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.

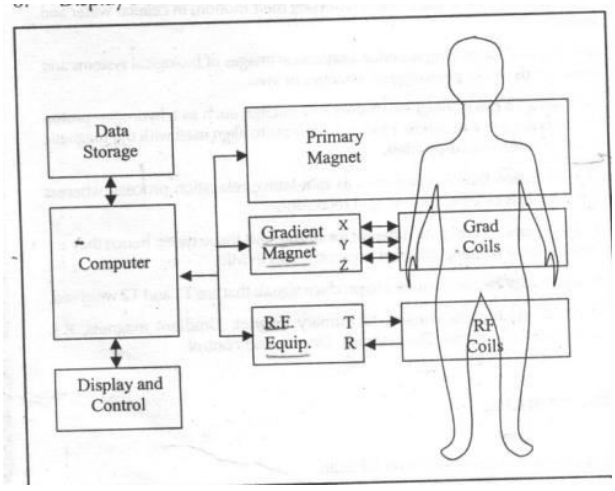
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

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		Mark Distribution
1a)	**Attempt any three of the following:**	**12**
i)	**State the basic principle of working of nuclear imaging.** Ans: It is a branch of medical imaging which deals with the application of radioisotopes for the assessment of functional status of biological organs and subsystem. In this type of imaging diagnosis is based on the evaluation of images of the organ obtained by a various devices such as rectilinear scanner, gamma camera and tomography systems like PET etc.. These images are referred to as medical images and are result of radio activity distribution in the organs or body site. This is done by administration of radioactive isotope inside the body and then detecting its distribution. Stepwise procedure of nuclear imaging: Radionuclide is administered via mouth or vein. They distribute in the body according to their strength for particular tissue called target tissue. Radionuclide emit gamma radiation Theses radiations are detected by a gamma camera, which forms the image showing the location of radionuclide in the body.	**04**

ii)	**State the steps involved in installation of an ultrasound machine**. Ans: Steps involved are as follows • Prepare lab area for installation machine. • Check electrical supply connection • Unpack the box. • Read user manual carefully. • When equipment arrives, it will be necessary to record the fact and to check that everything has been supplied that was ordered. It will also be necessary to check that the equipment is supplied in the right way. • Assemble all accessories of equipment. • Connect monitor scan control panel and ultrasound probes. • Check position of curser on the monitor by placing the electrode on sample. • Perform quality test on equipment • Perform demo test Any other (relevant diagram) answer should be consider as valid	**04**
iii)	**Draw and label the block diagram of an MRI detection system.** (Draw2m+label2m) Ans:  Fig .: Block diagram of MRI detection system It consist of primary magnet, gradient magnet, RF equipment, computer, data storage, display and control.	**04**

	Any other (relevant diagram) answer should be consider as valid	
iv)	**What are radio isotopes. Give their significance. Draw and label a Geiger Muller tube.** (for definition & significance 2 marks and labeled diagram 2m) Ans: Significance of radioactive Isotopes : Radioactive isotope, also called radioisotope, are of several species of the same chemical element with different masses whose nuclei are unstable and dissipate excess energy by spontaneously emitting radiation in the form of alpha, beta, and gamma rays. All elements with atomic numbers greater than 83 are radioisotopes meaning that these elements have unstable nuclei and are radioactive. Elements with atomic numbers of 83 and less, have isotopes (stable nucleus) and most have at least one radioisotope (unstable nucleus). The nucleus of a radioisotope is unstable. In an attempt to reach a more stable arrangement of its protons and neutrons, the nucleus will spontaneously decompose to form a different nucleus. If the number of neutrons changes in the process, a different isotope is formed. If the number of protons changes in the process, then an atom of a different element is formed. This decomposition of the nucleus is referred to as radioactive decay. During radioactive decay an unstable nucleus spontaneously decomposes to form a different nucleus, giving off radiation in the form of atomic particles or high energy rays. This decay occurs at a constant, predictable rate that is referred to as half-life. A stable nucleus will not undergo this kind of decay and is thus non-radioactive. Isotopes Used in Medicine • Reactor Radioisotopes (half-life indicated) • Molybdenum-99 (66 h): Used as the 'parent' in a generator to produce technetium-99m. • Technetium-99m (6 h): Used in to image the skeleton and heart muscle in particular, but also for brain, thyroid, lungs (perfusion and ventilation), liver, spleen, kidney (structure and filtration rate), gall bladder, bone marrow, salivary and lacrimal glands, heart blood pool, infection and numerous specialized medical studies. • Bismuth-213 (46 min): Used for TAT. • Chromium-51 (28 d): Used to label red blood cells and quantify gastro-intestinal protein loss. Cobalt-60 (10.5 mth): Formerly used for external beam radiotherapy	**04**

