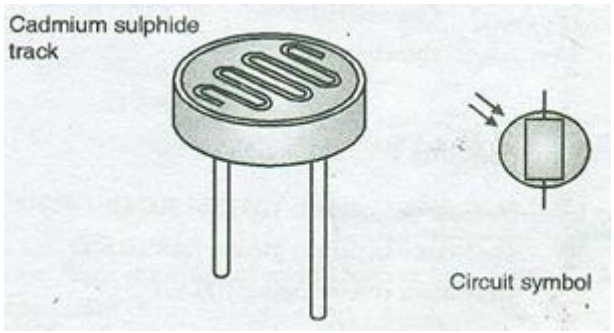
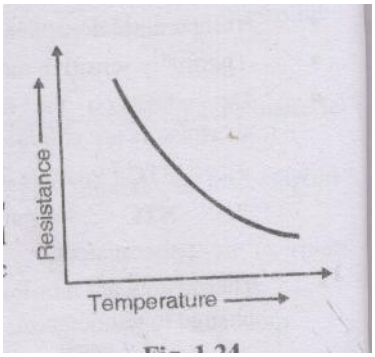
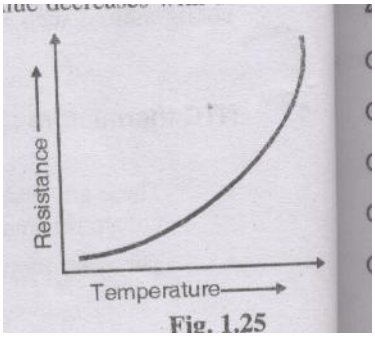
MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC – 27001 – 2005 Certified)

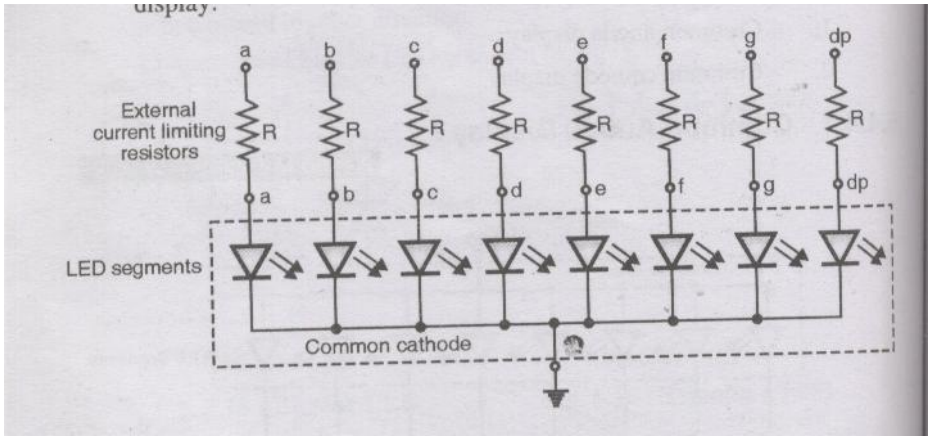
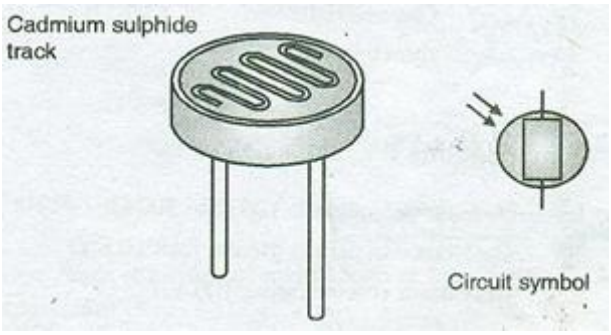
WINTER – 12 EXAMINATION
Model Answer

