Unit I BASIC THEORY

Part - A Questions

1. Define EMI

Electromagnetic interference is the degradation in the performance of a device, or equipment, or a System caused by an electromagnetic disturbance.

2. Define EMC

The ability of a receptor (a device, or equipment, or a system) to function satisfactorily in its Electromagnetic environment without at the same time introducing intolerable electromagnetic disturbances to any other device/equipment/system in that environment is called electromagnetic Compatibility.

3.What are the three criteria for an electromagnetically compatible system to satisfy?

An electromagnetically compatible system satisfies three criteria are

1. It does not interfere with the operations of other systems. 2. It is immune from the emissions of other systems. 3. It does not interfere with its own operation

4. What are the different EMI Sources in Circuits?

Local oscillators Switches Motors Filters Relays Circuit breakersLogic & Digital circuits

5. What are the three ways to prevent interference?

There are three ways to prevent interference: 1.Suppress the emission at its source. 2. Make the coupling path as inefficient as possible. 3. Make the receptor less susceptible to the emission.

6. What are the various methods to eliminate EMI?

The effective methods to eliminate EMI are: Shielding, Grounding, Bonding, Filtering, Isolation, Separation and orientation, Cable design.

7. What are the major elements of electromagnetic?

Source (also as an emitter) produces the emission. It may be a noisy component, or a transmitter **Receptor** (also as a victim) is a component or device that receives noise or interference from the source **Coupling path** transfers the emission energy to a receptor, where it is processed, resulting in either desired or undesired behavior.

8.What is Electro Static Discharge?

Electrostatic discharge (**ESD**) is the sudden flow of electricity between two electrically charged objects caused by contact, an electrical short, or dielectric breakdown. A buildup of static electricity can be caused by charging or by electrostatic induction.

10. What is electromagnetic pulse (EMP)?

A nuclear explosion results in generation of EMP which is highly intense compared to any natural source.

Nuclear EMP leads to generation of EMI in severe form.

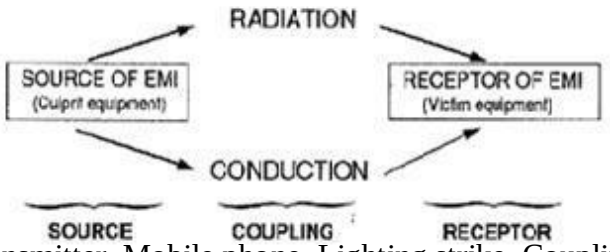
11. Mention the various methods of eliminating interference.

The primary methods available for combating interference are as follows:

1.Shielding 2.Grounding 3.Balancing 4.Filtering 5.Isolation 6.Separation and Orientation 7.Circuit Impedance and level control 8.Cable design 9.Cancelation techniques.

12. What are the primary components of an EMC problem?

The components of an EMC problem are source, coupling path and receptor.



Eg: EMI Source : Radio transmitter, Mobile phone, Lighting strike, Coupling path

Eg: EMI victim: Medical electronic equipment, pacemaker

8. What are the goals of EMC?

(i)To suppress any kind of EMI.

(i)To functional properly in its intended electromagnetic environment.

(i)Not to be a source of pollution to that environment.

(iv)To minimize the influence of electrical noise.

9. Why EMC has gained importance in recent years?

Electronic circuits are becomingly increasing sensitive.Distances between sensitive circuits(often electronic) and disturbing circuits(power circuits) Are becoming smaller. Disturbances are becoming stronger with increasing voltage and current values.

10. Mention few Victims of EMI.

Intended receivers

(i)Radio receivers0.01-1μVsensitivity

(ii) Broadcast receivers

(iii)TV receivers

(iv) Mobile communication receivers

(v)Microwave relay systems

(vi) Mobile Telephones

Unintended receivers

(i)Aircraft flying surface controls

(ii)Weapons systems, guided missiles

(iii)Video recording/ playback equipment

(iv) Signaling systems

(v)Heart pacemakers

11.What are the various EMI Control Techniques?

EMI is controlled by

1. Minimizing the disturbance at the source.

2. Introducing attenuation in the coupling path.

3. Increasing the Immunity of the Receptor.

EMI Control Techniques: 1.Grounding/Bonding

2.Cabling

3.Shielding

4.Filtering

12.Explain EMC Testing categories.

The test and evaluation for EMI and EMC involves measurement and compliance relating to:
(i)Conducted emission (CE)
(ii) Radiated emission (RE)
(iii) Susceptibility/immunity to conducted emission (CS)
(iv) Susceptibility/immunity to radiated emission (RS)

These tests cover both broadband emission and narrow emission. Narrowband tests deal with continuous wave (CW) mode emissions and interface. Broadband tests involve transients such as ESD or electrical surges or other similar transients.

