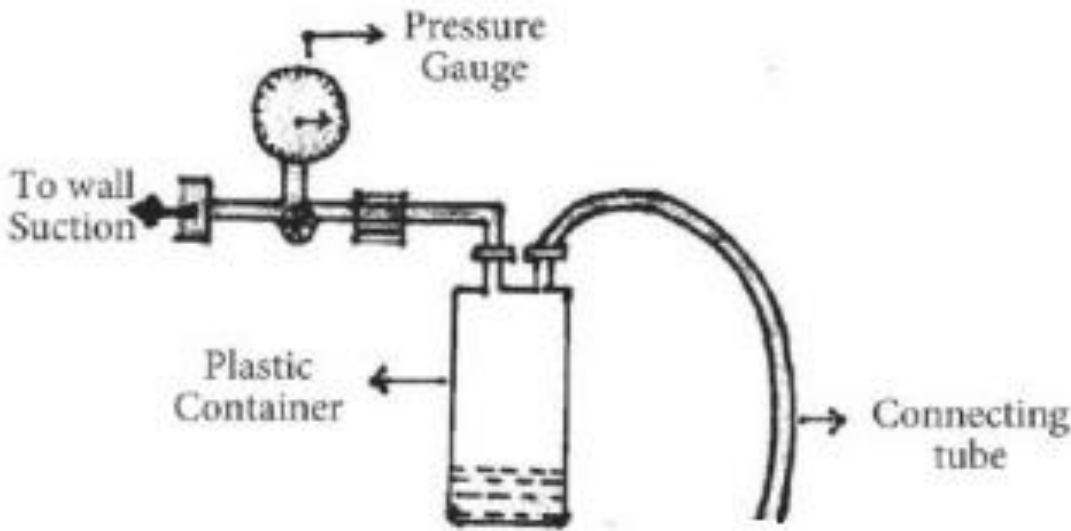
d) Draw the block diagram of programmable microprocessor based infusion pump.
Ans :



04 M

Fig: Block diagram of programmable microprocessor based infusion pump

	e)	<p>Compare AC and DC defibrillator. Ans : AC defibrillator: A defibrillation by applying a brief (0.25 -1 sec) burst pulse of 60 hertz at an intensity of around 6 amp to the chest of patient through appropriate electrodes. This application of an electrical shock to re-synchronises the heart is some time called counter shock. It is not used for atrial defibrillation. This is known as instant mode of defibrillation DC defibrillator: DC defibrillator is used to restore the synchronized working of the heart with the pacemaker of the body. For termination of ventricular tachycardia atrial fibrillation & other arrhythmias it is essential to use a defibrillator with synchronizer circuit. Defibrillation must take place during that period this is called cardio version. In this technique the ECG of the patient is fed to the defibrillator & the shock is given automatically at right instant. This is called capacitive discharge delay line or Dc defibrillator with synchronizer mode defibrillator.</p>	<p style="text-align: center;">02 M</p> <p style="text-align: center;">02 M</p>
	f)	<p>List any four faults related to ventilator. Ans :</p> <ul style="list-style-type: none"> • Trigger problems • Flow problems • Rate problems • Tidal volume/Pressure limit • Inadequate minute volume • Mode. • Leaks. • Inadequate oxygenation • Inadequate ventilatory support • Inadequate flow setting • Auto-PEEP • Increased ventilatory drive 	<p style="text-align: center;">04 M</p>
3.		<p>Attempt any FOUR:</p>	<p style="text-align: center;">16 M</p>
	a)	<p>List any four specification of Incubator. Ans :</p> <ol style="list-style-type: none"> 1) Recommended environment for operation 24⁰c to 30⁰c 2) Baby bed size 550* 390 mm 3) Heater wattage 250 watts 4) Electrical 230v AC 50 Hz 5) Weight 45kgs Approx. 	<p style="text-align: center;">04 M</p>
	b)	<p>State the concept of biphasic and monophasic defibrillator. Ans :</p> <div style="text-align: center;">  <p style="margin-left: 100px;">Monphasic</p> <p style="margin-left: 250px;">Biphasic</p> </div> <p style="text-align: center;">Fig: Biphasic and monophasic defibrillator</p>	<p style="text-align: center;">02 M</p>