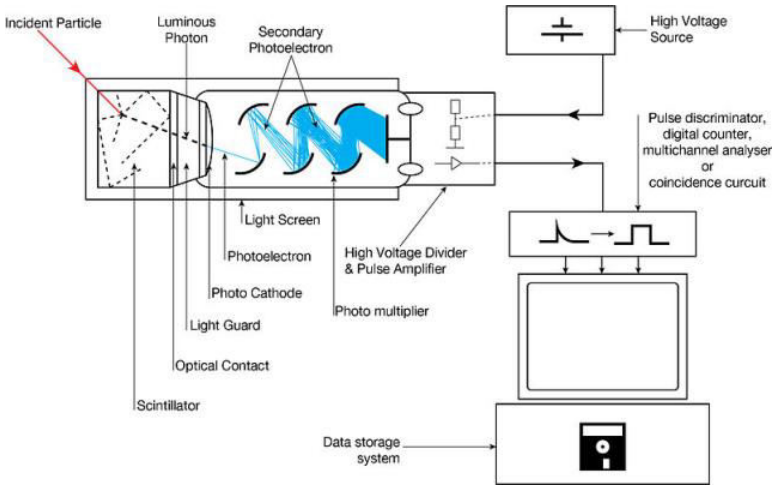


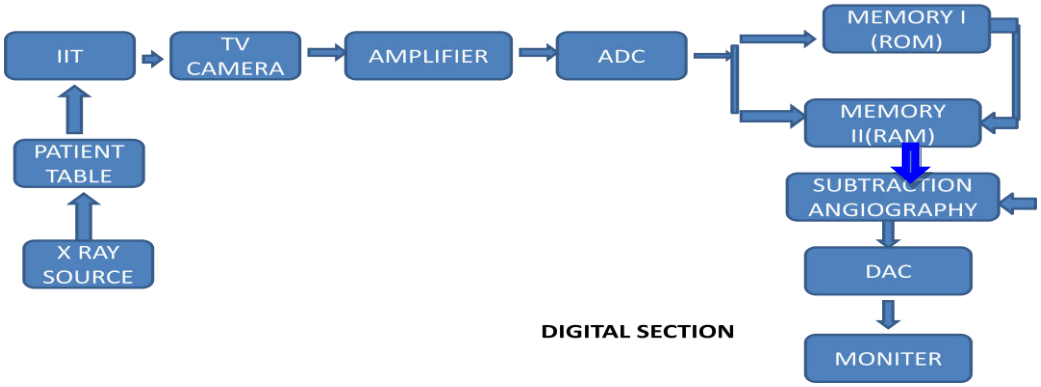
Fig: Geiger Muller tube

b) **Attempt any ONE of the following** **06**

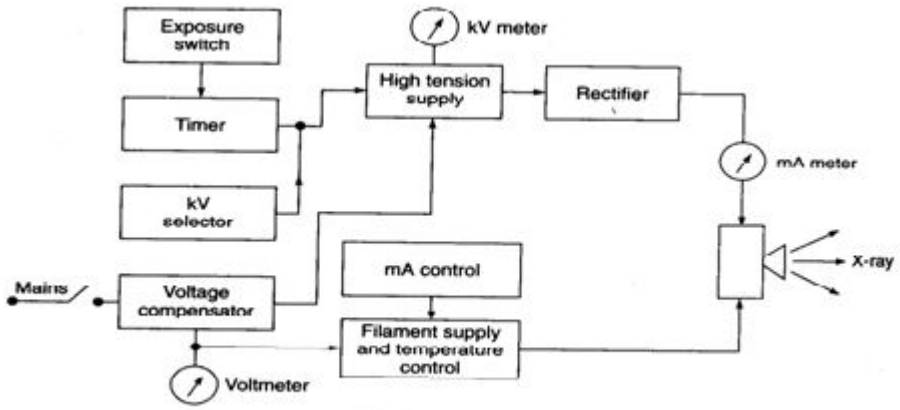
i) **Draw the block diagram of angiography system. State the function of each block. Give the significance of angiography**.(2m for diagram +2 m for function of each block +2 m for significance) **06**

Ans :

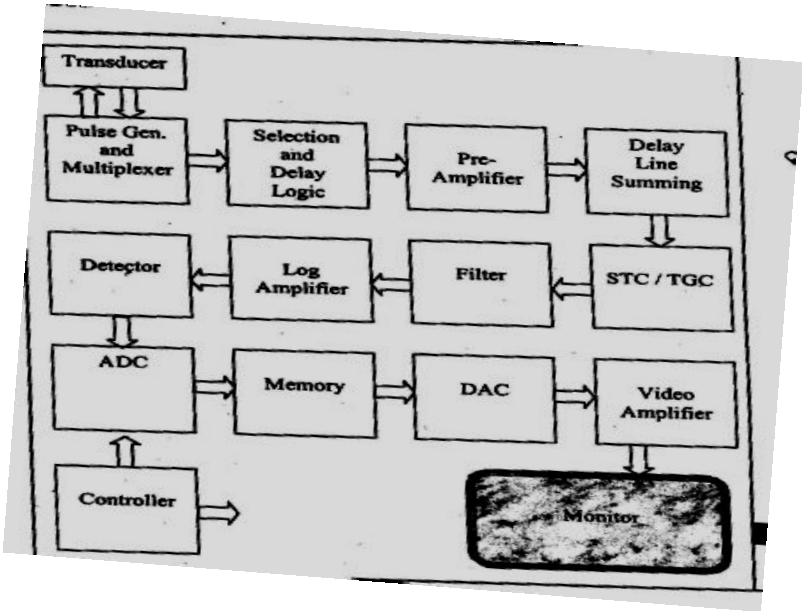
Block diagram of angiography:



X ray source:
It is used to pass narrow x ray beam to the patient.
Patient table: patient is lie on table.
IIT: The reflected x rays are collected by IIT unit in which brightness of image is increased & output is displayed on fluorescent screen.
Amplifier :It amplifies the output of image intensifier tube and gives it to the ADC where signal is converted into digital form
Memory i& ii : digitally converted signal is stored into the ram & rom memory
Subtraction angiography : to get a new image subtraction angiography is used to the analog signal on the monitor for which DAC is used
DAC: it converts digital signal into analog signal.
Monitor: by using TV camera unit +we can see the clear *& live image of an patient body on monitor.

	Significance of angiography : It is a diagnostic & therapeutic procedure which is related to the disease of circulatory system This procedure is carried out by using or by inserting contrast material called as radioisotopes mostly iodine containing compound which is radioactive in nature is used. The contrast material provides radiographic image which is viewed on TV screen they are recorded as a film or video. It is a invasive method that helps the physician to diagnose & treat the medical condition.	
ii)	**Draw the block diagram of an X-ray machine. Which controls in the x ray machine are responsible for** **1) Quality of x rays** **2) Quantity of x rays**(B.D.2m+Quality of x-rays2m+Quantity of x-rays2m) Ans:  *Block diagram of an X-ray machine* The quantity (exposure) and quality (spectrum) of the x-radiation produced can be controlled by adjusting the electrical quantities (KV, MA) and exposure time, S, applied to the tube. Controls responsible for Quality of x rays : KV (the voltage or electrical potential applied to the tube) MA (the electrical current that flows through the tube) S (duration of the exposure or exposure time, generally a fraction of a second) Quantity of x rays : High tension supply Filament supply and temperature control Timer kv selector	**06**

2	**Attempt any FOUR of the following**	**16**
a)	**What are CT numbers? List any four applications of Computed tomography.**(2m+2m) Ans: CT-number Itisnormalized value of the calculated xray absorption coefficient of a pixel (picture element) ina computed tomogram, expressed in Hounsfield units, where the CT number of air is -1000and that of water is 0. $\text{CT number} = \frac{\mu_{voxel} - \mu_{water}}{\mu_{water}} \times 1000$ Application of CT 1. Organs such as stomach, gall bladder, liver, spleen, pancreas, kidneys, lower gastrointestinal (GI) tract, the colon and rectum can be visualized with great clarity using CT imaging of the abdomen. 2. They are used for the diagnosis of appendicitis, stage of cancer, tumors and gangrene. 3. CT scan is used for the diagnosis of Alzheimer's disease, brain tumors, bleeds, injuries to the brain and other major brain diseases. Computed Tomography Angiography helps in the visualization of blood flow in the arteries throughout the body. It is used in the diagnosis of aneurysms (bulging), stenosis (narrowing) of the arteries, dissection of the aorta etc. 4. CT scan are used to take images of multiple tissues such as lungs, heart, bones, muscles, blood vessels, soft tissues etc. These images are used to detect acute and chronic changes in lung parenchyma, diagnose tumors, emphysema, inflammations etc. (any other relevant ans should be consider as a valid ans)	**04**
b)	**Draw & label the block diagram of an ultrasound B scanner machine. (2m+2m)** Ans: It consist of following blocks: Pulse generator and multiplexer Selection and delay logic Preamplifier Delay line summing STC/TGC Filter Log amplifier Detector ADC	**04**

