CMR INSTITUTE OF TECHNOLOGY	USN	

Improvement Test

Sub:	**ELECTRICAL ENGINEERING MATERIALS**								Code:	10EE666
Date:	10 / 05 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	6		Branch:	EEE

Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1.	Describe resins. Explain the basic properties and uses of resins.	[10]	CO2	L1
2	Explain magnetostrictive materials.	[10]	CO3	L4
3	Analyze the properties and uses of varnishes.	[10]	CO3	L4
4	Examine the construction and working of NMR Spectrometer with suitable diagram.	[10]	CO4	L3
5	Explain the following components used in Atomic Absorption Spectrometer (a)Radiation sources (b)Atomizer (c)Monochromator (d)Detector with a neat diagram	[10]	CO4	L4
6	Explain Electron microscopy with a neat sketch.	[10]	CO5	L4
7	Examine the working of magnetic resonance imaging.	[10]	CO5	L3
8	Describe Electron Spin Resonance. Summarize its applications.	[10]	CO4	L1

Solution for the Improvement Test

Electrical Engineering Materials – 6th Semester

Answer any five Questions.

Each Question carries 10 Marks

1. **Resin** is a sticky flammable organic substance, insoluble in water, exuded by some trees and other plants (notably fir and pine).

Epoxy resin : This is basically a polymer of epichlorhydrin and bisphenol. – 2 Marks

Properties : They are of transparent light amber colour(between gold and orange) and have very little shrinkage.As coating materials they have shown superior toughness, elasticity and chemical resistance.

As adhesives these materials have shown extremely high bond strength without the need for pressure for curing(toughening or hardening of a polymer.Good solvent and chemical resistance.Good adhesion to metals. – 4 Marks

Uses of Epoxy Resins : They are used as insulating materials in cable and boxes, cable point boxes and instrument transformers.They are used as insulating varnishes.They are also used as casting materials.

Uses of Silicon Resins :Used as cooling and impregnating liquids for capacitors and transformers.Used as varnishes.

Used as mouldings for high temperature applications.

Utilised as additives with rubber to make silicon rubber. – 4 Marks

2. **Magnetostrictivematerials** :It is a property of ferromagnetic materials that causes them to change their shape or dimensions during the process of magnetization.The variation of materials’s magnetization due to the applied magnetic field changes the magnetostrictive strain until reaching its

saturation value, λ.The effect was first identified in 1842 by James Joule when observing a sample of iron.A magnetostrictive material consists of tiny ferromagnets. These ferromagnets, usually iron, nickel or cobalt, have small magnetic moments as a result of their “3d” shells that are not completely filled with electrons. Essentially, the ferromagnets act like tiny permanent bar magnets. When a magnetic field is applied to the material, the randomly located magnets realign themselves with the field’s axis. This new ordered structure causes the solid to either stretch or shrink. When a mechanical force is applied to these materials, the opposite effect occurs: the material induces a magnetic field (Villari Effect).This field can be used to create an electric current and thus translate mechanical energy into electrical energy (Sensorland).Electric fields and magnetic fields are closely related. While electrostrictive materials differ in some ways, the principles behind the physics is very similar; when an electric field is applied, the material will either stretch or shrink. – 7 Marks

Diagram – 3 Marks

3. **Varnish** is a resin dissolved in a liquid for applying on wood, metal, or other materials to form a hard, clear, shiny surface when dry.These are generally classified according to composition as **oil varnishes** and **spirit varnishes. –** 2 Marks

Properties of Varnishes :**Oil varnishes** are made by combining a resin with a drying oil. It is usually necessary to melt or run with resin before adding the oil to get a clear solution.Varnishes with a high oil content are called long oil varnishes.Long oil varnishes are slow drying but deposit very flexible films.Short oil varnishes have high resin content and deposit a hard film.Oil varnishes hardenas a result of oxidation and polymerizationof the drying oils, such as linseed and soya bean.Drying is accelerated by adding small percentages of catalytic agents called driers usually in the form of resinates of lead, cobalt or manganese. **Spirit varnishes** dry by the evaporation of the solvent leaving a film of the dissolved resin.Cellulose nitrate and acetatevarnishes are in this class but areusually considered separately are lacquers. – 5 Marks

Uses of varnishes :To improve the insulating properties.

- To protect and brighten the painted surface.
- To improve the appearance of the unpainted wood surfaces.
- To increase mechanical strength.
- To give a fire retarding finish.
- To give protection from insects.
- To give protection from atmospheric corrosion.
- To give protection from moisture and rains. – 3 Marks

4. **NMR Spectrometer :** Block diagram – 4 Marks

   Working : In this arrangement of Nuclear magnetic resonance spectrometer, from the computer the system passes the signals to the pulse generator. The pulse generator receives the signal at high frequency and feeds to the RF generator. The low frequency signals are converted to high frequency signals. The signals are send to the switch. They are send to the RF amplifier. It sends RF signals to the the detector. The detector converts the signals to electrical signals. The analog to digital converter converts analog signals to digital form. This is given to the computer.