13. Define Open Area Test Site (OATS).

Open Area Test Site is a measurement which is internationally accepted standard for Measuring radiated emissions from an equipment or the radiation susceptibility of a Component or equipment.

14. Explain Conducted emissions.

Conducted emissions are generated inside electrical or electronic equipment and may be Transmitted outward through the equipment's data input or output lines, its control leads, or Power conductors. Conducted emissions can cause EMI between equipment that generates Useful emissions and other equipment with low immunity to those same emissions.

15. Explain Radiated emissions.

Radiated emissions travel through the air. These emissions are typically generated by Electronic equipment and may be emitted from poorly shielded or unshielded cables, leaky Equipment apertures, in adequately shielded equipment housings, or normally operating equipment antennae.

16. Define Electro Magnetic Compatibility (EMC).

EMC is defined as" the ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to co-located equipment or systems in that environment.

17. What are the important aspects of EMI?

Emission pertains to the interference-causing potential of a product. The purpose of controlling emissions is to limit the electromagnetic energy emitted and thereby to control the electromagnetic environment in which other products must operate. Susceptibility is the capability of a device or circuit to respond to unwanted electromagnetic energy (i.e., noise).The opposite of susceptibility is immunity.

18. Mention few EMC Standards.

CISPR (Committee International Special des Perturbations Radio electroniques) have defined a Series of EMC Standards-European Norms for use in complying with the EMC Directive.: CISPR

Is a special part of the IEC tasked with the development of standards dealing with un wanted Radiated emissions in the RF (Radio Frequency) spectrum.
IEC: IEC is a world-wide standards writing organization. Membership includes most Industrialized nations and is open to any nation that wishes to contribute. Within the IEC are Technical Committees, each tasked with developing and maintaining specific types of Standards.

19. Why is EMC a vital problem?

The electromagnetic interference coupled from its source to the receptor can interfere with the Normal operation of the receptor. The receptor becomes a victim when the intensity of Electromagnetic inference is above a tolerable limit .Here, EMC has a vital role to function Satisfactorily in its electromagnetic environment without introducing intolerable Electromagnetic disturbances to co-located equipment or systems.

20. Define susceptibility with respect to EMI / EMC.

Susceptibility is the capability of a device or circuit to respond to unwanted electromagnetic energy.

21. Why do we feel electric shock at times, when we touch TV and computer monitors?

We feel electric shock at times, when we touch TV and computer monitors because the static Electricity charge in our body gets discharged when we touch something metallic.

22. What are the three criteria to be satisfied by any system to become electromagnetically Compatible with its environment?

A system is said to be electromagnetically compatible if:

It doesn’t cause interference with other systems.

It is not susceptible to emissions from other systems.

It doesn't cause interference with itself.

23. How do you prevent emission?

Suppress the emission at the source point; the best method is to control EMI.

Make the coupling path as inefficient as possible.

Make the receiver less susceptible to emission.

24. What are the effects of cloud to cloud discharge?

The term cloud to cloud discharge refers to all discharges that do not contact the ground. Static charges acquired by a cloud produce a static electric field.

Part - B Questions

1. Distinguish between the features of conducted EMI and radiated EMI. (8m)(April/may 2017)
2. Explain the different sources of EMI in detail. Give examples. (8m) (April/may 2017)
3. Discriminate time domain and frequency domain EMI. Why does analysis is made in frequency approach analysis, design and location of high voltage equipments? (16m) (April/may2017)
4. Explain the mechanisms of EMI. Mention its applications. (8m) (Nov/Dec 2017)
5. What are the types of EMI? With real diagram explain the sources and consequences of EMI. (8m) (Nov/Dec 2017)
6. Explain the classification of electromagnetic radiation and its hazards. (8m) (Nov/Dec 2017)
7. Explain the effect of radiation on the human body. (8m) (Nov/Dec 2017)
8. Distinguish between conducted EMI and radiated EMI. (16m) (April/may 2018)
9. How do you break the transfer of electromagnetic energy with regard to the prevention of interference? Explain. (8m) (April/may 2018)
10. List the equipment to equipment effects and equipment to human effects with regard to EM interference. (8m) (April/may 2018)
11. Explain the various mechanisms in which electromagnetic interference can travel from its source to the receptor. (16m) (Nov/Dec 2016)
12. Discuss on the strong sources of atmospheric noise. (8m) (Nov/Dec 2016)
13. Discuss how lightning discharges affect the transmission line communications. (8m) (Nov/Dec 2016)

Unit-II COUPLINGMECHANISM

Part - A Questions

1.List the EMI coupling methods

(i)Inductive coupling (ii) Capacitive coupling (iii) Radiative coupling & (iv) Conductive coupling

2.What is meant by ground coupled interference?