	Memory DAC Video amplifier Monitor Controller  **Fig. ultrasound B scanner machine.** (any other relevant answer should be consider as a valid answer)	
c)	**Draw and label the block diagram of thermography machine. State the functions of each block.**(2m+2m) Ans:	**04**

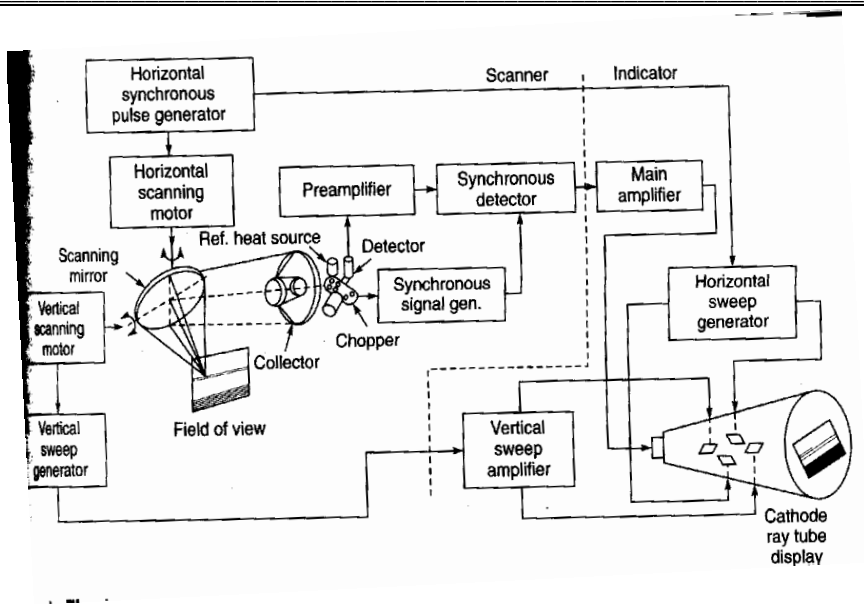


Fig: Thermography machine

It consist of two units :
1. a special infrared camera that scans the object
2. display unit

Camera is generally mounted on a tripod that is fitted on wheels.

Camera unit contains an optical system which scans the field of view at a very high speed and focuses the infrared radiation on detector that converts the radiation signal into electrical signal. The signal from camera is amplified and processed before being used to modulate the intensity of the beam in the picture tube.

The beam sweep across the tube face in a pattern corresponding to the scanning pattern of the camera. The picture on the screen can be adjusted for contrast and brightness by means of controls on display unit.

The double scanning movement of the plane mirror causes each spot on the patient body to be focused in turn on the cooled detector. The detector is mounted in a Dewar flask which also eliminates thermal noise.

The horizontal and vertical movements of the scanning mirror are controlled by individual motors. Scanning of flat mirrors generates horizontal synchronous pulses and vertical sweep signals for the display unit.

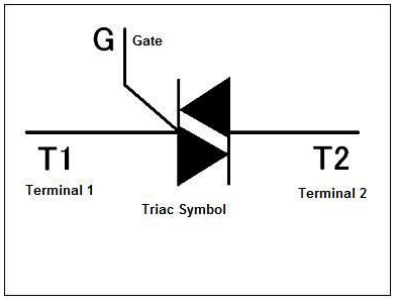
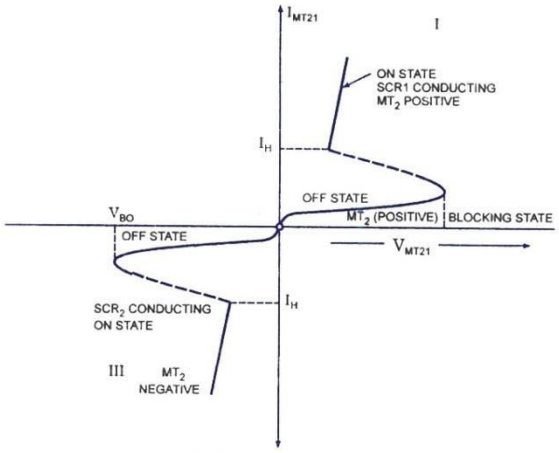
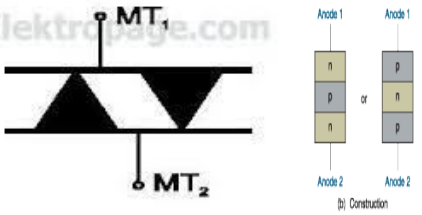
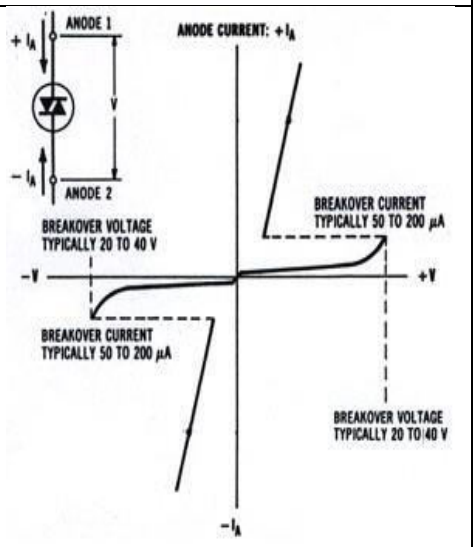
A chopper disc interrupts light from a std. heat source which intermittently illuminates a photocell and provides a phase reference to a coherent detector and to a bucking circuit employed to cancel out large standing signals.

The AC signal developed by the by the detector is amplified by the preamplifier. It is then rectified and fed to band pass filter where chopping frequency is determined, and signals are displayed on CRT tube.