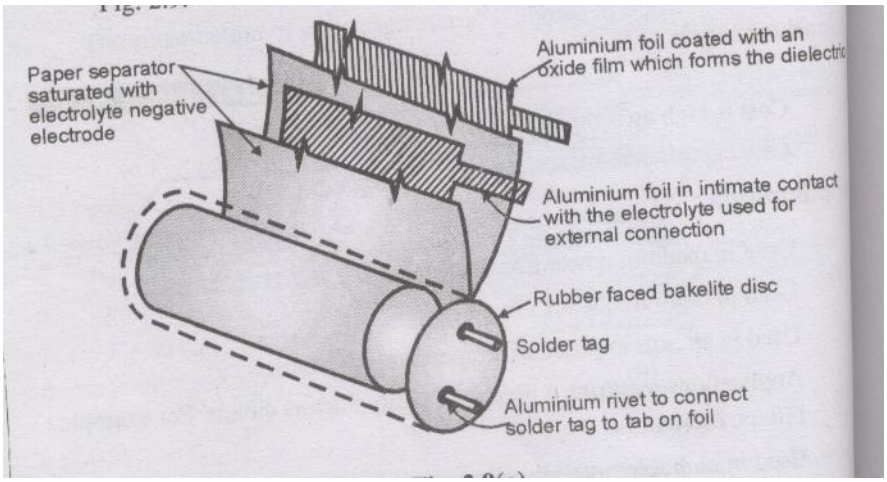
Subject Code: 12031

Q1 .	Attempt any TEN	20 Marks
Ans : a	iv) Electrolytic Capacitor.	2
Ans : b	Q factor or Quality factor of an inductor is defined as the ability to store energy as compared to the dissipation of energy within the inductor. It is also known as figure of merit. It is given as $Q = X_L / R_O$ Where X_L is inductive reactance and R_O is dc resistance of the coil.	2
Ans : c	The frequency range of BNC connector is 0 GHz to 4 GHz. The characteristic impedance of BNC connector is 50 ohm for frequencies up to 4 GHz and 75 ohm impedance for upto 2 GHz.	2
Ans : d	(Any four) Electrical properties of laminates used for PCB's are as follows : 1) Dielectric Strength 2) Dielectric Constant 3) Dissipation factor 4) Insulation Resistance. 5) Surface resistivity 6) Copper to base laminate bond characteristics. 7) Thickness 8) Flexual Strength 9) Water absorption.	2
Ans : e	SMD resistor is a surface mount resistor which are of two types thick film & thin film.	2
Ans : f	Specifications of resistor (any two) 1) Maximum voltage rating. 2) Power rating. 3) Temperature co-efficient of resistance 4) Tolerance 5) Operating temperature 6) Ohmic Range	2
Ans : g	Magnetic permeability is defined as the capability of a specific material to allow the flow of magnetic flux. Thus higher permeability enables a material to pass more magnetic flux. Or Permeability is the product of µo & µr where µo is permeability of free space and µr is materials relative permeability $\mu = \mu o \times \mu r$ Reluctivity is defined as the measure of the resistance of the material to the establishment of a magnetic field within it. **Or** (contd.pg.2)	2

	It is equal to the ratio of the intensity of the magnetic field to the magnetic induction of the material give as Reluctivity = $\frac{H}{B} = \frac{1}{\mu} = \frac{1}{\mu o \times \mu r}$ μr – relative permeability μo – permeability of free space	
Ans : h	The colour code of the following resistors is given as i) 100 , $\pm$ 10% is Brown, Black, Brown, Silver. ii) 47K, $\pm$ 5% Yellow, Violet, Orange, Gold.	2
Ans : i	Constructional Diagram of light dependent resistor.  The different parts of LDR are : 1) Light sensitive part of LDR is wavy track of Cadmium Sulphide 2) Electrodes 3) Leads are connected and placed in plastic case with synthetic resin.	2
Ans : j	Electrical life of a switch is defined as the operating period of a switch for which it can withstand its various ratings without any error. Mechanical life of a switch is defined as the operating period of a switch for which mechanical components will operate without any error.	2
Ans : k	Advantages of IC (any two) 1) The weight of an IC is less as compared to that of discrete circuits. 2) They have high reliability, reduced power consumption due to small size. 3) In practice interconnection errors are non-existent. 4) They may increase the speed of operation. 5) Temperature differences between components of a circuit are small. 6) They have reduced circuit cost, improved functional performance. 7) These are suitable for small signal operation because components are located very close to each other. 8) IC replacement is very easy in case of failure. 9) Active devices can be generously used as they are cheaper than passive components. 10) IC is more reliable due to absence of solder joints. 11) To obtain better functional characteristics more complex integrated circuits may be used.	2 Page2

Ans : l	Types of Integrated Circuits according to number of components used are 1) Small Scale Integration (SSI) 2) Medium Scale Integration (MSI) 3) Large Scale Integration (LSI) 4) Very Large Scale Integration (VLSI)	2
Ans : m	Types of displays are (any four) 1) Seven segment displays. a) Common anode display b) Common cathode display 2) Sixteen Segment Display 3) 14 Segment Display 4) DOT Matrix Display 5) Liquid Crystal Display (LCD)	2
Ans : n	Applications of reed relay (any two) 1) Used for logic control system. 2) Used for isolating input and output equipment interface. 3) Used in telephone exchanges.	2
Q2	**Attempt any FOUR of the following**	**16**
Ans:a	➢ NTC resistor have negative temperature co-efficient of resistance where resistance of the resistive material decrease with increase in temperature. ➢ NTC have inversely proportional relationship between resistance and temperature and characteristic curve is as shown in the diagram  R α l/J ➢ NTC thermistors can operate over 200^0 C to 1000^0 C. ➢ PTC resistors have positive temperature co-efficient of resistance in which resistance value decrease with decrease in temperature. ➢ PTC resistors operate over 60^0 C to 180^0 C. ➢ PTC have directly proportional relation between temperature and resistance and the characteristic curve is as shown in the diagram.  Fig. 1.25 R α J	2 2