Electromagnetic interference resulting from an electromagnetic disturbance coupled from one Circuit to another through a common earth or ground-return path.

3. What is crosstalk with reference to EMI/EMC design issues?

Coupling of electromagnetic energy from one cable to another in multi-conductor transmission lines

results from magnetic field coupling when two cables are located close to each other. This electromagnetic energy transfer or coupling from one transmission line to another is called **Crosstalk**. This is a most common source of electromagnetic interference generation in electrical and electronics circuits.

4. How interference is avoided in power supply lines?

The interference is avoided in power supply lines: 1.By using power line filter 2.Avoid unnecessary switching operations, 3.Noisy circuits (with a lot of switching activity) should be physically separated from the rest of the design. 4.Harmonic Wave Filters can be used. 5.Design for operation at lower signal levels, reducing the energy available for emission.

5. Why is grounding essential to suppress EMI?

Electrical grounding is essential for the protection of personnel against electric shock, fire threat Because of insulation burnout.

6.What is radiated Coupling?

In this type of coupling, when the source and victim are separated by a long distance Typically more than a wavelength. The source radiates the signal which may be wanted or Unwanted and the Victim receives it in a way that disturbs its performance.

7. What is inductive Coupling?

This coupling occurs when a varying magnetic field exists between two parallel conductors, Including a change in voltage along the receiving conductors and it is also called as magnetic Coupling.

8. Define transient Coupling.

Electrical transients and other disturbances are induced in power lines as a result of natural EM Phenomena and from the variety of equipment. Lightning can produce transients on power supply either by direct strike or by strike or nearby structure.

9. Define Near-field coupling

This coupling occurs by changing electric or magnetic field that is a closer distance than one-sixth of wavelength.

10.How to reduce differential mode-coupling?

For balanced lines 1.Use Twisted wire pairs. 2. Add a single braided shield.
For unbalanced line. 1. Select coaxial cable with lower transfer impedance.

11.What is pigtail effect?

Pigtail effect used to connect the outer conductor of a co-axial line to a shielded box. It causes the shield current to be concentrated on one side of the shield and liable to degrade shielding effectiveness.

12.How to reduce common-mode coupling?

 Reduce ground loop area. 2.Reduce cable length. 3.Reduce average cable height.
Shield an entire susceptible area

13.Define ground with respect to electrical gadgets.

Ground is a technique that provides a low resistance path between electrical or Electronic equipment and the earth or common reference low impedance planet to By pass fault current or EMI signal.A ground is normally defined as an equipotential point or plane that serves as a Reference potential for a circuit or system.(Equipotential point: A point where the Voltage does not change, regardless of the current applied to it or drawn from it.

14.What is the functionality of transient suppressor?

Transient suppressor is an array of devices that are designed to react to sudden or Momentary over voltage conditions. It responds to over voltage faster than the other Common over voltage protection component such as varistor. Example for transient Suppressor are Transient Voltage Suppressor diode, Metal oxide varistor and Avalanche diode.

15.What is differential mode coupling?

If the cable carries signal currents in differential mode (go and return) down the wires in Close proximity is called differential mode coupling. A radiated field can couple to the system and induce differential mode interference between the two wires and the differential current will induce a radiated field of its own.

16.What is the maximum value of the mutual inductance between two circuits?

The maximum value of the mutual inductance between two circuits is equal to the self inductance. $M12 \leq$ Lloop

17.What is mean by ground loop coupling?

The difference in voltage between two ground system can result in a potentially serious interference problem, which is referred as a ground loop.

18.Define common ground impedance coupling.

Common ground impedance coupling occurs when currents from two different circuits Flow through common impedance. The voltage drop across the impedance observed by Each circuit is influenced by the other circuit.

19.How we can block the common mode current in ground loop coupling?

The common mode current in ground loop coupling can be blocked by two methods:

(i) Uses of common-mode choke in the signal-return wires. (ii) Use of an optical coupler.

20.State the difference between common mode and differential mode interference.

The common mode interference are defined as the unwanted electrical potential difference between any current carrying conductor(s) and the reference ground. The differential mode interference are defined as the unwanted potential differences between any two current-carrying conductors.

21.Give examples for transient sources.