(any other relevant answer should be consider as a valid answer)

d)	**Draw the symbol, label terminals and sketch V I characteristics of DIAC & TRIAC.** (each symbol and label 1m+ each characteristics 1m)	**04**

Ans:

Symbol	VI characteristic
TRAIC 	 *V-I Characteristic of a Triac*
DIAC 	

e) **Define the term maintenance and list the steps involved in maintenance of angiography machine.** (1mDefination+3m for steps) **04**

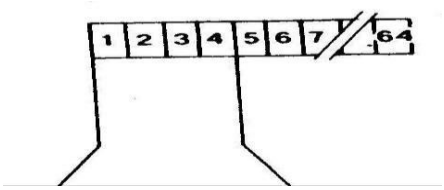
Ans :
Maintenance :
It is the defined as procedures which are used to minimize the risk of failure and to ensure continuous proper operation of equipment.
Maintenance of angiography:

	• Maintenance must be performed in the normal mode. • Check Program: Check Program must be performed in the normal mode. • perform calibration and maintenance with a personal computer, it is necessary to • prepare the following: • Personal computer where the Windows 95 / 98 has been installed. • adjust the DC power of the board surely because it is used as a reference voltage for A/D conversion. This adjustment should be made with all the units connected, including the Display Unit, console, and options. • Check calibration for motor of arm • Check calibration of position table for its up down movement. • Check collimator alignment and its position • Check x ray tube alignment & its position. • Check shutter & filter calibration. • Check battery & maintain cover. • Update software periodically. • Check TV camera connections ,IIT,XRAY TUBE (any other relevant answer should be consider as a valid answer)	
f)	**State the Steps involved in installation of an MRI machine.** Ans: • Prepare site planning. • Understand the RF shielding and magnetic shielding requirement. • Pay attention to exterior features. For example, moving metals, whether from a nearby garage or traffic outside the building are limiting factors. Overhead power lines or underground power can be challenging, as can running water or sewer lines above and below the magnet. • Consider Patient safety is key. • Floor area of MRI room must be even. • Unpack the shipment of MRI panels and organize them for easy access • Unpack and assemble • Set up a laser level in one corner of the room being covered and adjust it so it will show the desired elevation for the top of the MRI panels to be installed. • Install all the MRI PANELS ONE BY ONE • Once all the MRI PANELS installation is done, check the connection in console room • Perform a demo test to check the performance of machine. (any other relevent ans should be consider as a valid ans)	**04**
3 **a)**	**Attempt any four of the following** **Enlist the transducers used in ultrasound scanning .Draw and explain any anyone.**(1m+3m) Ans: Transducers used in ultrasound imaging	**16** **04**

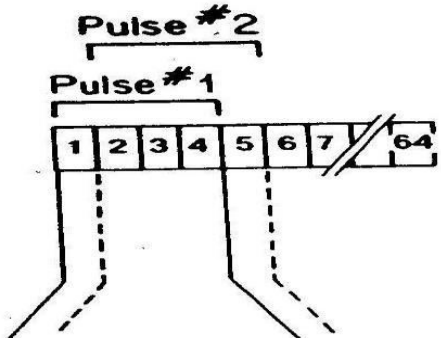
I. linear array transducer
II. Phased array transducer

Linear array transducer

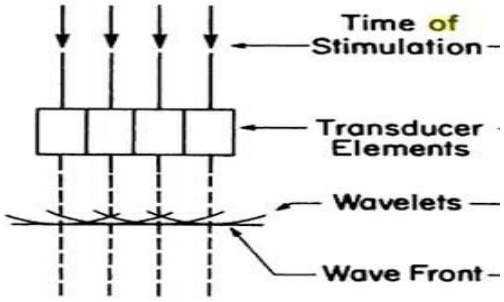
To produce useful patterns of beam or image for diagnostic purpose, in linear array
Firing pulse is given to the group of transducers elements as shown in fig. It gives better resolution.



linear array transducer pulsing with group of element
The fig. below illustrates the working of linear array transducer by giving pulsed sequence to group of four transducer.
Pulse 1 is generated by simultaneously pulsing elements 1, 2, 3 and 4.
After echoes returned from this first group .next pulse i.e. pulse 2 is given to group of transducer element 2, 3, 4 and 5.

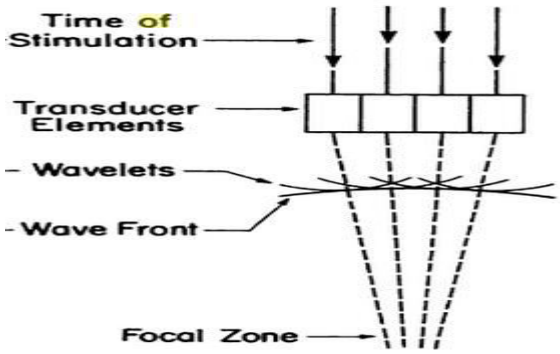


linear array transducer pulsing with group 1,2,3,4 element
This sequence is continuous until elements 61, 62, 63 and 64 forms final lines in frame.
By this mechanism there will be 61 lines in frame.
Time taken for pulsing all groups is approx. 1/20 to1/50 seconds produces 20 to 50 frames/second.
Ultrasonic beams originated from linear transducer are dispersed in nature. Hence focusing of ultrasonic beam is necessary.
When each transducer element in group is stimulated at same time, resultant wave front behaves like non focused refer to fig below



Linear array transducer pulsing with same time of simulation

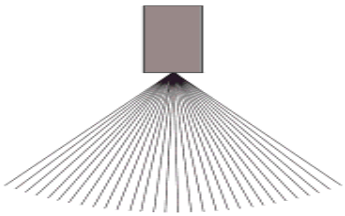
To produce focused beam ultrasound waves, all transducer elements in group are stimulated at a different time. Refer to fig below



Linear array transducer pulsing with different time of simulation

Phased array transducer

Phased array transducer produces a sector scan format in which scan line spread in fan like formation from a point in the centre of the transducer face. As shown in fig

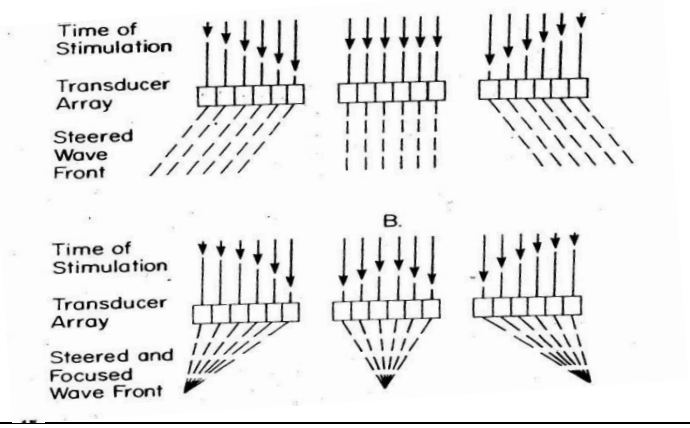


Sector scan format of phased /steered array scanner

Electronic focusing, is based on the use of electronic delays applied during emission and reception along each of the channels of the probe. These delays have an effect similar to that of a focusing lens and enables focusing to different depths. Electronic focusing allows only one phased array probe to be used where several single-element probes with different focal distances would be necessary.

