SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, RAMAPURAM CAMPUS, CHENNAI

DEPARTMENT OF PHYSICS

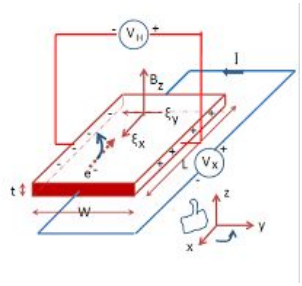
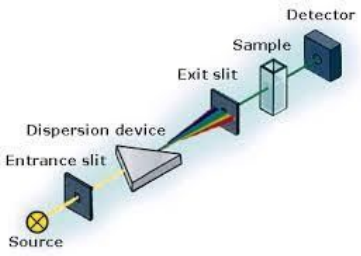
QUESTION BANK

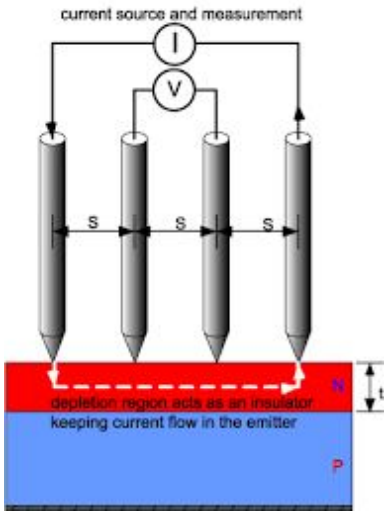
18PYB103J- SEMICONDUCTOR PHYSICS

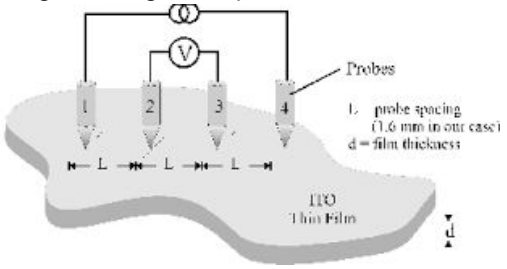
UNIT 4

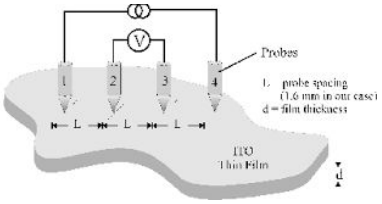
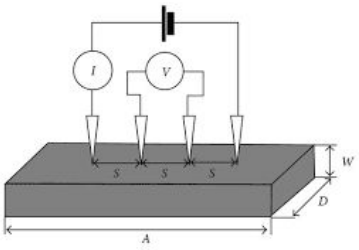
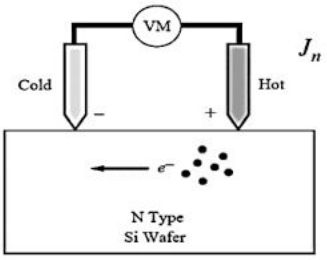
PART A-ONE MARK QUESTIONS

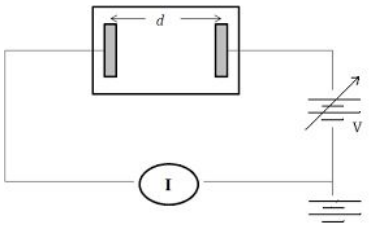
QUESTION NO.	QUESTIONS
1	In a ……., the electrons are ejected from photosensitive surface and are amplified within the cell. (A) Photodiode (B) Bolometer (C) Electrode **(D) photomultiplier tube**
2	Alkali metals and their oxides are best …… materials. **(A) Photo emissive** (B) Conducting (C) Insulating (D) Semiconducting
3	The crystalline solids absorbs energy and re-emits it in the visible region of the spectrum is called ……... (**A) Luminescence** (B) Photon emission nn (C) Phonon emission (D) Radiation
4	…….. Spectroscopy can be used to determine the concentration of absorbs in a solution. (A) Gamma (B) IR (C) Microwave **(D) UV Vis**
5	An ideal monochromator should have an …… narrow effective bandwidth. **(A) infinitely** (B) Small (C) Zero (D) finite
6	…….. is an instrumentation used to determine the traps in semiconductors (a) TGA **(B) DLTS** (C) DTA