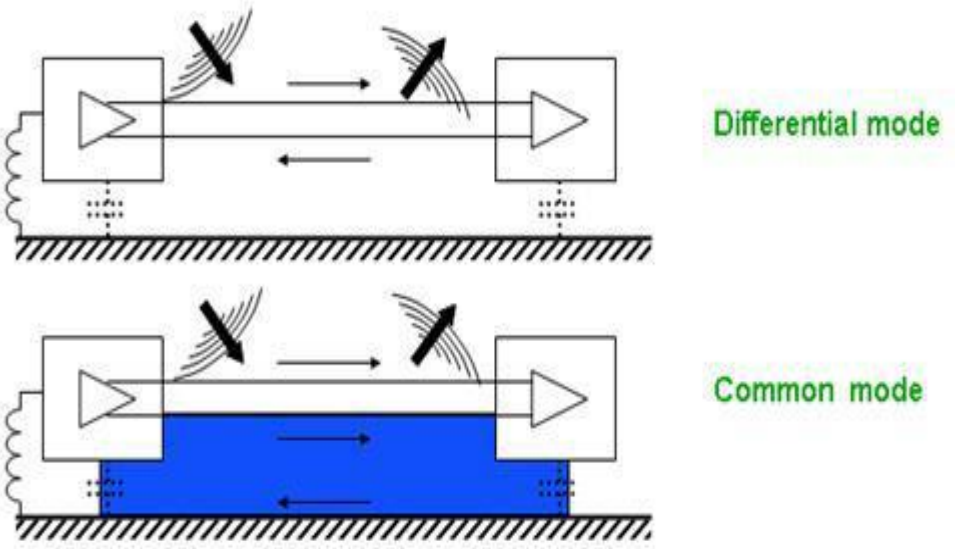
Electro static discharge(ESD)
Lighting
Switching

22.What are the various methods of noise coupling?

Conductively coupled noise

Common impedance coupling
Electric and Magnetic field coupling

23.Draw common mode and differential mode circuits.



24.Define ESD.

Electrostatic discharge (ESD) is the transfer of electric charge between bodies of Different electrostatic potential in proximity or through direct contact. ESD is observed As a high-voltage pulse that may cause damage or loss of functionality to susceptible devices.

Part - B Questions

1. Describe the cable related emissions and coupling briefly. (8m) (April/may 2017)
2. Demonstrate the common impedance ground couplings with examples. . (8m) (April/may 2017)
3. Explain how common mains supply acts as a frequent source of conducted interference. (8m) (April/may 2017)
4. Illustrate the electromagnetic impact of cable coupling in a system design. (8m) (April/may 2017)
5. Write short notes on (16m) (Nov/Dec 2017)
   i) Conducted coupling (5m)
   ii) Near-Field Coupling (5m)
   iii) Far field Coupling (6m)
6. Explain in detail about transient sources and automotive transients. (16m) (Nov/Dec 2017)
7. Comparing radiated DM Coupling and radiated CM coupling. (8m) (April/may 2018)
8. Explain the separation of conducted emissions into common and differential mode currents for diagnostic purposes. (8m) (April/may 2018)
9. Write the principle behind EFT and Surge. What are the typical modes of noise coupling? List the basic elements of EMI situations? (11m) (April/may 2018)
10. Explain the relation between Ground Loops and Subsystem Decoupling. (5m) (April/may 2018)
11. Discuss the impact of radiated common mode and differential mode coupling. Also explain how the surges on main power supply affect appliances and how it can be avoided with appropriate design. (16m) (Nov/Dec 2016)
12. Explain common mode, Differential mode and ground loop coupling. (16m) (Nov/Dec 2016)

Unit-III EMIMITIGATIONTECHNIQUES

Part - A Questions

1.What are the factors considered while improving shielding effectiveness?

1. Conductive contact, 2. Seam overlap, 3. Gasket/Seam contact points
2.

2.Define Grounding?

Grounding is a technique that provides a low resistance path between electrical or electronic Equipment and earth or common reference low impedance plane to bypass fault current or EMI Signal. (ii) It is used to protect against electrical shock, fire threat.

3.What is zoning?

This is a technique to reduce noise and EMI of a board and so as to reduce the need for extra PCB layers. (ii) Process of defining the placing of components in PCB in any traces.

4.What is meant by Shielding?

Electromagnetic Shielding is the technique that reduces or prevents coupling of undesired radiated electromagnetic energy into equipment, so to enable it to operate compatibly in its electromagnetic environment. Electromagnetic Shielding is effective in varying degrees over a large part of Th electromagnetic spectrum from DC to Microwave.

5.What are the advantages of single point and multipoint grounding?

Single point grounding scheme avoids problems of common mode impedance coupling.A single point grounding scheme operates better at low frequencies where the physical Length of the interconnection is small compared to wavelength that the frequency of operation.

Multipoint grounding behaves well at high frequencies where the dimension of the Grounding scheme is large compared to wavelength at the frequency of operation.

6.What is single point grounding system?

