

NATIONAL INSTITUTE OF TECHNOLOGY RAIPUR



BIOMEDICAL ENGINEERING ASSIGNMENT

5 Medical Devices

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Figure 1: X-Ray Machine

1 X-Ray Machine

An X-ray is a common imaging test that's been used for decades. It can help your doctor view the inside of your body without having to make an incision. This can help them diagnose, monitor, and treat many medical conditions.

1.1 X-Ray parts

X-Ray has 3 Main components

- operating console
- High Frequency Generator
- X-Ray Tube
 - Internal
 - External
- Other parts include
 - collimator and grid

- Bucky
- X-Ray Film

1.2 Working

An X-ray is produced when a negatively charged electrode is heated by electricity and electrons are released, thereby producing energy. That energy is directed toward a metal plate, or anode, at high velocity and an X-ray is produced when the energy collides with the atoms in the metal plate.

1.3 Uses

- examine an area where you're experiencing pain or discomfort
- monitor the progression of a diagnosed disease, such as osteoporosis
- check how well a prescribed treatment is working

1.4 Benefits

- noninvasively and painlessly help to diagnose disease and monitor therapy;
- support medical and surgical treatment planning
- guide medical personnel as they insert catheters, stents, or other devices inside the body, treat tumors, or remove blood clots or other blockages.

1.5 Risks

- a small increase in the possibility that a person exposed to X-rays will develop cancer later in life
- tissue effects such as cataracts, skin reddening, and hair loss, which occur at relatively high levels of radiation exposure and are rare for many types of imaging exams



Figure 2: MRI machine

2 MRI

Magnetic resonance imaging (MRI) is a medical imaging technique that uses a magnetic field and computer-generated radio waves to create detailed images of the organs and tissues in your body. Most MRI machines are large, tube-shaped magnets

2.1 MRI Parts

- A tube like structure called 'Bore'
- Magnet
- Gradient coil
- Shim coil, RF coil
- Computer

2.2 Working

MRI makes use of the magnetic properties of certain atomic nuclei. Hydrogen nucleus (single proton) present in water molecules, and therefore in all body

tissues. The Hydrogen nuclei partially aligned by a strong magnetic field in the scanner. The nuclei can be rotated using radio waves, and they subsequently oscillate in magnetic field while returning to equilibrium. Simultaneously they emit a radio signal. This is detected using antennas (coils). Very detailed images can be made of soft tissues.

2.3 Uses

- anomalies of the brain and spinal cord
- tumors, cysts, and other anomalies in various parts of the body
- breast cancer screening for women who face a high risk of breast cancer
- injuries or abnormalities of the joints, such as the back and knee
- Certain types of heart problems
- diseases of the liver and other abdominal organs
- still expanding in many areas

2.4 Benefits

- No ionizing radiation
- variable thickness in any plane
- better contrast v solution
- many details without iv contrast

2.5 Risks

- Very expensive
- Dangerous For Patients with metallic devices placed within body
- difficult to be performed on claustrophobic patients
- during scanning may cause blurry images



Figure 3: ECG MACHINE

3 ECG MACHINE

An electrocardiogram (ECG) is a simple test that can be used to check your heart's rhythm and electrical activity. Sensors attached to the skin are used to detect the electrical signals produced by your heart each time it beats.

3.1 Parts

- electrocardiograph
- electrocardiogram
- ecg paper
- ecg leads

3.2 Working

The electrodes are connected to an ECG machine by lead wires. The electrical activity of the heart is then measured, interpreted, and printed out. No electricity is sent into the body. Natural electrical impulses coordinate contractions of the different parts of the heart to keep blood flowing the way it should.

3.3 Uses

- help diagnose and monitor conditions affecting the heart
- It can be used to investigate symptoms of a possible heart problem, such as chest pain, palpitations (suddenly noticeable heartbeats), dizziness and shortness of breath.
- Dizziness, lightheadedness or confusion Heart palpitations Rapid pulse

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3.4 Benefits

- ECG is helpful to measure three basic parameters of clinical interest viz. rhythm and heart rate, axis of the heart and state of myocardial muscle.
- ECG represents data in the topographic form which provides higher diagnostical information
- ECG helps to prevent heart attacks by analyzing heart parameters at the initial stage.
- ECG is used to detect the cardiac conditions of the patients after surgical or any other operation and after application of anesthesia.
- ECG test is quick, painless and safe.

3.5 Risks

- It does not provide underlying heart problems for patients not having any symptoms.
- It does not always provide help in accurate diagnosis. More tests are needed to trace serious heart problems undetected by normal ECG curve.



Figure 4: Ventilator

4 Ventilator

A ventilator is a machine that provides mechanical ventilation by moving breathable air into and out of the lungs, to deliver breaths to a patient who is physically unable to breathe, or breathing insufficiently.

4.1 Ventilator Parts

- The Power Source
- The Controls
- The Monitors
- Safety Features

4.2 Working

The machine works by bringing oxygen to the lungs and taking carbon dioxide out of the lungs. This allows a patient who has trouble breathing to receive the proper amount of oxygen. It also helps the patient's body to heal, since it eliminates the extra energy of labored breathing.

4.3 Uses

People require ventilation if they are experiencing respiratory failure. When this occurs, a person cannot get enough oxygen and may not be able to expel carbon dioxide very well either. It can be a life threatening condition

There are many injuries and conditions that can cause respiratory failure, including

- head injury,stroke,lung disease
- spinal cord injury
- polio,sudden cardiac arrest,pneumonia

4.4 Benefits

- better gas distribution
- lower meanway pressure
- less hymodynamic disturbance
- less sedation is required
- weaning is easier(in most of the cases)

4.5 Risks

- The breathing tube in your airway could let in bacteria that infect the tiny air sacs in the walls of your lungs. Plus, the tube makes it harder to cough away debris that could irritate your lungs and cause an infection
- Medical staff members carefully measure the amount, type, speed, and force of the air the ventilator pushes into and pulls out of your lungs. Too much oxygen in the mix for too long can be bad for your lungs. If the force or amount of air is too much, or if your lungs are too weak, it can damage your lung tissue. Your doctor might call this ventilator-associated lung injury



Figure 5: Ultrasound

5 Ultrasound

an ultrasound is an imaging test that uses sound waves to create a picture (also known as a sonogram) of organs, tissues, and other structures inside the body. Unlike x-rays, ultrasounds don't use any radiation

5.1 Ultrasound Parts

- a transducer
- probe; the processing unit
- including the controls
- the display

5.2 Working

In an ultrasound exam, a transducer both sends the sound waves and records the echoing (returning) waves. When the transducer is pressed against the skin, it sends small pulses of inaudible, high-frequency sound waves into the body.

5.3 Uses

- View the uterus and ovaries during pregnancy and monitor the developing baby's health
- Diagnose gallbladder disease
- Evaluate blood flow
- Examine a breast lump
- Check your thyroid gland
- Detect genital and prostate problems

5.4 Benefits

- They are generally painless and do not require needles, injections, or incisions.
- Patients aren't exposed to ionizing radiation, making the procedure safer than diagnostic techniques such as X-rays and CT scans. In fact, there are no known harmful effects when used as directed by your health care provider.
- Ultrasound captures images of soft tissues that don't show up well on X-rays
- Ultrasounds are widely accessible and less expensive than other methods.

5.5 Risks

While ultrasound is generally considered to be safe with very low risks, the risks may increase with unnecessary prolonged exposure to ultrasound energy, or when untrained users operate the device.