Beam can be steered or directed to a desired angle by a similar mechanism of time delays.

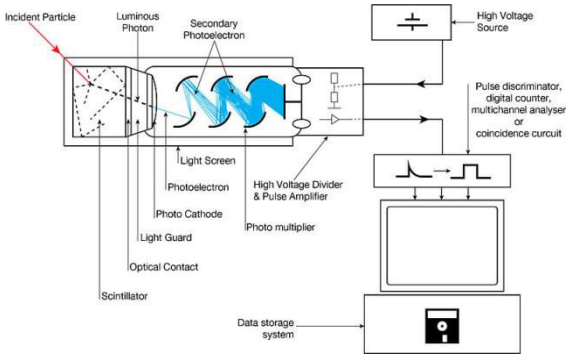
By choosing the appropriate time delay between the simulations of the individual elements of the transducer, it is possible to steer the beam or to steer and focus the beam simultaneously.

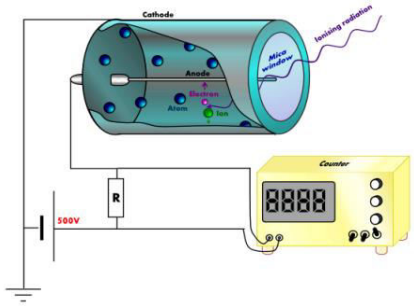


b) **Draw and label any one nuclear imaging transducer.**(2m+2m) **04**

Ans:

Transducers used in Nuclear Medical Imaging are i) Geiger muller tube detector ii) scintillation counter



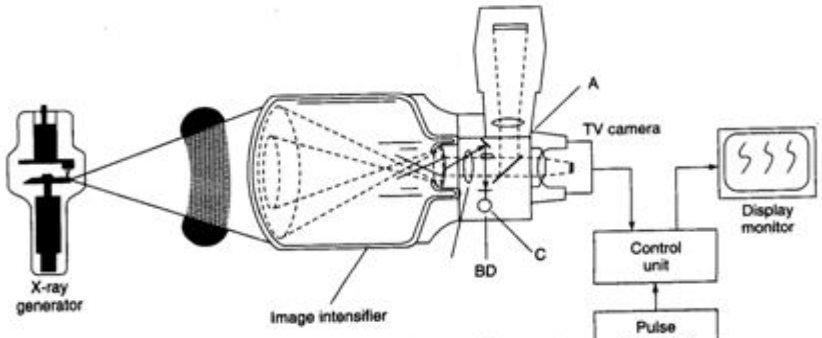


Geiger miller tube detector scintillation counter

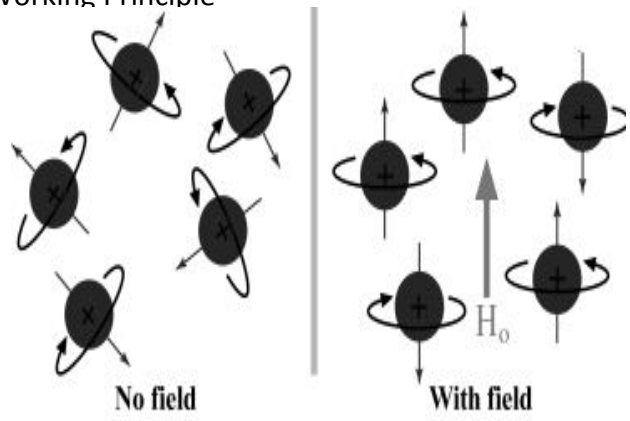
(any other relevant answer should be consider as a valid answer)

c) **Draw and label the block diagram of fluoroscopy machine.**(draw 2m+label2m) **04**

Ans: (any other relevant diagram should be considered)

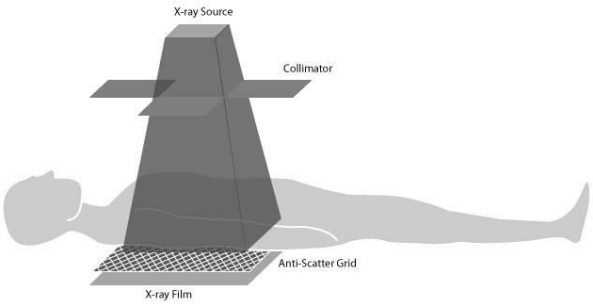


A. Two channel attachment—can take a TV camera and a 70 mm or cine camera.
B. Holder and lens. This produces a parallel light beam for the cameras.
C. Photo pick-up.
D. Electrical signal from photo pick-up. It provides the control for 70 mm and cinefluorography.

d)	**State the causes of the faults occurring in an x ray machine if: i)Millimameter indicates flow of excessive current when does not change by mA control. ii)More dark images are obtained.**(2m+2m) **Ans:** **i) Millimameter indicates flow of excessive current when does not change by mA control.** Cause: 1. Excessive temprature due to overheating of x ray tube anode 2. Breakdown in insulation of cables 3. Defective rectifier **ii) More dark images are obtained.** Cause: 1. Over exposure or over developing.	**04**
e)	**State the basic principle of NMR with diagram.(2m+2m)** **Ans.:-** Magnetic Resonance Imaging Magnetic Resonance imaging is a technique used to produce detailed images of any part of the body. It is a map of the distribution density of hydrogen nuclei and parameter reflecting their motion, in cellular water and lipids. Working Principle  • Hydrogen nucleus is present in every cell of our body. For imaging purposes the • hydrogen nucleus (a single proton) is used because of its abundance in water and fat. • Hydrogen atoms behaves like a small bar magnet. Under normal, these hydrogen proton "bar magnets" spin in the body with their axes randomly aligned. • When the body is placed in a strong magnetic field, such as an MRI scanner, the protons' axes all line up. This uniform alignment creates a magnetic vector oriented along the axis of the MRI scanner. • When the radiofrequency source is switched off the magnetic vector returns to its resting state, and this causes a signal (also a radio wave) to be	**04**