Ans:b	Seven segment display:  ➢ Seven segment display consists of seven LED's arranged in seven segments. ➢ Every segments forms part of the digit being displayed. ➢ By forward biasing different LED's we can display the digits 0 to 9. Cathode terminal of all seven segment LED's are made common & connected to ground. ➢ Anode terminal of each LED is separate. ➢ This terminal will get positive supply depending on the resistance R.	**2** 2
Ans:c	Constructional details of LDR:  ➢ LDR is made of a high resistance semiconductor material, which is generally cadmium sulphide. ➢ Light sensitive part of LDR is a way track of cadmium sulphide . ➢ Electrodes are formed by evaporating material in vaccum. ➢ Leads are connected & then it is placed in plastic case with synthetic resin. Applications of LDR. 1. Automatic contrast & brightness control in TV. 2. Used in camera light meters, street lights. 3. Used in alarms & outdoor clocks.	**2** 2

Ans:d	Constructional details of an aluminum electrolytic capacitor:  ➢ One electrode of the capacitor, usually called anode is made from thin foil of aluminum. ➢ This is oxidized to give a thin coating of aluminum oxide which acts as the dielectric. ➢ The other electrode of capacitor is formed by an electrolyte, usually glycol borate & is called as the cathode plain foil dry electrolyte is made by forming a coating of aluminum oxide on both sides of an aluminum foil. ➢ The cathode is in contact with a second aluminum foil called the cathode plate and the connections to the outside of the capacitor are made from this plate. ➢ The anode & cathode plates are separated by a layer of a very porous paper which is impregnated with the electrolyte. ➢ The foils & paper are wound together, the ends closed with wax and then sealed into metal can. ➢ In order to increase the capacitance value attainable from a given physical size, the aluminum foil may be etched.	**2** 2
Ans:e	The various test are performed for a co-axial cable are as given below: (any four points) 1. Maximum voltage handling capacity 2. Capacitance per unit length. 3. Inductance per unit length 4. Frequency band that can handle without applicable loss. The electrical testing methods before the use of co-axial cable for RF (HF) applications are. 5. Resistivity of inner conductors. 6. Dielectric strength of core 7. Insulation resistance. 8. Spark test and Discharge (corona) cable.	**4**
Ans:f	Differences between potentiometer & trimmer (any four points)	**4**

Sr. No.	Potentiometer	Trimmer
1	Rotating shaft is used to change the resistance value	Slot is used to change the resistance value.
2	Large size	Size is small
3	Potentiometers are used for continuous variation	Trimmers are used in devices which require in frequent adjustments.
4	Potentiometers are provided on front panel of the	Trimmers are present on the circuit board instead of

	equipment.	providing on front panel	
5	Less accurate.	Light degree of accuracy	
6	Large variation is possible.	Trimmers are used only for small adjustment.	

Q3 **Attempt any FOUR of the following** **16**

Ans : a Distinguish between Self Inductance and Mutual Inductance 2

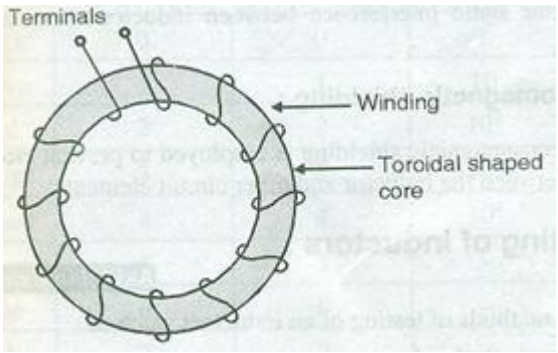
Sr. No.	Self Inductance	Mutual Inductance
1	The property of the coil to oppose any change in current flowing through it is known as self inductance.	It is defined as the property due to which the change in current through one coil produces an emf in the other coil placed nearby .
2	In this self induced emf is set-up in the coil itself.	In this, emf is set-up in the neighbouring coil.

They are related as, 2

$$K = \frac{M}{\sqrt{L_1 L_2}}$$

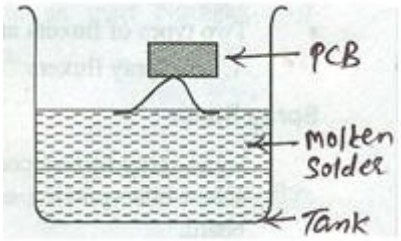
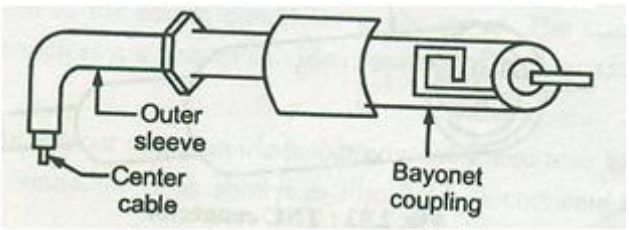
Where,
K = Coefficient of Coupling.
L1 = Self Inductance of first coil.
L2 =Self Inductance of second coil
M = Mutual inductance between two coils.