	<p>The direct current shock given can have a monophasic or biphasic wave form. In monophasic shock, the shock is given in only one direction from one electrode to the other. 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. Usually the initial voltage applied is higher than the reversed polarity shock. Biphasic wave forms were initially developed for use in implantable cardioverter defibrillators (ICD) and later adapted to external defibrillators. Biphasic truncated exponential wave form and rectilinear biphasic waveform are two types of biphasic waveforms used by different manufacturers. Defibrillators can sense the thoracic impedance and increase or decrease their internal resistance so that the selected level of energy is delivered to the subject. Biphasic shocks are more effective than monophasic shocks and need lesser energy. Typically when 360 Joules are delivered for defibrillation in a monophasic defibrillator, 200 Joules are given in a biphasic defibrillator. This could theoretically reduce the potential damage to the heart muscle by the high voltage shock.</p>	02 M
c)	<p>A patient requires clear Vomit. Suggest the equipment required for patient and draw its block diagram.</p> <p>Ans :</p>  <p>Fig: Suction pump</p> <p>If a patient requires clear Vomit, Suction pump should be used. 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.</p>	02 M
d)	<p>State the need of Infusion pump.</p> <p>Ans :</p> <p>Infusion pump:</p> <p>In many medical applications intra-venous (IV) fluids & drugs need to be infused over a period of time which could be several minutes, hours, & days. The most common method of doing this is by manual injection of bolus doses using syringes by manually setting the drip rate of gravity feed intra-venous infusion sets. The volumetric</p>	



		infusion pump is generally used to deliver larger volumes of fluid from a bag or bottle. This pump technology evolved from the desire to improve on the flow rate control provided by the simple mechanical roller clamp. The first improvement was the electronic drop counter that could quickly determine the drip rate of IV delivery. Soon thereafter came a device which could control the drop rate automatically. Control of secondary medications, variable delivery patterns, dose rate calculations & even in-line mixing of medications are other refinements resulting from the changing requirements of new drug therapies.	04 M
	e)	List any four technical specification of external pacemaker. Ans : 1) Output voltage 0-15v 2) Output current 1-12 mA 3) Maximum sensitivity 1.5 mv 4) Battery material lithium 5) Pulse width 2-3ms	04 M
4.	A)	Attempt any THREE :	12 M
	a)	State the meaning of Endocardial and Myocardial leads. Ans : (i) Endocardial: This is connected to inner side of heart chamber and used in external pacemaker. The Endocardial lead is inserted into the inside of the heart via a vein, usually in the chest area. Example : Porous tip electrode (ii) Myocardial: This is connected to outer wall of heart muscle and used in internal pacemaker. This type of lead is most often used when other cardiac surgery is being performed and there is already access to the heart. Example: Steroid eluting electrode.	02M 02M
	b)	Identify the equipment acts as a kidney in dialysis and list its types. Ans : Dialyzers acts as a kidney in Dialysis. Types of dialyzers : 1. Parallel Flow Dialyzers 2. Coil Dialyzers 3. Hollow Fiber Hemodialyser.	01 M 03 M
	c)	Explain the concept of energy analyzer. Ans: Energy analyzer: Energy analyzer is test instruments that are becoming increasingly important within the electrical and electronics industries as all aspects of power used by equipment large and small becomes a greater issue. Energy analyzer is able to measure a variety of parameters associated with power consumption and generation at frequencies that range from 50 / 60 Hz right up to many kilohertz. Energy analyzer is used for measuring a host of aspects of electrical power for applications which include testing power electronics, inverters, motors and drives, lighting, home appliances, office equipment, power supplies, industrial machinery, Hospital machinery and more.	04 M
	d)	Draw the block diagram of bedside monitor. Ans:	