In single point grounding system each sub system grounded to separate ground plane.These separate ground planes are connected by shortest path to system reference Ground point.

7.What is hybrid grounding?

In hybrid grounding ground appears as single point at low frequency and as multipoint In high frequency.

8.State the functions of grounding in EMI control.

Grounding is a technique that provides a low resistance path between electrical or Electronic equipment and earth or common reference low impedance plane to bypass Fault current or electromagnetic interference signal . Thus, electrical grounding is Essential for the protection of personnel against electrical shock, fire threat because of Insulation burn out from lightning or electrical short circuit and protection of equipment and systems against EMI.

9.What is shielding?

Electromagnetic shielding is the technique that reduces or prevents coupling of Undesired radiated electromagnetic energy into equipment, so to enable it to operate Compatibly in its electromagnetic environment.

10.Define shielding effectiveness.

Shielding effectiveness can be defined as the reduction in magnetic, electric or Electromagnetic field magnitude caused by the shield. Total shielding effectiveness SE(dB)=AdB+RdB+IRdB

Where A is the absorption loss,R is the Reflective loss and IR is the Internal Reflection loss (expressed in decibels)

11.What are the various shielding methods?

(i) Single shield
(ii) Multimedia laminated shield
(iii) Isolated double shield

12.What are the parameters to be considered for practical shielding performance?

Frequency
Distance of interference source from the shielding walls.
Polarization of the field
Discontinuities in the shield

13.What is the purpose of apertures in shielding?

Apertures are holes in a shielded enclosure such as those required for ventilation, Optical displays, plastic components, or mechanical supports. In order for the enclosure To provide shielding, currents must be able to flow on the surface unimpeded.

14.State the importance of EMC gaskets.

EMC gaskets are shielding arrangements used to reduce the leakage of electromagnetic energy at metal-to-metal joints. Typical shielding effectiveness of commercially available EMC gaskets is of the order of 80-100dB.

15.What are the various Gasketing techniques?

Knitted wire-mesh gaskets.

Wire-screen gaskets.

Oriented wire mesh

Conductive Elastomer

Transparent conductive windows
Conductive Adhesive

Conductive Grease

.Conductive Coatings

16. What is Conductive Elastomer?

Conductive elastomer gaskets are formed by filling silicone elastomer with conductive Materials such as pure silver, carbon particles, silver-plated copper, nickel or aluminum Particles designed to achieve high shielding effectiveness and corrosion resistance. Conductive elastomers are ideal for applications requiring both environmental sealing and EMI shielding. They provide shielding effectiveness upto120dBat10GHzwitha Wide choice of profiles to fit a larger applications.

17. List the parameters that describe the performance of filter.

Insertion loss
Input and output impedances
Steady state and transient voltage rating
Attenuation in the pass band

18. Define filtering and state its importance in EMI mitigation.

Filtering is an important mitigation technique for suppressing undesired conducted Electromagnetic interference (EMI). Filters are designed to attenuate at certain frequencies, while permitting energy at other frequencies to pass.

19.How EMI filters are classified?

Low-pass power line filter: to pass 50 and 60Hz power line frequency and attenuate Higher harmonics and RF

Low-pass telephone line filter: to pass 0-4KHz and attenuate higher frequencies

High-pass data line filter: to pass high-frequency components and attenuate low-Frequency components.

Band pass communication filters: to pass a band of RF frequencies

Band reject filters: to eliminate the fundamental frequency of the transmitter from Entering into the receiver circuits.

20. Mention few surge and transient suppression devices.

Gas-Tube surge suppressor

Metal Oxide Varistor (MOV)

Silicon Zener Diode (SZD)

Bipolar Avalanche Diode (BAD)

21. Define wave impedance.

The ratio of the electric field (E) to the magnetic field (H)is called wave impedance.

22.What are the two basic methods for shielding against low frequency?

1. Diversion of the magnetic flux with high-permeability materials

2. Generation of opposing flux via Faraday's law, known as "shorted turn" method.

23.What are the different types of earth electrode system?

Single Rod electrode

Linear Array of Vertical Rods

Driven Square Array of Vertical Rods

Buried Horizontal Grid

Bedof Vertical Rods connected by a Buried Grid

24.State the purpose of EMC grounding.

1. The realization of signal, power and electrical safety paths necessary for effective Performance without introducing excessive common-mode interference
2. Establishment of a path to divert interference energy existing on external conductors,Or present in the environment, away from susceptible circuits.

25.How signal ground network can be classified?

Single-point ground

Multipoint ground

Hybrid ground or a Floating ground

26.What are the objectives of signal rounding?