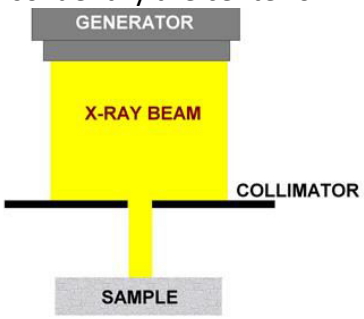
	emitted. It is this signal which is used to create the MR images. • Multiple transmitted radiofrequency pulses can be used in sequence to emphasize particular tissues or abnormalities. A different emphasis occurs because different tissues relax at different rates when the transmitted radiofrequency pulse is switched off. • The time taken for the protons to fully relax is measured in two ways. The first is the time taken for the magnetic vector to return to its resting state and the second is the time needed for the axial spin to return to its resting state. The first is called T1 relaxation; the second is called T2 relaxation. • An MR examination is thus made up of a series of pulse sequences. • Most diseases manifest themselves by an increase in water content, so MRI is a sensitive test for the detection of disease. (any other relevant answer should be consider as a valid answer)	
.4 a) i)	**Attempt any THREE of the following** **State the different types of magnets used in MRI. Explain anyone.**(2m+2m) Ans: Types of magnets used in MRI : 1. Resistive magnet 2. Permanent magnet 3. Super conductive magnet Permanent Magnets Certain alloys possess ferromagnetic properties. A magnet built of such materials has the advantage of needing no power to maintain the field strength. Likewise, it needs no cooling because there is no power dissipation. Such systems have small fringe (stray) fields when compared to the other magnet systems. Capital and operational costs of permanent magnets are low. The disadvantages are the weight of the currently produced systems for whole-body imaging, although new alloys developed during recent years have cut down the weight of permanent systems from 100 tons to less than 20 tons. Another drawback of permanent magnet systems are the field-strength limitations, which presently seem to be about 0.3 T for magnetic resonance imaging. Most of them operate at about 0.2 T. Many permanent magnets have a vertical magnetic field which distinguishes them from some resistive and most superconducting systems with horizontal fields (Figure 03-04). The field direction has an impact on the use of certain transmitter and receiver coils.	**12** **04**

	Electromagnets or Resistive Systems Resistive systems consist basically of a suitable coil or collection of coils through which a strong electric current is passed. If these coils are set up in a proper geometry, a homogeneous magnetic field can be created, as shown in Figure 03-01 and Figure 03-05. Such systems have a high power consumption (e.g., a 0.1 T unit requires about 20 kW), create a lot of heat, and therefore need large-capacity cooling systems. super conducting magnet A superconducting magnet is an electromagnet made from coils of superconducting wire. They must be cooled to cryogenic temperatures during operation. In its superconducting state the wire can conduct much larger electric currents than ordinary wire, creating intense magnetic fields. Superconducting magnets can produce greater magnetic fields than all but the strongest electromagnets and can be cheaper to operate because no energy is dissipated as heat in the windings. They are used in MRI machines in hospitals, and in scientific equipment such as NMR spectrometers, mass spectrometers and particle accelerators. (any other relevant answer should be consider as a valid answer)	
ii)	**Name the imaging technique which will be used to diagnose Breast cancer ,to monitor inflammatory bones and deep vein thrombosis. Explain the principle of working of this technique.**(2m+2m) **Ans:** Thermography is used to diagnose breast cancer ,to monitor inflammatory bones and deep vein thrombosis . Principle of Thermography : The principle of infrared thermography is based on the physical phenomenon that any body of a temperature above absolute zero (-273.15 °C) emits electromagnetic radiation. There is clear correlation between the surface of a body and the intensity and spectral composition of its emitted radiation. By determining its radiation intensity the temperature of an object can thereby be determined in a non-contact way. (any other relevant ans should be consider as a valid ans)	**04**
iii)	**Explain the need and placement of grids and collimators in x ray imaging with suitable diagram.** (2m grid+ 2m collimator) **Ans:**	**04**

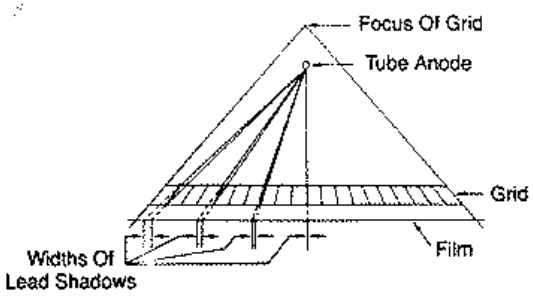


COLLIMATOR:
It is device attached in opening to x ray tube to regulate the shape & size of x ray beam.
It has two advantages :

i) It provides infinite variety of rectangular & square x ray fields.
ii) It can also identify the center of x ray beam



B: GRID:it is the most effective way of removing scattered radiation.
They consist of lead foils & separated by a transparent spacer.
They are used to absorb scattered radiation & improve image contrast.
Leads are characterized by grid ratio. it is the ratio of height of lead strips to distance between them. They are of two types linear & crossed.



(any other relevant answer should be consider as a valid answer)

iv)	**Define the term installation and state the steps included in installation of an angiography machine.** (2m+2m) Ans: Installation : It is the action or process of making machine ready to be used in certain place. Installation is process that put all piece of equipment together & make it ready	**04**

	for use. Installation of angiography 1. Prepare lab area layout. 2. Unpack the box 3. Read the user manual carefully . 4. Check environmental condition of room 5. Check electrical supply of the room. 6. Assemble all the accessories of equipment 7. Mount TV camera ,heat exchanger ,power supply, x ray tube and attached assembly cover , c arm unit ,driver unit ,image intensifier tube 8. Install control cabinet & mount display unit. 9. Please check alignment of x ray beam mount collimator & check its alignment . 10. Install other optional components like monitor support, remote console, console cart . 11. Check the settings ,inspect all the connection. 12. Perform demo test (any other relevant ans should be consider as a valid ans)	
b)	**Attempt any ONE of the following**	**06**
i)	**Enlist the steps involved in installation of an x ray machine.** Ans: While installing the x ray system we have to consider following steps i) The basic radiological system designed by world health organization. • for x ray laboratory minimum two room are required i.e. x ray tube and dark room • The BRS is also specify the difficult requirements for the x ray system i.e. it deals with different components of x ray. • the floor plan for 3 or 2 rooms is suggested by BRS ii) Dark room requirement • for manual processing the dark room should have floor area of 5m2 • for automatic processing the dark room should have floor area small dimensions. • the dark room must have entirely light proof arrangement even with the bright sunlight. • the different light sources require in dark room & the paint used in dark room is also has to be consider while designing the x ray dark room iii) Electrical supply • check the characteristics of available power supply while connecting the x ray generator to AC mains. • the main power cord has proper connectors instrument is properly	**06**

grounded.