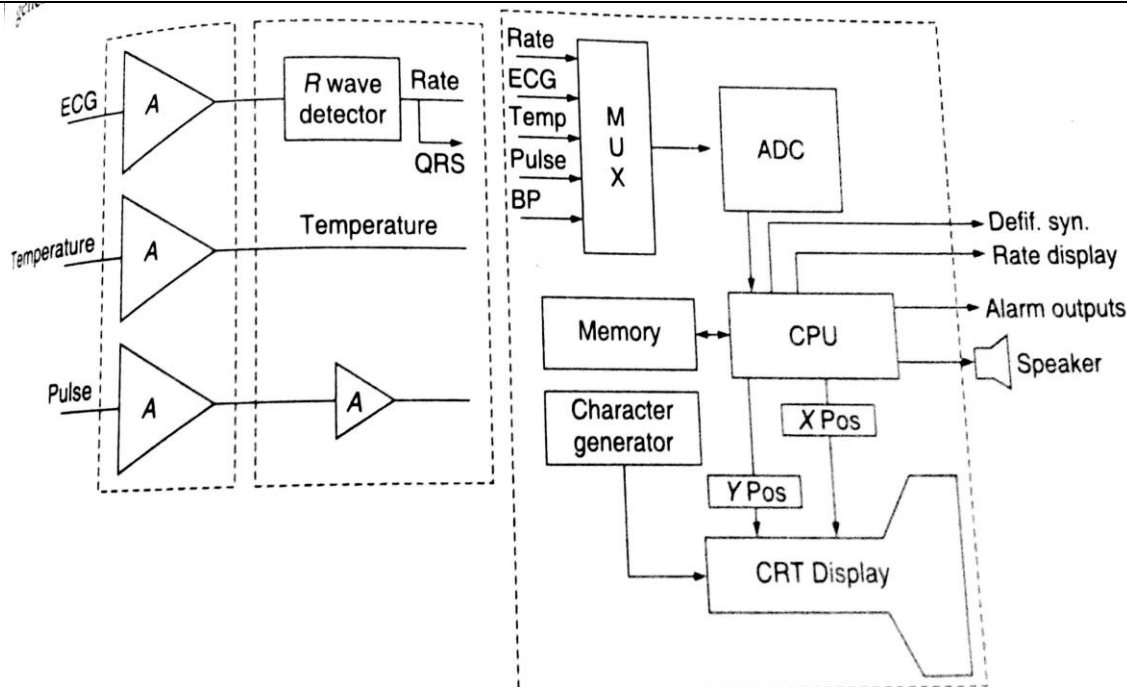


Figure 5.42 Block diagram of a typical bed side monitoring system.

Fig: Block diagram of bedside monitor

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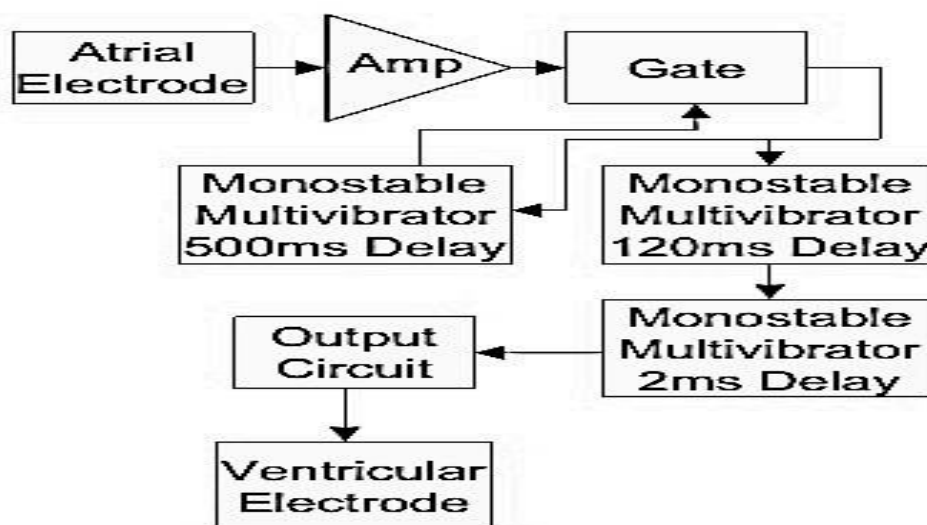
B) Attempt any ONE :

06 M

a) Explain the atrial synchronous pacemaker with neat diagram.

Ans :

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.