(i) Not to interrupt the ground return path (ii) Return the current through the smallest loop possible (iii) Be aware of possible common impedance coupling in the ground.

Part - B Questions

1. How does an isolation transformer control EMI? Explain shielding and filtering methods of controlling EMI. (8m) (April/may 2017)
2. Explain various methods of grounding with examples. (8m) (April/may 2017)
3. How does cable routing control EMI? How is signal control achieved? (8m) (April/may 2017)
4. Describe the shielding effectiveness of both solid and non-solid materials including multiple soil shields and thin film shading. (8m) (April/may 2017)
5. Describe the strategy used in EMC grounding for large systems. (10m) (Nov/Dec 2017)
6. Explain the precautions used in earthing. (6m) (Nov/Dec 2017)
7. Define filter. With neat diagram, explain in detail about different types of filter. (16m) (Nov/Dec 2017)
8. List the important techniques to control EMI at source point. Explain about the shielding effectiveness for far-field sources. (8+3m) (April/may 2018)
9. Explain the effect of filter elements on common and differential mode currents. (5m) (April/may 2018)
10. Explain the features of power supply filters. Describe about shielding effectiveness for near field sources. (8+8m) (April/may 2018)
11. Explain about the various types of shielding techniques. (16m) (Nov/Dec 2016)
12. Discuss on the grounding strategies for i)Large systems ii) mixed signal systems. (16m) (Nov/Dec 2016)

Unit-IV STANDARDSANDREGULATION

Part - A Questions

1. What is need for standards?

The EMC standards are required for trouble free co-existence and to ensure satisfactory operation. They are also required to provide compatibility between electrical, electronic, computer, control and other systems. Standards are required as manufacturer-user interaction and user's knowledge on EMI are limited. They are also required for establishing harmonized standards to reduce international trade barriers and to improve product reliability and life of the product.

2. What are the types EMC STANDARDS?

There are two of standards: Military Standards and Civilian Standards

Military Standards

Military EMC standards are made in order to ensure system-to-system compatibility in the real time military environment. Military standards are more stringent than civilian standards. Most of the military standards are broadly based on MIL-STD 461 and 462.

Civilian Standards

The civilian EMC standards are applicable for equipments used for commercial, industrial and domestic applications.The emission standards are specified to protect the broadcast services from interference.

3. What are the advantages of EMC standards?

The advantages are:

Compatibility, reliability and maintainability are increased.

Design safety margin is provided.

The equipment operates in EMI scenario satisfactorily.

Product life and profits are increased.

.4. What are the EMC STANDARDS IN DIFFERENT COUNTRIES?

S. No	Standard Name	Meaning	Country
1.	CISPR	Committee International Special Perturbations Radio	International committee
	(IEC)	electriques – Europe	
2.	FCC	Federal Communications Council	USA
3.	SAE	Society of Automobile Engineers	Trade Association Technical Committee
4.	VG	Military standard	Germany
5.	VDE	Verband Deutscher Electro tecknikev	Germany
6.	ISI	EMI measurements & measuring apparatus	India

5.State the importance of standards.

A standard (generally published in the form of a document) represents a consensus of those substantially concerned with the scope and provisions of the particular standard. Standards are used as a guide to aid the manufacturer, the user and others who are likely to be affected.

6. Name few EMC standards.

ANSI–American National Standards Institution (US)

CSIPR-Committee International Special des Perturbations Radio electrique (Europe)

(International Special Committee On Radio Interference)

MIL-Military Standards (US Department of Defense)

7.What are the measurement and compliance related to the test and evaluation for EMI and EMC?

The measurement and compliance related to the test and evaluation for EMI and EMC is listed below.

Conducted Emission (CE)
Radiated Emission (RE)
Susceptibility/immunity to conducted emission (CS)
Susceptibity/immunity to radiated emission (RS)

8.State the importance of narrowband and broadband emission tests.

(i) Narrow band tests deals with continouswave (CW) mode emissions and interferences.

(i) Broadband tests involve transient such as electrostatic discharge or electrical Surges or other similar transients experienced in practice.

9.What are MIL Standards?

Military Standards(MIL) 461 and 462 constitutes a most comprehensive set of standards in EMC.

MIL-STD 462 specifies test methodologies and detailed procedures for compliance with

MIL-STD 461.MIL-STD 461 lists the EMI/EMC related performance specifications for

electrical, electronic and electromechanical equipment and subsystems.

10. What are FCC standards?

The Federal Communications Commission (FCC) in the US is responsible for evolving and ensuring implementation of various regulations concerning the operation of radio broadcast and transmission facilities in the US. The FCC has also the responsible for regulations to control electromagnetic emissions From various electrical and electronic devices and equipment.

