University of Virginia

Department of Physics

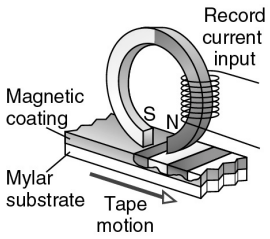
Physics 606: How Things Work II

Lecture #20 Slides:

Audio Amplifiers

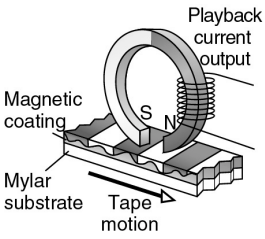
Recording Tape

- "Sound" current sent through ring-shaped electromagnet
- Split in ring develops north and south poles
- Nearby tape region becomes magnetized



Playing Back Tape

- Tape moves past gap in ring-shaped electromagnet
- Fluctuating magnetism in ring induces current in playback coil



Recording Details

- Louder sound → deeper magnetization
- Higher pitch → closer magnetic reversals
- Stereo → two separate magnetic tracks/heads
- Noise reduction → high pitch expansion
- Pitch control → tape speed control
- Sound degradation → magnetization damage

Question:

Iron powder sticks to a permanent magnet. If you sprinkle iron powder on a strip of recorded audio tape, will the iron powder stick?

Audio Amplifiers

Question:

If you install a pocket radio's batteries backward, it won't work because its

1. speaker will move the wrong direction.
2. parts can only conduct current one way.
3. batteries will absorb power and recharge.

Speakers

- Sound is produced by a moving surface
- Surface is pushed and pulled magnetically
  - Surface's wire coil carries current → magnetic
  - Coil is attracted/repelled by stationary magnet
- "Sound" current → surface acceleration
- Sound pressure proportional to "sound" current

Microphones (magnetic)

- Sound is received by a moveable surface
- Surface movement produces electric current
  - Surface's wire coil moves near stationary magnet
  - Electric field pushes current through moving coil
- Sound pressure → surface acceleration
- "Sound" current proportional to sound pressure

Microphones (electric)

- Surface movement produces electric current
  - Surface's charge moves near stationary wire
  - Electric field pushes current through wire

Audio Amplifier

- Three circuits:
  - Input circuit: current/voltage represents sound
  - Output circuit: amplified "sound" current/voltage
  - Power circuit: provides power for amplification
- Amplifier produces "enlarged" copy of input

Amplifier Components

- Resistors – provide voltage drops, limit current
- Capacitors – store charge, shift voltages
- Diodes – one-way devices for current
- Transistors – control current flow

Resistors

- Simple ohmic devices
  - Voltage drop is proportional to current
  - Resistance is the proportionality constant
  - Many values of resistance are available
- Reduce a current's voltage
- Produce a current proportional to voltage
- Limit current based on voltage drop

Capacitors

- Two separated conducting surfaces
- Charge (and energy) storage devices
  - One surface is positive, the other negative
  - Charge is proportional to voltage difference
  - Capacitance is proportionality constant
  - Many values of capacitance are available
- Store separated charge and associated energy
- Shift a current's voltage

Diodes

- One-way devices for charge & current
- Usually composed of two semiconductors

Doped Semiconductors

- Pure semiconductors are insulating
  - Valence levels are filled and can't conduct
  - Conduction levels are empty and can't conduct
- Impure semiconductors can be conducting
  - Extra valence levels → valence band conduction
  - Extra electrons → conduction band conduction