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OR

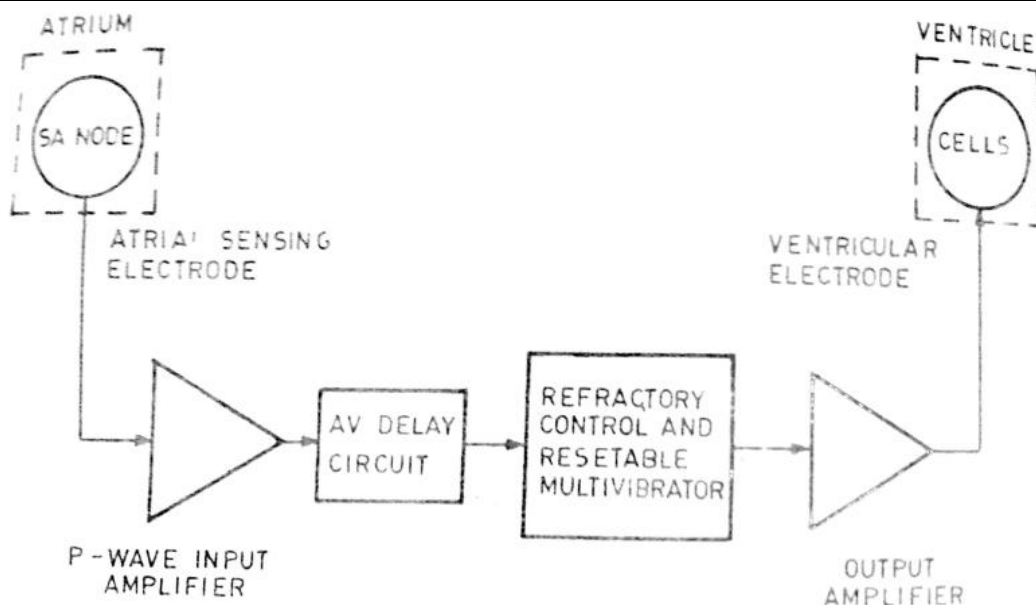


Fig : Block diagram of synchronous pacemaker

b) Draw the block diagram of Hemodialysis machine and explain it.

Ans:

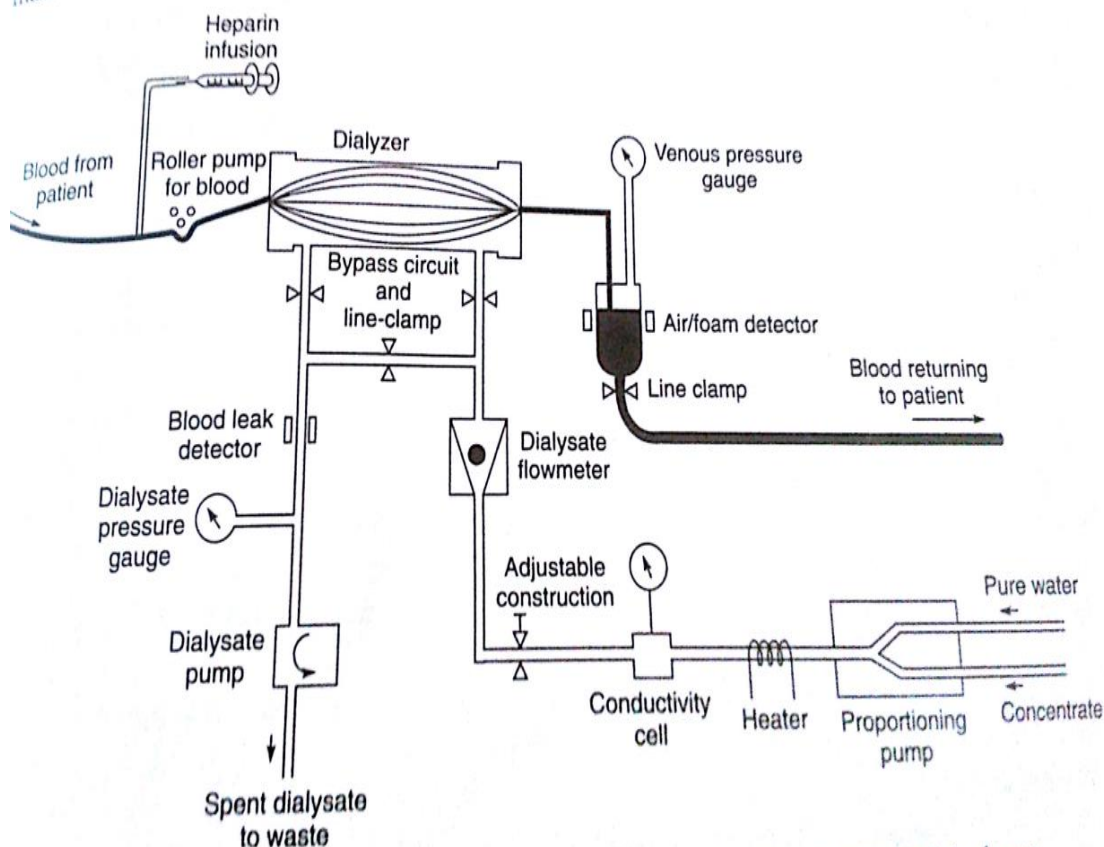
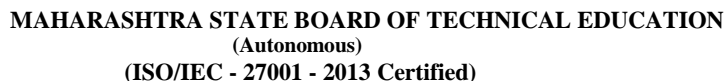
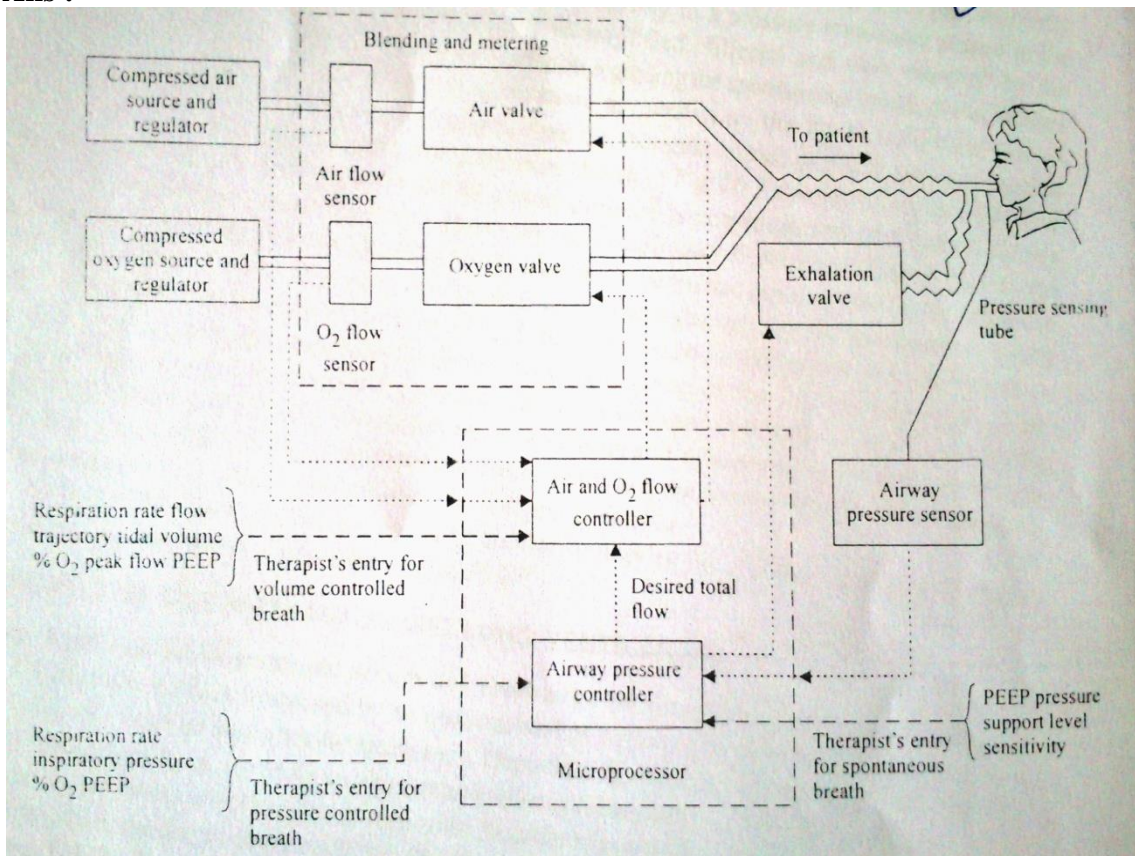