11. What are BSI (British Standards Institution) standards?

The BSI standards include product specific EMC specification standards such as for household appliances, radio and TV broadcast receiver, IT product and industrial Process measurement and control equipment.

12. **What are Class A devices with reference to FCC?**

FCC Part 15 Sub part A contains specific information regarding testing and certification. Information like, scope of the rules and legal implications, definitions, prohibition against eavesdropping, labeling, and other sections. Class "A digital device that is marketed for use in a

commercial, industrial or business environment, exclusive of a device which is marketed for use by the general publicities intended to be used in the home."

13.Expand the terms CISPR, FCC ,IEC, ANSI, BSI and MIL.

FCC–Federal Communication Commission (US)

IEC–International Electro technical Commission (Europe)

ANSI–American National Standards Institution (US)

BSI–British Standards Institution (UK)

MIL-Military Standards (US)

14.Mention BSI standards concerning EMI/EMC.

Subject	Standards
Definitions and terminology	BS 4727, BS 5406
Test and measurement procedures	BS 727,BS 800,BS 833, BS 1597, BS 4809, BS 5049, BS 5394, BS 6299, BS 6527, BS 6667, BS 6839 - :BS 613, BS 800, BS 833,BS 905,
Performance limits, specifications	BS 1597, BS 4809, BS 5394, BS 5406, BS 6527

Part - B Questions

1. Summarize FCC and CISPR Conducted Emission and Radiated Emission standards. (16m) (April/may 2017)
2. Write short notes on (16m) (April/may 2017)
   (i) BSI
   (ii) CENELEC.
3. Briefly explain the following standards. (16m) (Nov/Dec 2017)
   i) CISPR (8m)
   ii) CENELEC (8m)
4. Explain in detail about the CE,CS,RE,RS limits in military standards. (16m) (Nov/Dec 2017)
5. Explain about the measurement of radiated and conducted emissions for verification of compliance. (16m) (April/may 2018)
6. List out the emission and susceptibility requirements of MIL-STD-461E. (8m) (April/may 2018)
7. List the requirements for commercial products marketed in the United States. (8m) (April/may 2018)
8. Explain the civilian standards FCC, CISPR and IEC in detail. (16m) (Nov/Dec 2016)
9. Discuss in detail the specifications for emissions and susceptibility given in MIL461E standard. (16m) (Nov/Dec 2016)

Unit-V EMITESTMETHODSANDINSTRUMENTATION

Part - A Questions

1. What is LISN?

LISN means Line Impedance Stabilization Network. A network inserted in the supply mains lead of an apparatus to be tested providing in a given frequency range a specified load impedance for the measurement of disturbance voltages and possibly isolating the apparatus from the supply mains in that frequency range.

2.What are the two main objectives of LISN? The two main objectives are:

(i) Provide constant impedance over range of frequency. (ii) Provide pure power without EM noise.

3.What are the four stages involved in EMC test?

The four stages involved in EMC test: Development test , Pre-compliance test , EMC compliance test

And Production test

4. Mention the various type of EMC test.

The various type of EMC test conducted at the various stages during the development cycle are Conducted emissions, Radiated emissions , Conducted immunity ,Radiated immunity,ESD immunity ,Transient immunity and Surge immunity .

5. What is spectrum analyzer? List the types of spectrum analyzer.

Spectrum analyzer is a broad band super heterodyne receiver which is used to display a wave in frequency domain additionally, power measurements, side bands can also be observed. Types: Real time spectrum analyzer and Swept tuned frequency spectrum analyzer

6. List some application of spectrum analyzer.

Identifying frequency terms and their power levels, Measuring harmonic distortion in a wave Determine type of wave modulation, Signal to noise ratio, For identifying wave distortion

7. Mention the test Methods to measure Shielding Effectiveness.

(i) MIL STD 285
(ii) The Coaxial Holder Method
(i) The Dual TEM Cell Method
(ii) Time Domain Method

8.Mention the importance of coaxial holder method.

This method is recommended by the American Society for Testing Materials (ASTM) for Shielding effectiveness measurement of samples of conductive coatings of composite Materials and conducted loaded plastics.

Advantage: Far-field testing of the sample is possible by taking the measurement in a TEM mode field inside a coaxial line.

9.What is importance of Dual cell method?

Measurements for both electric field shielding and magnetic field shielding can be done using A Dual TEM Cell method. The dualTEM Cell fixture uses one cell to drive another through an aperture in a common wall.

10 .Why time domain method is preferred?

The limitations on the shielding measurements in the far field using coaxial holders and dual TEM cells are overcome by Time Domain method.

11.State the limitations in coaxial holder and Dual TEM Cell.