iv) Different components of x ray machine

v) Safety precaution s for radiation hazards

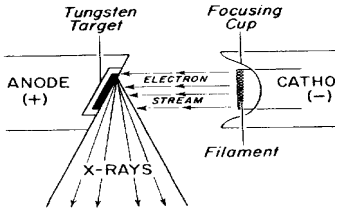
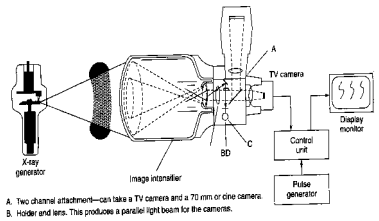
- operating control panel has in its front a protective lead screen with lead glass window minimum size 30*30

(any other relevant answer should be consider as a valid answer)

ii) State the difference between fluoroscopy and radiography based on **06**

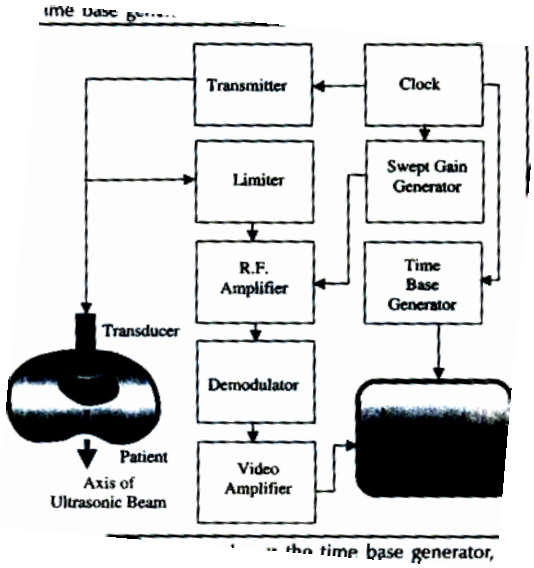
1. **Diagram**
2. **Working principle**
3. **Viewing media**
4. **Advantages**
5. **Disadvantages**
6. **Application.**

(one mark each)

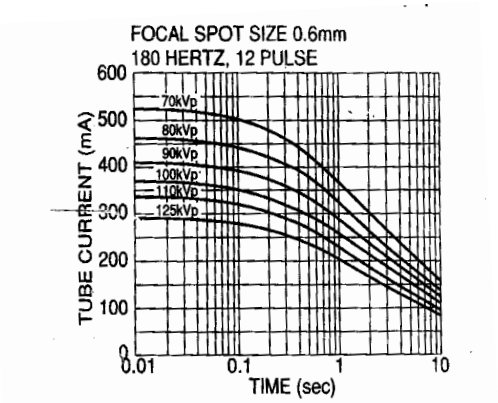
Diagram	 **Figure 2–4** Lateral view of the cathode and anode of a stationary anode x-ray tube	 A. Two channel attachment—can take a TV camera and a 70 mm or cine camera. B. Holder and lens. This produces a parallel light beam for the cameras. C. Photo pick-up. D. Electrical signal from photo pick-up. It provides the control for 70 mm and cinefluorography. Fig. 19.21 *X-ray image intensifier system*
Principle	Radiography is an imaging technique that uses electromagnetic radiation other than visible light, especially X-rays, to view the internal structure of a non-uniformly composed and opaque object (i.e. a non-transparent object of varying density and composition) such as the human body	Fluoroscopy is a technique for obtaining "live" X-ray images of a living patient - it is like an X-ray TV camera. The Radiologist uses a switch to control an X-Ray beam that is transmitted through the patient. The X-rays then strike a fluorescent plate that is coupled to an "image intensifier" that is (in turn) coupled to a television camera. The Radiologist can then watch the images "live" on a TV

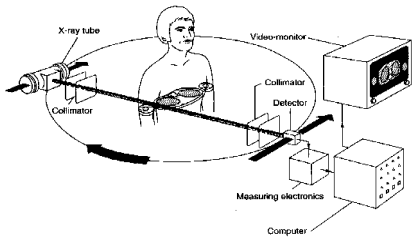
		monitor
Viewing media used	Radiographic film	TV camera
Advantages	1. Accurate Diagnosis 2. Nondestructive 3. Pictorial Presentation of Information 4. Portable 5. Versatile Applications	Allows a physician to see a live image of the body's internal organs in order to observe their size, shape and movement. Provide dynamic and functional information. Readily available. Inexpensive. Allow real time interaction. Good for visualized bony structure.
Disadvantages	1. Very small increased risk of cancer in future from exposure to ionizing radiation (x-rays). Risk is greater for children	2. Although radiation is minimal, there is the chance of skin injury due to radiation exposure, as well as the usual risks associated with radiation. 3. May display overlapping anatomy. 4. May be limited by patient mobility and ability to comply. 5. Poor soft tissue resolution. 6. Use ionizing radiation.
Application (any one or	1. X ray: x rays are used for to detect	1. To obtain real-time moving images of

	two)	cracks, fractures in bones. 2. It is also used for killing cancerous cells 3. CT scan: CT scanning is used for diagnosing some urgent and emergent conditions, such as cerebral hemorrhage, pulmonary (clots in the arteries of the lungs), aortic dissection (tearing of the aortic wall), appendicitis, d iverticulitis, and obstructing kidney stones. Ultrasound: it is used for obtain images of almost entire range of internal organs in abdomen .development of fetus during development. Thermmography :it gives video of temperature distribution over the surface of the skin. NMI: used to detect biochemical process are occurring normally and where they are occurring too slowly or quickly. MRI: To obtain anatomical information about human body	the internal structures of a patient 2. Investigations of the gastrointestinal tract, including barium enemas, defecating proctograms, barium meals and barium swallows, and enteroclysis. 3. Orthopedic surgery to guide fracture reduction and the placement of metalwork. 4. Angiography of the leg, heart and cerebral vessels. 5. Placement of a PICC (peripherally inserted central catheter) 6. Urological surgery 7. Cardiology for diagnostic angiography, 8. Implementation of pacemakers, implant able cardioverter defibrillators and car diac resynchronization devices) 9. Discography, an invasive diagnostic procedure for evaluation for intervertebral disc pathology.	