	(D) IR
7	……. is used for separating source radiation wavelengths. (A) Detector (B) Antenna **(C) Monochromator** (D) Displaydevice
8	In ……. the conductivity increases with increasing temperature (A) IR (B) DTA (C) Phonos **(D) Semiconductors**
9	In ……. semiconductor, the Hall coefficient is negative (A) P-type (B) Dilute **(C) N-type** (D) Magnetic
10	The given diagram represents …….. effect  **(A) Hall effect** (B) Thermoelectric effect (C) Faradays effect (D) Photoelectric effect
11	The given diagram represents instrumentation of ……. spectroscopy  (A) IR (B) NMR (C) Gamma ray **(D) UV**

12	The given diagram represents …….. experiment  **(A) Four probe** (B) Hall effect (C) Two probe (D) DMS
13	…… law states that, when a beam of monochromatic light passes through an absorbing medium, the rate of decrease in intensity with the thickness of the medium, is proportional to the intensity of light. (A) Snell's (B) Beer's **(C) Lambert's** (D) Photoelectric
14	A …….. is a method of determining quickly whether a semiconductor sample is n (negative) type or p (positive) type (A) Electrolysis **(B) Hot probe method** (C) Hydrogenation (D) Rectification
15	The …….. method is used to measure the resistance (A) Hydrogenation (B) Rectification **(C) Vander Pauw** (D) Electolysis
16	The energy gap in a semiconductor is also called as ……. **(A) Forbidden gap** (B) Large gap

	(C) Narrow gap (D) Electrical gap
17	The …… is the ratio of the voltage measured across the sample to the current driven through the sample (A) Capacitance **(B) resistance** (C) Inductance (D) capacitor
18	The given diagram represents …… method  **(A) Vander Pauw** (B) Electolysis (C) Hydrogenation (D) Rectification
19	For determining the resistivity of a semiconductor, the diameter of contacts between the probe and the semiconductor should be …… the gap between the probes. **(A) Smaller Than** (B) Greater than (C) Equal to (D) Double
20	…….. is a technique for characterizing semiconductor materials and device, where the applied voltage is varied, and the capacitance is measured and plotted as a function of voltage. **(A) Capacitive – voltage profiling** (B) Current profiling (C) Voltage profiling (D) Baising

QUESTION NO.	QUESTIONS
21	Identify the resistivity measurement by four probe linear method (A)  This technique is commonly used to measure the resistivity and the Hall coefficient of a sample **(B)**  **This technique involves using four equally-spaced,known as a four-point probe to make electrical contact with the material.** (C)  The method of determining quickly whether a semiconductor sample is n type or p type. A voltmeter or ammeter is attached to the sample, and a heat source, such as a soldering iron, is placed on one of the leads.

	(D)  This Method is one of the standard and most commonly used method for the measurement of resistivity of very high resistivity samples like sheets/films of polymers
22	Illustrate the properties of Photoluminescence …… (I) The Principle of this method is based on the absorption of ultraviolet light or visible light by chemical compounds, which results in the production of distinct spectra. Spectroscopy is based on the interaction between light and matter. (II) It is a process in which a molecule absorbs a photon in the visible region, exciting one of its electrons to a higher electronic excited state, and then radiates a photon as the electron returns to a lower energy state. (III) This method is routinely used in analytical chemistry for the quantitative determination of different analytes, such as transition metal ions, highly conjugated organic compounds, and biological macromolecules. (IV) It is the spontaneous emission of light from a material following optical excitation. It is a powerful technique to probe discrete energy levels and to extract valuable information about semiconductor sample composition, quantum well thickness or quantum dot sample mono dispersity. (A) All the four Incorrect (B) Both II and III correct (C) Both III and I correct **(D) Both II and IV correct**
23	Analyse the device Photoemissive cell I) This cell is commonly known as a phototube, makes use of the photoelectric effect, the phenomenon whereby light-sensitive surfaces give off electrons when struck by

	light. These cells are sometimes called photocells or electric eyes. (II) This is is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect, which is a physical and chemical phenomenon. (III) In this cell the photons passed their energy in fixed quantities to atoms inside the metal, knocking some of their electrons out of them, so producing an electric current. The photons need a minimum threshold frequency to free electrons and produce an effect, known as the work function. (IV) These are the class of vacuum tubes, and more specifically vacuum phototubes, are extremely sensitive detectors of light in the ultraviolet, visible, and near-infrared ranges of the electromagnetic spectrum. These detectors multiply the current produced by incident light by as much as 100 million times or 108 (i.e., 160 dB)[1], in multiple dynode stages (A) Both I and II correct **(B) Both I and III correct** (C) Both II and IV correct (D) Both I and II correct
24	Point out the applications of Uv- Vis Spectroscopy. (I) Quantitative and not Qualitative analysis. (II) Determination of molecular weight. (III) Determination of molar absorbance coefficient. (IV) Determination of known compound. (V) Detection of non-functional group. (VI) Detection of isomers and geometrical isomers. (VII) Detection of impurities. (a) The statements I, II, VII and V are correct (b) The statements I, II, VI and V are correct (c) The statements II, III,VI and VII are correct (d) The statements I, V, VI and VII are correct
25	If the drift velocity of holes under a field gradient of 100v/m is 5m/s, the mobility is **A. 0.05**