Limitation in Coaxial holders: Limitation in frequency because of the appearance of the higher Order modes.

Limitation in dual TEM Cell: Limited in frequency because of the appearance of higher-order modes, especially when resonances occur.

13. What are the test configurations in the open-area test site?

The test configurations in the open-area test site are:

(i) Stationary EUT

(ii) Stationary Antenna

14. Draw the sketch to show how RE can be measured?

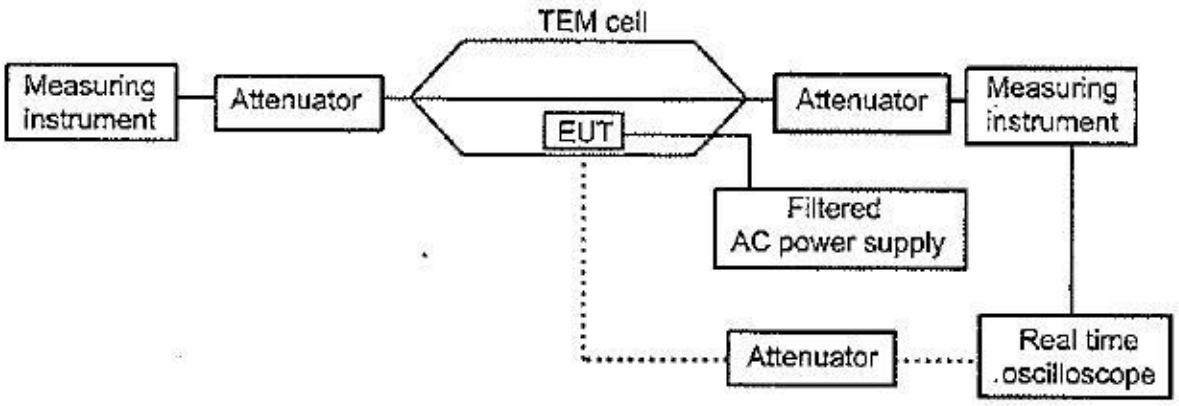


Figure Experimental setup for measuring radiated emissions

15. Write a brief note on anechoic chamber.

A most common laboratory approach for EMI/EMC measurement is the use of microwave anechoic chamber. Such chamber provides an indoor facility for measurements. They also provide high isolation from the external electromagnetic environment and they are highly sensitive in measurement.

16. What is TEM Cell?

Transverse electromagnetic (TEM) transmission-line cells are device used for establishing Standard EM fields in a shielded environment. TEM cells are used for emission testing of small equipment for calibration of RF probes and For biomedical equipments.

17. What are the limitations of TEM cell?

The limitations of TEM cells are:

Field distribution

Higher order modes

Field-intensity voltage relationship

19. Why EMI measurements are normally performed in Open Area Test Sites?

Open area test sites are normally preformed because it is most direct and universally accepted Standard approach for measuring radiated emissions from equipment or the radiated Susceptibility of a component or equipment.

20. What are the various EMI measuring instruments?

The various EMI measuring instruments are:

Anechoic chamber

Transverse Electromagnetic cell
Reverberating chamber
Open Area Test Site

21.What are the functions of a feed through capacitor?
The function of a feed through capacitor is to increase the resonant frequency of a capacitor.
21.What are the laboratory techniques for radiated interference measurements?
Anechoic chamber
Transverse Electromagnetic cell
Reverberating chamber
22.Name few commonly used test antennas.

Antenna Type	Frequency (MHz)
Rod antenna	01-30
Loop antenna	01-30
Biconical antenna	30-220
Dipole antenna	30-1000
Logperiodic antenna	200-1000

Part - B Questions

1. Describe about the open area test site measurements. What are its limitations? Outline the characteristics of open area test site. (16m) (April/may 2017)
2. Formulate the various EMI Test instruments. Develop a test bed for EFT. (16m) (April/may 2017)
3. With neat diagram, explain the super-heterodyne spectrum analyzer. (16m) (Nov/Dec 2017)
4. Define EMI test receiver. Explain list out the key features used to design EMI test receiver. (16m) (Nov/Dec 2017)
5. Explain the applications of spectrum analyzers in EMI/EMC area. Distinguish between international antennas and unintentional antennas. (14+2m) (April/may 2018)
6. Write the purpose and methodology for EMC system. (4.5m) (April/may 2018)
7. Explain the significance of shielding effectiveness tests. Write the application of current probes. (10+1.5m) (April/may 2018)
8. Give a detailed account on EMI test receivers and EMI test wave simulators. (16m) (Nov/Dec 2016)
9. Give detailed account on anechoic chamber used for EMI measurement and explain the procedure for RE and RS measurement. (16m) (Nov/Dec2016)