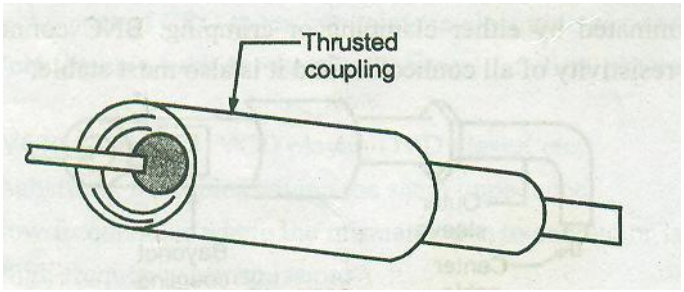
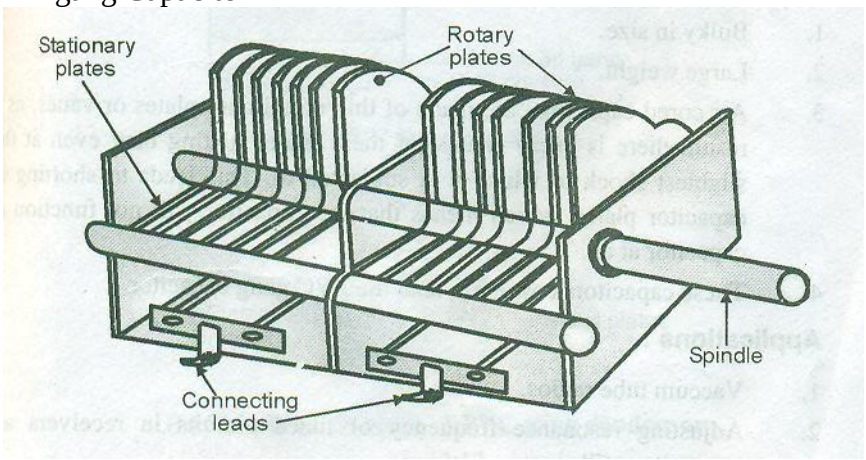
Ans : b Toroidal Inductor 2

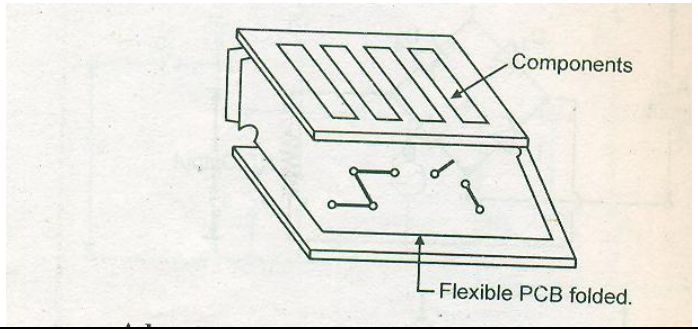


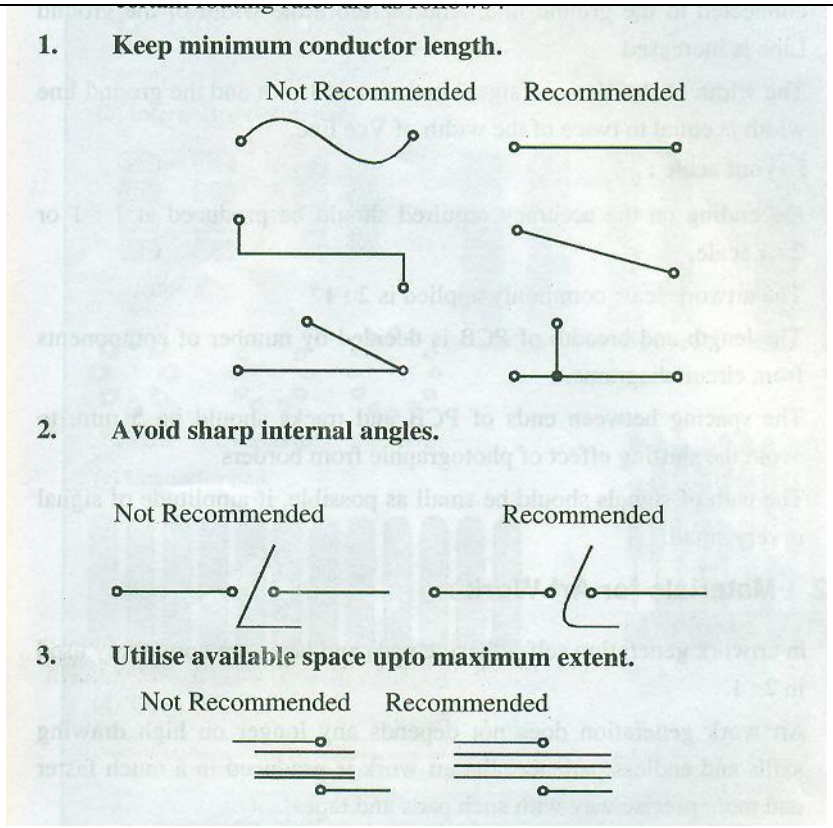
Construction : 2

- They are usually smaller in size, of lower cost and can be made from a variety of alloys.
- In this type of inductor, the core is toroid or doughnut shape.
- The advantage of this shape is that it provides a continuous magnetic path and flux is confined to the volume enclosed by winding.
- They are manufactured from following materials cobalt alloy, ferrite, metallic glass, nickel alloys.
- The result is large inductance value for its size.
- Depending on the frequency of application, the coil has few or more turns. The only difficulty is in winding of this coil.
- The main advantage of this coil is that it has less stray magnetic field.