5	**Attempt any FOUR of the following:**	**16**
a)	**An endoscope has the following defects. What can be the reason for these.** **i) There is no fluid flow** **ii)There is leakage in flexible endoscope.**(2m+2m) **Ans: i)There is no fluid flow** Cause : blocked air /water nozzle Loose or damage setscrew **ii)There is leakage in flexible endoscope**. Cause : Tears or cut in flexible shafts	**04**
b)	**Identify the missing blocks in the block diagram of ultrasound scanner and state the function of each block.(Refer Figure No-1)**(2m+2m) Ans :  **Fig No1 : Ultrasound scanner** Missing blocks are limiter, swept gain generator, time base generator. It consists of clock, transmitter, limiter, RF amplifier, demodulator, swept gain generator, video amplifier, time base generator. Clock simultaneously triggers the time base generator, transmitter and swept gain generator. Transmitter generates a train of short duration pulses at repetition frequency determined by the clock. these electrical pulses are then converted into	**04**

	corresponding ultrasound pulses by piezoelectric crystal acting as transducer and injected into patient body. Echoes of ultrasound are converted into into electrical, signal by the same transducer. then theses signals are amplified suitably by a RF amplifier. The swept gain generator increase the gain of RF amplifier with time to correct the amplitude of echo according to depth of echo producing target. Output of RF amplifier is demodulated and fed to the video amplifier to display on CRT tube Y deflection plate. x plate is driven by the time base. (any other relevant answer should be consider as a valid answer)	
c)	**State the biological effects of MRI imaging .** **Ans:** Biological effects/hazards of MRI imaging • If patients with cardiac pacemakers, cerebral aneurysm clips or other metallic foreign body undergo for MRI then due to strong magnetism, these devices can malfunction or get damaged. Same holds true for • implanted electrode such as neuro stimulator and bone growth stimulator or internal drug diffusion pump • Time varying magnetic fields induce currents in patients which can produce muscle contraction and cardiac arrhythmia. • It can cause the augmentation in T wave of ECG. • It can cause deafness in the patient (any other relevant answer should be consider as a valid answer)	**04**
d)	**Enlist the risks involved in handling an x ray equipment.** Ans**:** Risk factors involved in handling of x ray equipment are: 1. X rays are highly absorbed in soft tissue, and severe burns can result from exposure of the hands, arms, skin or eyes to the direct or diffracted beams. 2. High dose can cause reddening of the skin or erythema. 3. Loss of hair or epilation 4. If a large area of skin is irradiated, erythema and pigmentation will occur with the pigmentation eventually fading. 5. If enough radiation of the proper energy is absorbed in the skin this will result in permanent destruction of either hair or sweat glands, or whole skin, with a resulting scar. 6. It can cause chronic radiation dermatitis, Radiation cancer. 7. It can affect fetus if it is used for pregnant women.	**04**

	(any other relevant answer should be consider as a valid answer)	
e)	**State and explain x ray tube ratings and give significance of heat units.**(2m+2m) **Ans:** X ray tube ratings are • Electrical rating • Thermal rating In x ray tube rating is measured in terms of K watt. It is commonly used to express ability of x ray tube to make single exposure of a reasonable duration.  Figure 2–9 An x-ray tube rating chart The x ray tube rating is decided by the same factors that are used to decide the quality and quantity of the x ray output. They are kVp, mA, time(S) The product of these three factors is known as heat unit (HU) HEAT UNIT (HU)= KVp*mA*S (any other relevant answer should be consider as a valid answer)	**04**
f)	**Draw the block diagram of CT machine. Enlist various image reconstruction techniques used in CT.**(2m+2m) **Ans:**	**04**



Block diagram of CT scanner consist of following parts

1. X ray tube
2. Collimator
3. Detectors
4. Measuring electronics
5. Display

Various image reconstruction techniques used in CT are (any two)

i) Back projection method
ii) Filtered back projection
iii) Iterative method

(any other relevant answer should be consider as a valid answer)

6	**Attempt any FOUR the following:**	**16**
a)	**List advantages and disadvantages of x rays.**(2m+2m)	**04**

Ans :

Advantages of x-rays:

X-rays are used to treat malign tumors before its spreads throughout the human body.

- They help radiologists identify cracks, infections, injury, and abnormal bones.
- They also help in identifying bone cancer.
- X-rays help in locating alien objects inside the bones or around them.

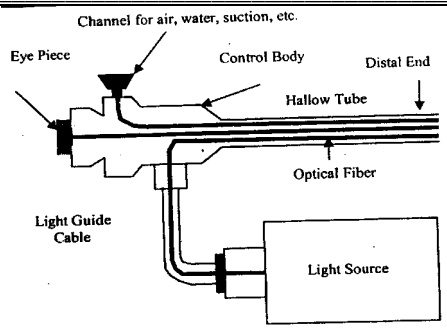
Disadvantages of x-rays:

- x-rays makes our blood cells to have higher level of hydrogen peroxide which could cause cell damage.
- a higher risk of getting cancer from X-rays.
- The X-rays are able to change the base of the DNA causing a mutation.

(any other relevant answer should be consider as a valid answer)

b)	**Which imaging technique can be used to diagram different brain tissues ,normal and coagulated blood. State the significance of each term in the equation It=I0 e^(-ux) used in this technique.** (Imaging technique 2 Marks + significance of	**04**

	each term in the equation 1/ 2 Mark each) **Ans:** Computed tomography (CT) imaging technique can be used to diagram different brain tissue, normal and coagulated blood. Principle : when x rays are passed through the patient body at tomographic section, they get absorbed by different tissues & bones .All the tissues are having different attenuation coefficient which is given by It=I0 e^(-ux) It is the equation used for calculating exponential coefficient. I0 - no of initial photons It - no of transmitted photons u - linear attenuation coefficient X - Thickness of the tissue (Any other valid should be considered)	
c)	**State any four properties of ultrasound.**(1 mark for each) **Ans:** 1. Frequency of Ultrasound is above 20 kHz. 2. Ultrasound travels at a velocity of about 1500m/s in soft tissue of the body. 3. The velocity of ultrasound waves in various biological media is approx. the same and nearly equal to that in water. 4. Velocity in bone about 3 times higher and in air it is 3 times less. (Any other relevant points should be considered)	**04**
d)	**Is endoscopy an invasive or noninvasive imaging technique? Draw and label the parts of an endoscopy machine.**(Imaging technique 1 mark+ Diagram with correct labeling 3 marks) **Ans:** Endoscopic surgery uses scopes going through small incisions or natural body openings in order to diagnose and treat disease. Hence it is minimally invasive surgery (MIS), which emphasizes that diagnosis and treatments can be done with reduced body cavity invasion.	**04**

	 **Fig. Endoscopy Machine**	
e)	**State the causes of the faults occurring in an ultrasound scanner.** **i) Image quality is poor.** **ii) Equipment is not running.** **Ans:** **Image quality is poor.(Marks 2)** **Cause:** • Insufficient gel • Controls set incorrectly • Main voltage is too low • Probe/display problem **Equipment is not running.(Marks 2)** **Cause:** • No power from mains socket • Electrical cable fault	**04**