	B. 0.55 C. 500 D. 50
26	A silicon sample is uniformly doped with 10^{16} phosphorus atoms/cm^3 and 2×10^{16} boron atoms/cm^3. If all the dopants are fully ionized, the material is: A. n-type with carrier concentration of $3 \times 10^{16}/cm^3$ **B. p-type with carrier concentration of $10^{16}/cm^3$** C. p-type with carrier concentration of $4 \times 10^{16}/cm^3$ D. Intrinsic
27.	In Photoluminescence process, electrons change energy states by either resonantly gaining energy from absorption of a ……. or losing energy by emitting ……. A. Mesons B. Phonons C. Baryons **D. Photons**
28.	In hot probe technique, …….. probe is connected to the positive terminal of the meter while the ……. probe is connected to the negative terminal. A. Cold, Hot B. Thick, Thin C. Thin, Thick **D. Hot, Cold**
29	The wavelength range used in UV – Vis. Spectrophotometer is ……. **A. 200 nm to 2500 nm** B. 200 nm to 3500 nm C. 200 nm to 4000 nm D. 400 nm to 700 nm
30	The Lambert law and Beer law may be combined into single relationship which shows the effect of both …….. and ……of absorbing substance. A. Composition, Refractive Index

	B. Thickness, Concentration C. Elasticity, Plasticity D. Hardness, Isotropy
31.	What is the unit of absorbance which can be derived from Beer Lambert's law? A. $Lmol^{-1}cm^{-1}$ B. $gm^{-1}cm^{-1}$ C. cm **D. No unit**
32.	In conventional DLTS the capacitance transients are investigated by using a …… A. Hartley oscillator B. Cathode Ray Oscilloscope **C. Lock-in- Amplifier** D. Intermediate frequency amplifier
33.	The temperature range of the most of the semiconductors to characterize in DLTS is …….. **A. 77 K to 380 K** B. 87 K to 380 K C. 77 K to 383 K D. 77 K to 400 K
34.	The DLTS is used to characterize ……. A. Conductors **B. Semiconductors** C. Insulators D. Superconductors
35.	To characterize the material in DLTS, it is necessary to form …… A. Thin film B. Nano particles **C. PN junction** D. Solution of the material
36.	…….. is not taking part in CV measurement A. Accumulation

	B. Depletion C. Inversion **D. Emission**
37.	The leakage current occurs in ……. A. Forward Bias **B. Reverse Bias** C. Both forward and reverse bias D. LDR
38.	C-V measurements are capable of yielding information about the ……. and concentration of charge carriers A. Drift potential **B. Diffusion potential** C. Bonding D. Crystal structure
39.	The exponential …….. in current steeps as the diode current becomes limited by the resistance of undepleted region of diode A. Increase B. Decrease C. Zero D.equals
40.	In linear four probe method the tip of probe diameter is usually …….. than the probe spacing A. Larger B. Cooler C. Hotter **D. Smaller**
41.	Van der Pauw technique measures the resistivity and ……. of the sample A. Coefficient of Friction

	B. Absorption **C. Hall coefficient** D. Emission
42.	To identify the nature of semiconductor (p-type or n–type) …….. methods will be used, A. Two-point method B. Linear four-point method C. Van der Pauw four-point method **D. Hall effect**
43.	The leakage current occurs in …… A. Forward Bias **B. Reverse Bias** C. Both forward and reverse bias D. LDR

QUESTION NO.	QUESTIONS
44	Hall Effect is defined as (I) The production of a voltage difference across an electrical conductor, transverse to an electric current in the conductor and to an applied magnetic field perpendicular to the current. (II) The production of a magnetic field across an electrical conductor, transverse to an electric current in the conductor and to the applied voltage perpendicular to the current. (III) The production of a current across an electrical conductor, transverse to voltage in the conductor and to an applied magnetic field perpendicular to the current. (IV) The production of a potential difference across an electrical conductor when a magnetic field is applied in a direction perpendicular to that of the flow of current.. (a) Both I and III correct (b) All the four Incorrect (c) Both II and III correct **(d) Both I and IV correct**