Ans : c	Differences between Switch and Relay (any Four) **Sr. No.** / **Switch** / **Relay** 1 / It is a device which is used to make and break the circuit. / It is an electrically operated switch used to control electric power. 2 / It can control low power. / It can control large power. 3 / It is a manually operated switch. / It is a electrically operated remote control switch. 4 / Switches work with low currents. / Relays work with high currents. 5 / Switches are mounted on the front panel of the instrument. / Relays are mounted in the electronic circuit.	4
Ans : d	Wave Soldering  ➢ Wave Soldering is a large-scale soldering process by which electronic components are soldered to a PCB. ➢ It uses waves of molten solder to attach metal components to the PCB. ➢ The process uses a tank to hold a quantity of molten solder; the components are inserted into or placed on the PCB and the loaded PCB is passed across a pumped wave or wave fall of solder. ➢ The solder wets the exposed metallic areas of the board, creating a reliable mechanical and electrical connection. ➢ The process is much faster and can create a higher quality product than manual soldering of components. ➢ Wave soldering is used for both through-hole printed circuit assemblies and surface mount. ➢ Standard wave solder machine consists of three zones, i) The preheating zone ii) The fluxing zone and iii) Soldering zone. ➢ Additional fourth zone, cleaning is used depending on the type of flux applied.	2 2
Ans : e	BNC connector  	1 ½

	TNC connector  Applications of BNC Connector (any one) 1) It is extensively used in test equipments. 2) They are used in electronic measuring instruments like CRO, communication receivers, DVM, Radar, TV, etc. Applications of TNC Connector (any one) 1) It is used in test equipments at very high frequencies upto 15 GHz. 2) Camera multiplexing unit, uses TNC connectors to send power to a camera.	1 ½ ½ ½
Ans : f	Types of SMD Packages 1) Small Outline Integrated Circuits (SOIC) Package 2) Plastic Leaded-Chip Carriers (PLCC) Package 3) Quadrapack 4) Leadless Ceramic-Chip Carriers (LCCC) Package. Applications of SMDs (any two) 1) It is used in electronic tuners of colour TVs. 2) It is used in electronic pocket calculators. 3) It is used in electronic telephones. 4) It is used in radio receivers.	2 2
Q4	**Attempt any FOUR**	**16**
a	Air gang Capacitor  Air gang Capacitor ➢ It consists of two sets of metal plates separated from each other by air i.e. air acts as dielectric for this type of capacitor. ➢ One set of plate is stationary and is called as stator which is insulated round the spindle of the capacitor upon which it is mounted. ➢ The other set of plate is connected to the spindle and can be rotated called “rotor”. The rotor can be made to rotate in between stator by means of a spindle on which the rotor is fixed, so that the area of capacitor plates varies. This varies the capacitance logarithmically.	2 2

	➢ The capacitance is maximum when rotor plates are fully inwards and vice-versa. ➢ If there are "K" number of movable plates separated by an air as dielectric and being operated with single spindle it is known as "Ganged Condenser" which is popularly used in radio receivers.	
b	Flexible PCB  	4
c	Different Types of IC The integrated circuits can be broadly divided into four important classes based on : 1) Active devices used : a) Bipolar ICs b) Unipolar ICs 2) Functions performed a) Linear (or analog) ICs b) Non-linear (or digital) ICs 3) Fabrication techniques used : a) Monolithic ICs b) Thin and thick film ICs c) Hybrid ICs. 4) According to number of components : a) Small Scale integration (SSI) b) Medium Scale integration (MSI) c) Large Scale integration (LSI) d) Very Large Scale integration (VLSI) Advantages of IC (any two) 1) The weight of an IC is less. 2) They have high reliability 3) They may increase the speed of operation 4) The IC is much more reliable due to absence of solder joints. Disadvantages of IC (any two) 1) The L and C cannot be fabricated. 2) It is not possible to produce high power ICs. 3) High frequency response is limited. 4) High grade PNP unit is not possible.	2 1 1
d	General Artwork Rules (any four) i) Conductor orientation. ii) Conductor routing practice	4



iii) The width of the Vcc and Signal Path line is 1 mm and the ground line width is equal to twice of the width of Vcc line.

iv) The artwork scale commonly applied is 2:1

v) The length and breadth of PCB is decided by number of components from circuit diagrams.

vi) The spacing between ends of PCB and tracks should be 5 mm.

e Suitable Cables and Connectors for given applications

i) Input of CRO
Co-axial Cable and BNC connector — 2

ii) Telephone handset
Twisted pair cable and phone plugs and jack connector. — 2

f Difference between Analog IC and Digital IC (Any four) — 4

Sr. No.	Analog IC	Digital IC
1	They are designed to handle and process analog signals.	They are designed to handle and process digital signals.
2	Output voltage vary according to input voltage.	Output voltage is either high or low.
3	It is a linear IC	It is a non-linear IC
4	It takes any inputs and produce output of any level.	It expects high/low, true/false inputs and outputs.
5	Examples are op-amp, voltage comparator, voltage regulator, power amplifiers, voltage amplifiers, etc.	Examples are logic circuits, flip-flops, counters, ADC, DAC, RAM, ROM, etc.
6	Applications are in audio amplifiers, aircrafts Radar, TV, etc.	Applications are in microprocessors, computers, digital clocks, etc.

