

Physics (G485) Revision Notes.

E.M.F Induction in Transformers – 3 Marks

- A changing magnetic flux is produced in the primary coil.
- The iron core links this magnetic flux density to the secondary coils.
- The changing magnetic flux through secondary coils induces e.m.f. in secondary coils.

Alpha-Scattering Experiment – 5 Marks

- Most of the alpha particles went straight through therefore most of the atom is empty space.
- A very small number of alpha particles were repelled through large angles / angles more than 90 degrees.
- This showed the existence of a tiny positive nucleus.
- The size of the nucleus is about 10^{-14} m.

Positron Emission Tomography (PET) Principles – 5 Marks

- A positron emitting tracer is used.
- The positron annihilates with an electron inside the patient.
- This produces two gamma photons which travel in opposite directions.
- The patient is surrounded by a ring of gamma detectors.
- The arrival times of the photons / delay time indicates the location of where the positron was emitted.
- A 3-D image is created by the computer.

Ultrasound Scanning Principles

- A piezoelectric crystal, or transducer, is used to send pulses of ultrasound into the patient.
- Wave / ultrasound / pulse / signal is reflected at the boundary of tissue.
- The intensity of the reflected signal depends on the acoustic impedances at the boundary; this identifies the type of tissue.
- The time of delay is used to determine the depth / thickness.
- A-scan: one direction only e.g. depth finding
- B-scan: uses a number of sensors to build up an image.

Carbon Dating – 4 Marks

- Living things take in carbon dioxide and stop taking in carbon after they die.
- The ratio of carbon-14 to carbon-12 nuclei for the relic sample is determined.
- The *current* ratio of carbon-14 to carbon-12 nuclei is determined.

- The age of the relic is found using equation.
- Limitations:
 - The ratio of carbon-14 to carbon-12 is assumed to be constant.
 - The count-rate from relic may be comparable to background count-rate.

Gamma Camera – 5 marks

- *Collimator* – Gamma ray photons travel along the axis of lead tubes to the scintillator. This only allows photons through which are travelling parallel to the tubes.
- Having thin / long / narrow lead tubes makes the image sharper.
- *Scintillator* – When gamma ray photon hit the Scintillator (which can be a crystal), it produces thousands of photons of visible light.
- The *Photomultiplier tubes* detects the photons of visible light and produce an electrical pulse which is sent to the computer.
- The *Computer* uses the signals from the *Photomultiplier Tubes* to produce an image.

Measuring speed of blood via Ultrasound – 3 Marks

- Ultrasound is reflected by moving blood cells.
- The frequency / wavelength of the reflected Ultrasound is changed.
- The change in frequency is proportional to the speed of the blood.

Formation of the Sun.

- Regions of higher density in space attract each other, forming nebulae.
- Stars are formed from these nebulae.
- Gravitational collapse occurs. This is when the nebula continues to grow in density and the attractive force becomes stronger.
- The temperature of the cloud increases due to the kinetic energy of it increasing; gravitational potential energy gets converted into kinetic energy.
- When the pressure and temperature is great enough, fusion begins to occur.
- This is when hydrogen is combined in helium.
- A stable, or main sequence star, is formed when it is in thermal equilibrium; the thermal pressure is equal to gravitational pressure.

Death of our Sun

- When hydrogen runs out the outer layers of the star expand; the core shrinks.
- A red giant formed and the core becomes a white dwarf.

Evidence of Hot Big Bang Theory

- Galaxies are moving apart.
- If they're moving apart they must have started from a point.
- Galaxies further away, travel faster.
- There is a 2.7 K microwave background radiation.
- There is more helium in the universe than one would expect.

Principles of Magnetic Resonance

- Some nuclei behave as small magnets; they line up in the magnetic field.
- A strong magnetic field is required.
- Nuclei precess at a frequency known as the Larmor frequency.
- A coil sends out a pulse of radio waves which causes resonance; the nuclei absorb a lot of energy.
- When the RF pulse is stopped, the nuclei relax and emit the energy they previously gained as a RF signal.
- The emitted RF signal is detected by the coil.
- Different tissues/materials can be detected by the different relaxation times of the hydrogen nuclei in the tissue.
- A non-uniform magnetic field is used so that the Larmor frequency is not the same everywhere which allows the location of the nuclei in the body to be found.

Image Intensifiers

- X-rays are absorbed by photographic film.
- A scintillator/intensifier can be used which produces an increased number of photons of visible light from a x-ray photon which are then absorbed by the film.
- Scan shows *outline* of soft tissue.

Contrast Medium

- Different *soft* body *tissue* produce don't have a big difference in contrast.
- A barium meal can be used to give better contrast.
- High Z number.
- Or liquids can be injected into the body.
- Scan shows *outline* of soft tissue.