45. The Hall coefficient of sample (A) of a semiconductor is measured at room temperature. The hall coefficient of (A) at room temperature is $4x10^{-4}$ m^3 $coulomb^{-1}$ .The carrier concentration in sample A at room temperature is

A. ~ 10^{21} m^{-3}

B. ~ 10^{20} m^{-3}

C. ~ 10^{22} m^{-3}

D. ~ 10^{23} m^{-3}

46. Applications of Hall effect

(I) The probes are often used as magnetometers, i.e. to measure magnetic fields, or inspect materials (such as tubing or pipelines) using the principles of magnetic flux leakage. These devices produce a very low signal level and thus require amplification.

(II) This converts mechanical energy into electrical energy, which is why it's useful during a power outage. This is when a current flows through a coil on a stovetop, which produces a magnetic field.

(III) These sensors are used to time the speed of wheels and shafts. These are used to detect the position of permanent magnet in brushless electric DC motors. The sensors are embedded in digital electronic devices along with linear transducers.

(IV) This can be used to solve complex electrostatic problems involving unique symmetries like cylindrical, spherical or planar symmetry. This can be used to simplify evaluation of electric field.

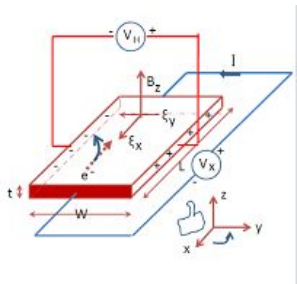
(A) Both III and IV are correct

(B) Both I and III are correct

(C) All the four correct

(D) Both II and III are correct

47. The given diagram represents …… effect



(a) Hall effect

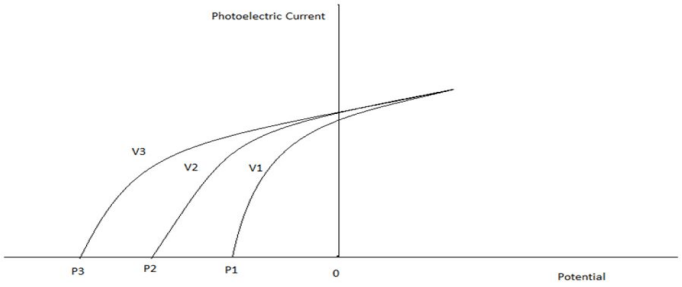
	(b) Thermoelectric effect (c) Faradays effect (d) Photoelectric effect
48. 49.	Hot probe method (I) This method is routinely used in analytical chemistry for the quantitative determination of different analytes, such as transition metal ions, highly conjugated organic compounds, and biological macromolecules. (II) This method of determining quickly whether a semiconductor sample is n (negative) type or p (positive) type. A voltmeter or ammeter is attached to the sample, and a heat source, such as a soldering iron, is placed on one of the leads. (III) This technique is commonly used to measure the resistivity and the Hall coefficient of a sample (IV) The conventional characterization method enables only the definition of a semiconductor type, P or N, by identifying the majority of the charged carriers **(A) Both II and IV correct** (B) Both III and IV correct (C) Both I and IV correct (D) All the four correct Vander paw method. (I) This Method is a technique not commonly used to measure the resistivity and the Hall coefficient of a sample. (II) The doping type i.e. whether it is a P-type or N-type material (III) The sheet carrier density of the majority carrier cannot be determined. (IV) The charge density and doping level can be found (V) The mobility of the majority carrier can be found (VI) This method involves applying a current and measuring voltage using four small contacts on the circumference of a flat, arbitrarily shaped sample of uniform thickness. (VII) This method is particularly useful for measuring very small samples because geometric spacing of the contacts is unimportant.