Q 5	**Attempt any four of the following:**	16

Ans : a — 4

Differentiate between iron core and ferrite core inductor on the basis of eddy current loss and application:

Parameter	**Iron core inductor**	**Ferrite core inductor**
Eddy current loss	Eddy current loss is present. Iron core is laminated to reduce eddy current losses	Winding is placed in annular spaces so eddy current loss is absent
Application	It is used in filter circuit and in audio frequency application	Used at high and medium frequencies .

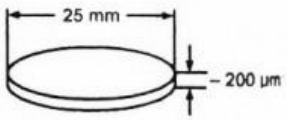
Ans : b — 4

Compare hard solder and soft solder on the following points.
Melting pt strength of joint example Application:

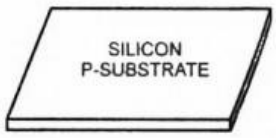
Parameter	**Hard solder**	**Soft solder**
Melting pt	high 600°c to 850°c	Low 400°c
Strength of joint	High	Low
Example	Tin-lead-Silvers	Tin -Antimony
Applications	Used for strong soldering joint	Used for moderate soldering joint

Ans : c — 4

A **monolithic IC** is one in which all circuit components and their inter-connections are formed on a single thin wafer, called the *substrate.* The basic production processes for the monolithic ICs are given below :



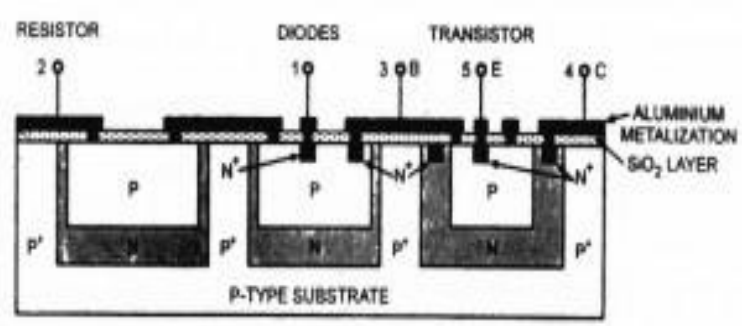
Wafer



Rectangular Wafer

P-Substrate- It is the bottom most layer that serves as the body or substrate upon which the complete IC is built. A typical P-type crystal is grown in dimensions of 250 mm length and 25 mm diameter, as shown in figure. Silicon is preferred because its characteristics are more suitable for manufacture of ICs. The crystal is then cut by a diamond saw into thin slices called *wafers.*

Epitaxial Growth - **On** the high resistivity P-type substrate a low resistivity 25 a m thick layer of N-type is epitaxially grown. For this purpose, the wafers are placed in a diffusion furnace at 1,200°

	C and a gas mixture of silicon atoms and pentavalent atoms is passed over the wafers. This forms a thin layer of N- type semiconductor on the heated surface of the substrate, *Insulation Layer* In order to prevent the contamination of the epitaxial layer, a thin layer of Si02 is formed over the entire surface, as illustrated in figure. The Si Monolayer is grown by exposing the epitaxial layer to an oxygen atmosphere to about 1,000° C. This surface layer of Si02 will prevent any impurities from enter-ing4he N-type epitaxial layer. **Photolithographic Process**-The monolithic technique requires the selective removal of the silicon-dioxide (SiO2) to form openings through which impurities may be diffused, if required. The photolithographic process shown in figure. is used for this purpose. **Isolation Diffusion**- The wafer is now subjected to isolation diffusion at a suitably high temperature and for appropriate time period allowing P-type impurity (boron in this case) to penetrate into the N-type epitaxial layer through the openings in Si02 layer and ultimately reach the P-type substrate. **Aluminium Metalization** For making electrical connection between various components of the IC, several windows are opened on a newly created Si02 layer. Now a thin layer of aluminium is deposited on the entire top surface.  *Aluminium Metalization*	
Ans : d	➢ The shielding is provided to avoid interference of noise with original signal. ➢ At high frequencies, if the cables are not shielded, it will lead to large noise interference and will cause loss of information. ➢ In a balanced audio circuit, the shield serves as a grounded centre conductor and prevents undesirable radiations from either leaving or entering the conductor. ➢ It is used to connect microphones, tape recorders, remote lines to control room equipment, radio receivers, television, etc. ➢ Hence the cables should be shielded when used at high frequencies.	4

<table>
<tr><td>Ans : e</td><td>Compare LED and LCD.(ANY 4 PTS).