Fig: Hemodialysis machine

Hemodialysis 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 Hemodialysis 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

03 M

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	<p>Heart block: Whenever the conduction system fails to transmit the pacing impulses from the atria to the ventricles properly it is called heart block.</p> <p>Cardiac Arrhythmia: Any change in normal sinus rhythm is called an Cardiac Arrhythmia.</p>	<p>02 M</p> <p>02 M</p>
d)	<p>Draw and explain block diagram of Microprocessor based ventilator. Ans :</p>  <p style="text-align: center;">Fig: Block diagram of Microprocessor based ventilator</p> <p>The pneumatic flow system enables the flow of gas through the ventilator. Oxygen and medical grade air enter in ventilator. These gases enter air oxygen mixer where they combine the required percentage. As gases leave ventilator they pass by an oxygen analyzers. The electronic control system use one or more microprocessor and software to perform monitoring and control functions in a ventilator.</p>	<p>02 M</p> <p>02 M</p>
e)	<p>Give the function of oxygenator and heat exchanger in heart lung machine. Ans : Oxygenator : Oxygenator is a device that is capable of exchange in oxygen and carbon dioxide in the blood of human body during surgical procedure. The oxygenator repeatedly draws of the blood from the veins, deoxygenates and pumps it into the arterial system. The oxygenator serves as the lung during the open heart surgery as the lung.</p> <p>Heat exchanger : It consists of water coils, isolated from but thermally coupled to the blood. A temperature control per minutes the pump operator to keep the blood at a proper temperature & compensates for the heat loss through radiation from the lungs.</p>	<p>02 M</p> <p>02 M</p>
f)	<p>Draw the block diagram of baby Incubator and give the significance of humidity sensor and temperature sensor in it.</p>	

Ans :

