SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35.

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.

DEPARTMENT OF AUTOMOBILE ENGINEERING

COURSE NAME : 19AUB204 – AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING

II YEAR / IV SEMESTER

Unit 5 – Electronics Systems

Topic : Electromagnetic interference Suppression and Electromagnetic Compatibility

ELECTROMAGNETIC INTERFERENCE SUPPRESSION

- Electromagnetic Interference (EMI) refers to the disturbance caused by electromagnetic radiation emitted from electronic devices or natural sources, which interferes with the operation of other electronic devices, equipment, or systems.
- EMI can manifest in various forms, including electromagnetic fields, radio frequency interference (RFI), or conducted interference through electrical wiring.
- Electromagnetic Interference (EMI) suppression is crucial in maintaining the proper functioning of electronic systems by preventing unwanted electromagnetic disturbances.

SHIELDING

- **Enclosures**: Use metal cases or covers around electronic devices to block external electromagnetic fields.
- **Cable Shielding**: Employ shielded cables with conductive layers to protect the internal wires from external interferenc

FILTERING

- **Low-pass Filters**: Allow low-frequency signals to pass while blocking high-frequency noise.
- **High-pass Filters**: Permit high-frequency signals to pass and block low-frequency noise.
- **Band-pass Filters**: Allow a specific range of frequencies to pass and block others.
- **Common-mode Chokes**: Used in power lines to filter common-mode noise by providing high impedance to unwanted signals.

GROUNDING

- **Single-point Grounding**: Use a single grounding point to avoid ground loops that can introduce noise.
- **Multi-point Grounding**: Connect multiple points to the ground to reduce the path for EMI.

PCB Design Techniques

- **Proper Layout**: Arrange components to minimize loop areas that can pick up or emit EMI.
- **Trace Routing**: Use short and straight traces to reduce the chances of EMI.
- **Ground Planes**: Implement continuous ground planes to provide a return path for signals and reduce EMI.

TWISTED PAIR CABLES

- **Twisting Wires**: Pair and twist wires together to cancel out electromagnetic fields and reduce interference.

FERRITE BEADS AND CORES

- **Ferrite Beads**: Attach beads to cables to suppress high-frequency noise.
- **Ferrite Cores**: Encircle cables with ferrite cores to absorb EMI and prevent it from propagating.

ELECTROMAGNETIC COMPATIBILITY

- Electromagnetic Compatibility (EMC) is the ability of electronic devices and systems to function properly in their electromagnetic environment without causing or experiencing unacceptable levels of electromagnetic interference (EMI).
- Achieving EMC involves both controlling emissions and ensuring immunity to interference.

EMISSION CONTROL

- **Conducted Emissions**: These are electromagnetic disturbances conducted through electrical connections, such as power lines and signal cables.
- **Radiated Emissions**: These are electromagnetic disturbances emitted through the air from the device.

IMMUNITY

- **Conducted Immunity**: The ability of a device to withstand conducted disturbances on its power and signal lines.
- **Radiated Immunity**: The ability of a device to withstand electromagnetic fields present in its environmenT

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EMC STRATEGIES

❖ Design Techniques

- **Proper PCB Layout**: Minimize loop areas, use ground planes, and separate high-speed and low-speed circuits.
- **Component Placement**: Keep noisy and sensitive components apart, and use shielded components where necessary.
- **Trace Routing**: Use short, direct traces, and avoid parallel runs of high-speed signals to minimize crosstalk.

EMC STRATEGIES

❖ Shielding

- **Enclosures**: Use metal enclosures to block electromagnetic fields from entering or leaving the device.
- **Cable Shielding**: Employ shielded cables to protect against external EMI and prevent internal emissions from escaping.

EMC STRATEGIES

❖ Filtering

- ➢ **Power Line Filters**: Use filters on power lines to suppress conducted emissions and improve immunity.
- ➢ **Signal Line Filters**: Apply filters on signal lines to reduce noise and prevent interference.

❖ Grounding

- ➢ **Single-Point Grounding**: Use a single ground point to avoid ground loops that can cause interference.
- ➢ **Multi-Point Grounding**: In some designs, multiple grounding points might be used to improve EMC, especially in large or complex systems.

EMC STRATEGIES

❖ Decoupling and Bypass Capacitors

- **Decoupling Capacitors**: Place capacitors near power pins of ICs to filter out high-frequency noise.
- **Bypass Capacitors**: Provide low impedance paths to ground for high-frequency signals, reducing potential interference.

❖ EMI Suppression Components

- **Ferrite Beads and Cores**: Attach ferrite beads to cables and use ferrite cores around cables to absorb EMI.
- **Chokes**: Use common-mode and differential-mode chokes to suppress noise on power and signal lines.

EMC STRATEGIES

- **Circuit Design Techniques**
  - **Balanced Circuits**: Use differential signaling to reduce noise susceptibility.
  - **Ground Planes**: Implement continuous ground planes to provide a stable reference and reduce EMI.
- **Environmental Considerations**
  - **Cabling and Routing**: Properly route cables to minimize EMI. Use twisted pair cables to cancel out noise.
  - **Environmental Shielding**: In environments with high EMI, additional shielding might be necessary.

THANK YOU !!!