50.	(A) All are correct (B) All are Incorrect **(C) II,IV,V,VI and VII are correct** (D) I, II, III, VI and VII are correct Two probe method (I) This converts mechanical energy into electrical energy, which is why it's useful during a power outage. This is when a current flows through a coil on a stovetop, which produces a magnetic field. (II) The production of a voltage difference across an electrical conductor, transverse to an electric current in the conductor and to an applied magnetic field perpendicular to the current. (III) This method is one of the standard and most commonly used method for the measurement of resistivity of very high resistivity samples like sheets/films of polymers. (IV) 1. Remote sensing areas. 2. Resistance thermometer. 3. Induction hardening processes. 4. Precise estimation of geometrical factors. 5. Characterization of fuel cells bipolar plates (A) Both II and IV correct **(B) Both III and IV correct** (C) Both I and IV correct (D) All the four correct
51.	The basic components of UV-Vis Spectrometer. (A) They have three basic parts: (1) a large magnet, which is responsible for the static magnetic field H0, (2) a transmitter, which provides the alternating field H1, and (3) a receiver. (B) This consists of three basic components: radiation source, monochromator, and detector.The common radiation source for the spectrometer is an inert solid heated electrically to 1000 to 1800 °C. **(C) They have five main components: the light source, monochromator, sample holder, detector, and interpreter. The standard light source consists of a deuterium arc (190–330 nm) and a tungsten filament lamp (330–800 nm), which together generates a light beam across the 190–800 nm spectral range.**

	(D) A LASER source is needed to excite the target species. A filter collects the scattered light (Stokes) and filters out the Raleigh and Anti Stokes light.
52.	What is the unit of molar absorptivity or absorptivity which is used to determine absorbance A in Beer Lambert's formula? **i) L mol^{-1} cm^{-1}** ii) L gm^{-1} cm^{-1} iii) Cm iv) No unit
53.	Transmittance is given as T = P/Po. If Po is the power incident on the sample, what does P represent? **i) Radiant power transmitted by the sample** ii) Radiant power absorbed by the sample iii) Sum of powers absorbed and scattered iv) Sum of powers transmitted and reflected
54.	Which of the following is not true about Absorption spectroscopy? i) It involves transmission ii) Scattering is kept minimum **iii) Reflection is kept maximum** iv) Intensity of radiation leaving the substance is an indication of concentration

55.	The representation of Beer Lambert's law is given as A = abc. If 'b' represents distance, 'c' represents concentration and 'A' represents absorption, what does 'a' represent? a) Intensity b) Transmittance **c) Absorptivity** d) Admittance
56.	Which of the following is not a limitation of Beer Lambert's law, which gives the relation between absorption, thickness, and concentration? a) Concentration must be lower **b) Radiation must have higher bandwidth** c) Radiation source must be monochromatic d) Does not consider factors other than thickness and concentration that affect absorbance
57.	In which of the following ways, absorption is related to transmittance? a) Absorption is the logarithm of transmittance b) Absorption is the reciprocal of transmittance **c) Absorption is the negative logarithm of transmittance** d) Absorption is a multiple of transmittance
58.	Beer Lambert's law gives the relation between which of the following? a) Reflected radiation and concentration b) Scattered radiation and concentration **c) Energy absorption and concentration**

	d) Energy absorption and reflected radiation
59.	In photo emissive transducers, electrons are attracted by …… a) Cathode **b) Anode** c) Grid d) Body
60.	During Einstein's Photoelectric Experiment, what changes are observed when the frequency of the incident radiation is increased? a) The value of saturation current increases b) No effect **c) The value of stopping potential increases** d) The value of stopping potential decreases
61.	What is the time lag between the incidence of photons and the ejection of photoelectrons? a) Greater than 10^{-5} s b) Between 10^{-5} s and 10^{-9} s **c) Less than 10^{-9} s** d) 1 second
62.	How does the intensity affect the photoelectric current? **a) As intensity increases, the photoelectric effect increases** b) As the intensity increases, the photoelectric effect decreases c) As the intensity decreases, the photoelectric effect becomes twice d) No effect

63.	Identify the correct order of frequencies.  a) $v_1 > v_2 > v_3$ b) $v_2 > v_3 > v_1$ **c) $v_3 > v_2 > v_1$** d) $v_1 > v_3 > v_2$
64.	The work function of lithium is 2.5 eV. The maximum wavelength of light that can cause the photoelectric effect in lithium is …….. a) 3980 Å **b) 4980 Å** c) 5980 Å d) 6980 Å
65.	Light of wavelength 3500 Å is incident on two metals A and B. Which metal will yield more photoelectrons if their work functions are 5 eV and 2 eV respectively? a) A **b) B** c) A & B d) C
66.	The Kinetic energy of a photoelectron emitted on shining a light of wavelength 6.2 X 10^{-6} m on a metal surface of work function 0.1 eV is …….. a) 0.01 eV

	b) 0.02 eV **c) 0.1 eV** d) 1 eV