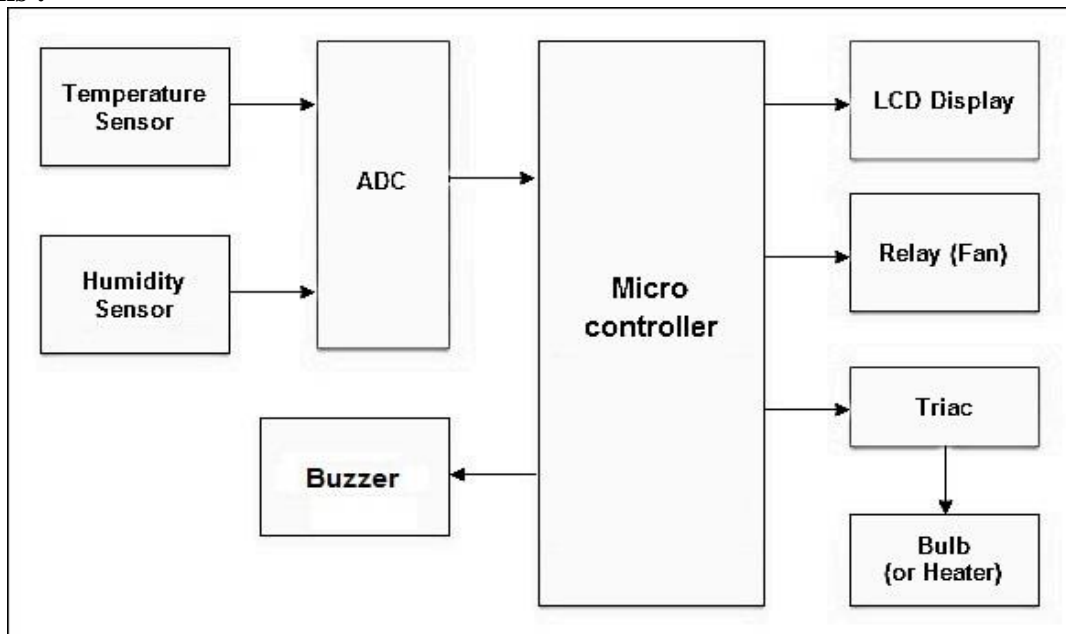


Fig: Baby Incubator

Baby incubator provides stable levels of temperature, relative humidity. Temperature controlled air is passed through the chamber in which the baby is located to maintain it at set temperature. The temperature is controlled in modern units by means of proportional control system which is as shown in fig. Temperature in the air supply lines varies a thermistor resistance that is compared with a fixed resistance that corresponds to the set temperature. If the temperature of air entering the infant's chamber is lower than the set temperature power is applied to the heater to correct for difference. In this system, the amount of power applied to the heater is proportional to the difference between the actual air temperature and set point. In this system the thermistor in a bridge circuit with the set point resistance as another arm of bridge. The bridge output is amplified, giving the voltage V_1 at the output, which is proportional to difference in temp between the thermistor and the set point.

6.

Attempt any FOUR :

16 M

a) State the need of artificial kidney and baby Incubator.

Ans :

Need of artificial kidney :

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.

Need of baby Incubator :

Baby incubator generally used to provide a safe and stable environment for new born infants, often those who were born prematurely or with an illness or disability that makes them especially vulnerable for the first several months of life. Incubators are used to protect babies from a wide range of possible dangers. Incubators are fully temperature controlled, shielding infants from harmful cold, and they provide insulation from outside noise, making it easier for them to get plenty of comfortable rest. Incubator environments can be kept sterile, protecting infants from germs and minimizing the risk of infection. The enclosure also keeps out all airborne irritants like dust and other

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		allergens. This protects infants from too much handling, which can be a concern in the case of some premature births.	
	b)	Define unipolar and bipolar leads. Ans : 1. Unipolar leads: 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. 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.	02 M 02 M
	c)	List any four technical specification of bedside monitor. Ans: Technical specification of bedside monitor 1. Band pass filter -3 dB at 0.3 Hz and 150 Hz Bandwidth 0.3 - 128 Hz 2. Analogue to digital converter Delta sigma (1 per channel) 3. Sampling rate 256 samples/sec with 512 times oversampling Resolution 21 bits effective at 256 Hz 4. Input impedance 33 MΩ in parallel with 4.7nF Allowed DC offset ±0.35 VDC at input Noise < 1μVp-p 5. Common mode rejection >137 dB Operation (all components) 6. Temperature 0 to 40 °C (32 to 104 °F) Relative humidity 25 to 90% at 40 °C (non-condensing) 7. Power supply unit input voltage 100 - 240 VAC, 47-63 Hz, 1.1 – 0.45 A Power supply unit output voltage 24 VDC, 3.33 A maximum (80 W)	04 M
	d)	Explain the fibrillation of heart. Ans: Fibrillation of heart: As we know the heart is able to perform its important pumping function only through precisely synchronized action of the heart muscle fibers. The rapid spread of action potentials over the surface of the atria causes these two chambers of the heart to contract together and pump blood through the two atrio ventricular valves into the ventricles After a critical time delay, the powerful. Ventricular muscles are synchronously activated to pump blood through the pulmonary and systemic circulatory system. A condition in which this necessary synchronism is lost is known as fibrillation. During fibrillation the normal rhythmic contractions of either the atria or the ventricles are replaced by rapid irregular twitching of the muscular wall. Fibrillation of atrial muscles is called atrial fibrillation. Fibrillation of the ventricles is known as ventricular fibrillation.	04 M



e)	<p>Name the Fig. Identify the missing block A and B. Give the importance of it.</p> <pre>graph LR; A[A] --> CC[Controller Circuit]; CC --> B[B]; B --> LWE[Lead Wire and electrode System]; CC --> CA[Control algorithm]</pre> <p>Fig: Rate Responsive Pacemaker</p> <p>Ans :</p> <p>Missing block A and B:</p> <p>Block A : Sensor</p> <p>Block B : Pulse Generator</p> <p>Sensor: 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.</p> <p>Pulse Generator: The pacemaker's pulse generator sends electrical impulses to the heart to help it pump properly. An electrode is placed next to the heart wall and small electrical charges travel through the wire to the heart.</p>	<p>01 M</p> <p>01 M</p> <p>01 M</p> <p>01 M</p>
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