

OVER VIEW OF MEDICAL ELECTRONIC EQUIPMENT

- Block diagram and operation of an x-ray machine

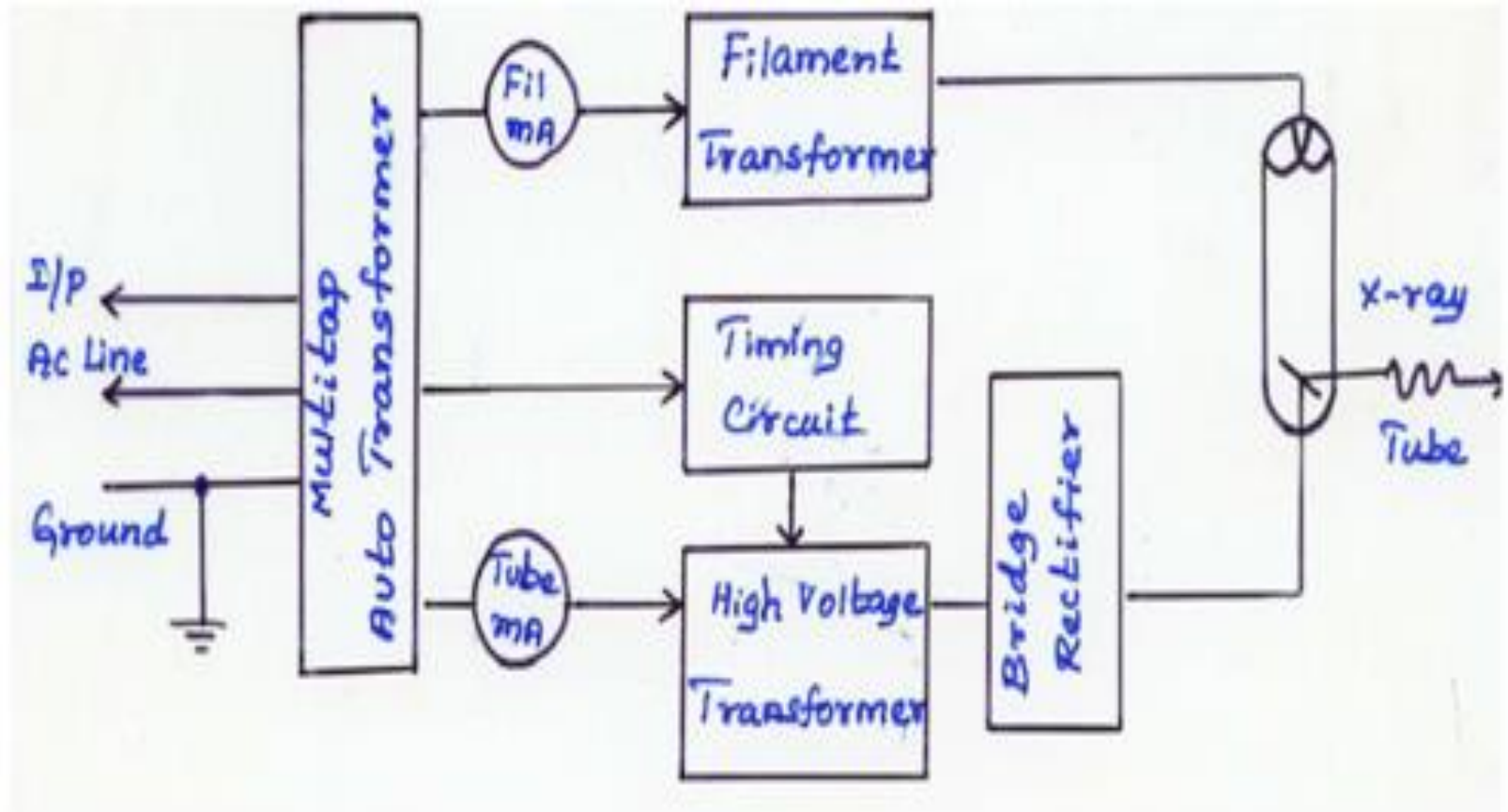
Introduction

- X-ray machine generate high energy, high electromagnetic waves (X-rays) to be used in diagnosing and treating disease.
- On the X-ray machine three basic controls knobs to control patient X-ray dose (**penetrating quality, quantity, and timing**) are provided.
- These are interrelated and must be properly chosen to suit the slim or obese patient. Good photographic results are sometimes difficult to obtain.