   Construction : Nuclear magnetic resonance spectrometer consists of pulse generator, RF generator, Switch RF amplifier, Computer, probe , sample and

RF amplifier, AF amplifier , detector and A/D converter. – 6 Marks

5. **Atomic absorption spectrometer** – Block diagram – 3Marks

Atomic absorption spectroscopy is a very common technique for detecting metals and metalloids in samples.It is very reliable and simple to use.It can analyze over 62 elements.It also measures theconcentration of metalsin the sample.

Radiation sources :Hollow Cathode Lampis the most common radiation source in AAS.It contains a tungsten anodeand a hollow cylindrical cathode made of the element to be determined.These are sealed in a glass tube filled with an inert gas(Neon or Argon). Each element has its own unique lampwhich must be used for that analysis.

Atomizer :Elements to be analyzedneeds to be in an atomic state.and breaking molecules into atoms.Atomization is the separation of particles into individual molecules .This is done by exposing theanalyte to high temperatures in a flame or graphite furnace.

Monochromator: This is a very important part in an AA spectrometer.It is used to separate out all of the thousands of lines.

A monochromatoris used to select the specific wavelength of light which is absorbed by the sample and to exclude other wavelengths.

The selection of the specific light allows the determination of the selected element in the presence of others.

Detector :The light selected by the monochromator is directed onto a detector.The detector is typically a photomultiplier tube, whose function is to convert the light signal into an electrical signal proportional to the light intensity.The processing of electrical signalis fulfilled by a signal amplifier.The signal could be displayed, for readout or further fed into a data station for printout by the requested format. – 7 Marks

6. **Electron microscopy :** diagram – 4 Marks

Conventional Transmission Electron Microscopes(CTEM or TEM) are electron optical instruments analogous to light microscopes where the specimen is illuminated by an electron beam.This requires operation in vacuumsince air scatters electrons.High resolutionis possible because of the short wavelengthof the electrons. Typical instruments use accelerating voltages from 40 – 120 kV and microscopes are becoming more common in the range of 200 – 400 kV.TEM image contrast is due toelectron scattering.Electrons scattered to large anglesby the sampledo not contribute the image in bright field.Dark field(DF) imagesnormally have much higher contrast than the bright field(BF) images,but are much weaker in intensity.In STEM**,** a fine electron beam orprobe is formed and scanned across the specimen.Here the specimen is thinand the intensity of a signal is detected, amplified and synchronized with a display of the image. Theimage can be processed to give a wide range of structural and chemical information.The resolution in STEMis limited by the probe size. – 6 Marks

7. **Magnetic Resonance Imaging(MRI) :** Magnetic resonance imaging (MRI) is a medical imaging technique used in radiology to form pictures of the anatomy and the physiological processes of the body in both health and disease. MRI scanners use strong magnetic fields, radio waves, and field gradients to generate images of the organs in the body.MRI does not involve X-rays,which distinguishes it from Computed Tomography (CT or CAT).

While the hazards of x-rays are now well-controlled in most Medicalcontexts, MRI can still be seen as superior to CTin this regard.MRI can often yield different diagnostic information compared with CT. There can be risks and discomfort associated with MRI scans. Compared with CT, MRI scans typicallytake far more time, arelouder, and usually require that the subject go into a narrow, confined tube. In addition, people with some medical implantsor other non-removable metal inside the body may be unable to safely undergo anMRI examination.Magnetic resonance imaging (MRI)is done for many reasons. It is used to find problems such as tumors, bleeding, injury, bloodvessel diseases, or infection.MRI also may be doneto provide more information about a problemseen on an X-ray, Ultrasound scan, or CT scan. – 7 Marks

Diagram – 3 Marks

8. **Electron spin resonance** is a branch of absorption spectroscopy in which radiationhaving frequency in the microwave regionis absorbed by paramagnetic substancesto induce transitions between magneticenergy levels of electrons with unpaired

electrons.The magnetic energy splittingis done by
applying a static magnetic field. The electron spin resonance phenomena is shown by atoms having an odd number of electrons, ions having partly filled inner electron shells and other molecules that carry angular momentum of electronic origin.

- 3 Marks

Diagram – 3 Marks

Applications of Electron Spin Resonance

- EPR/ESR spectroscopy is used in various branches of science, such as Biology, Chemistry and Physics, for the detection and identification of free radicals and paramagnetic centers such as F-centres.
- EPR is a sensitive, specific method for studying both radicals formed in chemical reactions and the reactions themselves.
- For example, when ice (solid H_2O) is decomposed by exposure to high-energy radiation, radicals such as H, OH, and HO_2 are produced.
- Such radicals can be identified and studied by EPR.
- Organic and inorganic radicals can be detected in electrochemical systems and in materials exposed to UV light.

- 4 Marks