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- These controls are filament heat control (mA) for **exposure strength**, not depth; kilovolt control (kV) for **penetration depth and contrast**; and timing devices for **time exposure length**.
- It is extremely important to observe X-ray tube heat ratings. Excessive heat will damage a very expensive tube, and the cost and inconvenience of replacement are equally high.
- To accomplish this, X-ray machines should have the following major sections, as shown in the figure below

Block diagram



Multi tap AC line autotransformer

- Which allows selection of taps to compensate for incoming variations. These also permit the operator to choose voltages for specific applications.
- The multi-tap AC line autotransformer has several purposes.
 - One is to compensate for normal input line voltage (230V) variations, a voltage compensator is included in the circuit.
 - secondly the autotransformer contains switch settings for coarse (10 kV) and fine (1 kV) high-voltage selection.

X-ray tube filament circuit and transformer

- transforms the ac line to supply power for heating the cathode filament.
- This power can be selected by taps to change filament heat (filament mA), which changes X-ray tube current (tube mA) and, hence, total X-ray delivered to the patient.

X-ray tube high-voltage circuit, transformer, bridge rectifier

- Transforms the **ac** line to supply the high **dc** voltage for accelerating electrons from cathode to anode.
- The high voltage can be selected by taps to change the kVp (kilovolt peak) and, hence, total X-ray energy delivered to the patient.
- The diode bridge provides full wave rectified DC voltage to the X-ray tube anode. X-ray tube current meter shows the milliamperes passing through the tube.

Timing circuit

- Controls turn-on, turn-off, and length of X-ray exposure delivered to the patient.
- An electronic timer circuit is used to switch on and off the X-ray tube. Larger X-ray machines have three phase power instead of 120 peaks per second in single phase

Compare invasive and noninvasive diagnostic procedures.

- Noninvasive procedures do not require inserting devices, breaking the skin, or special monitoring and use conventional x-ray machines or specialized instruments to visualize internal organs. Invasive procedures require surgical aseptic technique for the insertion of a catheter, wire, or other testing device into an organ or blood vessel

Computed Tomography -CT

- **Computed tomography (or computerized axial tomography) is an examination that uses X-ray and computer to obtain a cross-sectional image of the human body.**

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- When X-rays are irradiated on the human body, some of the rays are absorbed and some pass through the body to produce an image. In plain X-ray imaging, the film directly absorbs penetrated X-rays. In CAT scanning, an electronic device called a "detector array" absorbs the penetrated X-rays, measures the X-ray amount, and transmits the data to a computer system. A sophisticated computer system, in turn, calculates and analyzes data from each detector in each level, and finally reconstructs multiple, two-dimensional, cross-sectional images.

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- CT scanners use one or more narrow, **fan-shaped** x-ray beams that rotate around the patient to produce a series of thin, transverse images of the patient.
- The x-ray beam, attenuated by the patient, reaches a detector array consisting of several hundred separate detectors which record the intensity of the x-ray beam at each point.



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- Gas detectors (usually Xenon) convert x-ray photons into electrical signals.
- Solid state detectors perform an indirect conversion, using photo-diodes coupled to scintillator systems.
- The CT image is mathematically reconstructed from the measured data.



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- CT operates with an x-ray tube potential in the range of perhaps **90-140 kV peak**.
- The geometry of the x-ray beam is primarily determined by the size of the x-ray tube **focal spot** (0.5 - 2 mm) and pre-patient **collimation**.
- **Shaped attenuation filters and/or detector collimation** are often used **to minimize scattered radiation** reaching the detectors and hence degrading the image.

Assignment-2

- What are the differences between conventional X-ray and CT-Scan.

**Thank you for your
attention**