<table><tr><td>Parameter</td><td>LED</td><td>LCD</td></tr><tr><td>1.power required:-</td><td>High power (10 to 250 mw) per digit</td><td>Low power (10 to 200μw) per digit</td></tr><tr><td>2.Operating frequency</td><td>Operates at very high frequency</td><td>operates at low frequency.</td></tr><tr><td>3. Response time</td><td>50 to 5000 msecs.
Fast</td><td>50 to 200 msecs
Slow</td></tr><tr><td>4. Colour</td><td>It emits red, orange, green and yellow colour</td><td>It does not emit light but reflects light.the colour depends on the illumination</td></tr></table></td><td>4</td></tr>
<tr><td>Ans : f</td><td>Surface mount technique is a method for constructing electronic circuit in which the components which are surface mount components are mounted directly onto the surface of printed circuit board. As in SMT ,holes are not used for leads. Its components are smaller than through hole components. Since it has smaller leads or no leads.SMT is generally implanted for reduction in size and weight of the board.
Applications of SMDs
➢ SMD are used in CTV tuners.
➢ Used in radio and disc drives.
➢ Used in VLSI design.
➢ Used in pocket calculators</td><td>2

2</td></tr>
<tr><td>Q6</td><td>Attempt ANY FOUR of the following:</td><td>16</td></tr>
<tr><td>Ans : a</td><td>Defects in soldering are:- Any four points

1. NON–WETTING:-It is also called as partial wetting and occurs due to incomplete coverage of the surface by the solder film.

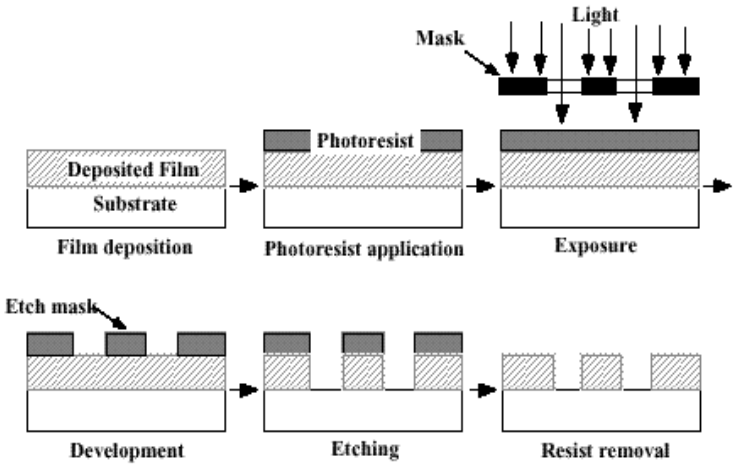
2. DEWETTING:-It has the appearance of water on the greasy surface. It occurs due to contaminated base metal surface because of embedded abrasive particles.

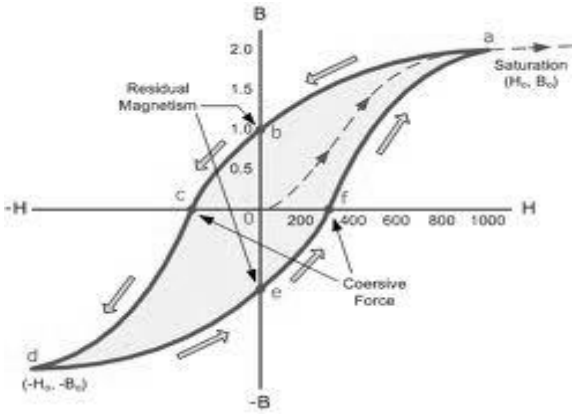
Or

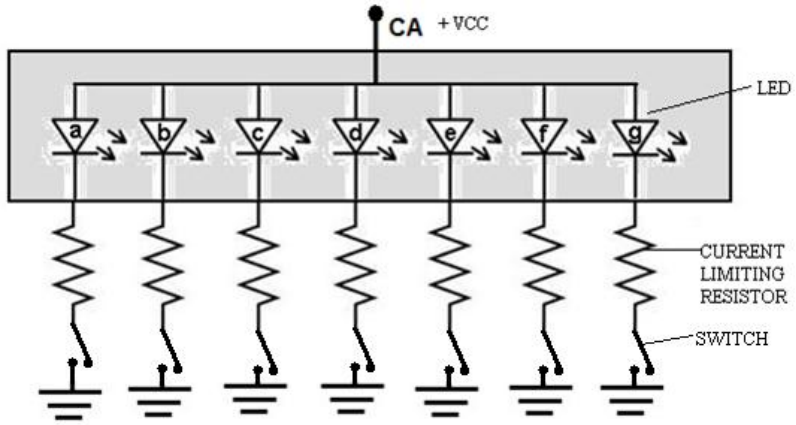
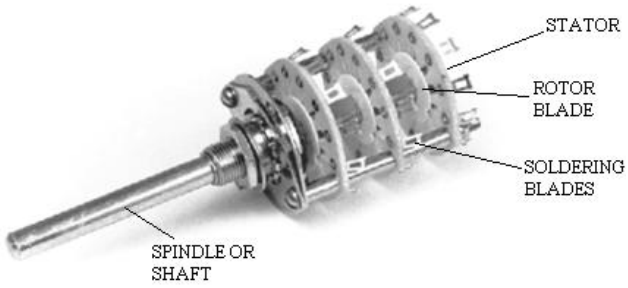
It occurs if solder gets adheres and retracts immediately then the defect occurs
3. Poorly filled joints: - It occurs due to insufficient solder in the joint and occurs due to improper fluxing or soldering conditions.
4. Bridging: - it occurs when a pair of adjacent copper tracks gets shorted or short circuited by solder layer.
5. Overheated joints- it is generally formed during, manual soldering process.
6. Excess solder: - It takes place only during Manual soldering Process.</td><td>4</td></tr>
<tr><td>Ans : b</td><td>Photolithography technique:

➢ Isolation is nothing but removal of Sio2 layer from the surface of N-type layer and diffusion is nothing but addition of impurities.</td><td>4

Page 13</td></tr>
</table>

	This process will take place according to the number of components are to be fabricated on Si slice or wafer. ➢ Here isolation is nothing but the removal of Sio2 by means of photolithography which is similar to etching.  ➢ In this process, the wafer is fully coated with a uniform film of photosensitive emulsion. ➢ On this mask black and white layout is placed and reduced photographically. ➢ This reduction takes place only when UV rays are passed through mask. ➢ Because of diffusion of UV rays, photoresist becomes polymerized under the transparent regions. ➢ Then mask is taken out and photoresist which was under the black portion of mask is dissolved in the solution of trichlorethy and then surface pattern will be as shown in diag. ➢ Now, removal of Sio_2 is done by using hydrofluoric acid. Here the portions of Sio_2 which are protected by resist material will remains as it is. ➢ At last , resist emulsion is removed by chemical solvent like H_2SO_4 . ➢ Here the Photolithography will get done.	
Ans : c	B-H curve is shown in fig.The **Magnetic Hysteresis** loop above, shows the behavior of a ferromagnetic core graphically as the relationship between B and H is non-linear. Starting with an unmagnetised core both B and H will be at zero, point 0 on the magnetisation curve. ➢ If the magnetisation current, i is increased in a positive direction to some value the magnetic field strength H increases linearly with i and the flux density B will also increase as shown by the curve from point 0 to point a as it heads towards saturation. Now if the magnetising current in the coil is reduced to zero the magnetic field around the core reduces to zero but the magnetic flux does not reach zero due to the residual magnetism present within the core and this is shown on the curve from point a to point b. ➢ To reduce the flux density at point b to zero we need to reverse the current flowing through the coil. The magnetising force which must be applied to null the residual flux density is called a "Coercive Force". This coercive force reverses the magnetic field re-arranging the molecular magnets until the core becomes u ➢ nmagnetised at point c. An increase in the reverse current causes the core to be magnetised in the opposite direction and increasing	2

	this magnetisation current will cause the core to reach saturation but in the opposite direction, point d on the cure which is symmetrical to point b. If the magnetising current is reduced again to zero the residual magnetism present in the core will be equal to the previous value but in reverse at point e.  ➢ Again reversing the magnetising current flowing through the coil this time into a positive direction will cause the magnetic flux to reach zero, point f on the curve and as before increasing the magnetisation current further in a positive direction will cause the core to reach saturation at point a. ➢ Then the B-Hcurve follows the path of a-b-c-d-e-f-a as the magnetising current flowing through the coil alternates between a positive and negative value such as the cycle of an AC voltage. This path is called a Magnetic Hysteresis Loop.	2
Ans : d	The different types of losses in magnetic materials are: 1. Hysteresis loss 2. Eddy current loss and 3. Iron loss or core loss ➢ Hysteresis loss may be reduced by reducing the frequency of magnetization, reducing the volume of the material and reducing the area of hysteresis loop. ➢ Eddy current may be reduced by introducing insulated, thin, iron sheets called as lamination instead of solid iron. Eddy current may also be reduced by using materials of high resistivity such as silicon steel. ➢ Core loss or iron loss may be reduced by following ways:- ➢ Use magnetic materials having narrow hysteresis loop and low hysteresis coefficient. ➢ Use laminated cores to reduce the eddy current loss. ➢ Reduce the working flux density B.	4
e	Seven segment displays consist of seven LEDs arranged in seven segments. In rectangular fashion and are labeled a thro'9. ➢ Every segment forms a part of the digit being displayed. ➢ By forward biasing different LEDs we can display the digits 0 to 9. ➢ Anode terminal of all seven segments LEDs are connected together and positive supply is to them. ➢ Current limiting resistors are connected in series with each LED. ➢ Cathode terminal is separate for each LED and depending on the	4

	number to be display, respective LEDs will get ground connection.  	
Ans : f	 ➢ A **rotary** switch is a switch operated by rotation. These are often chosen when more than 2 positions are needed. ➢ A rotary switch consists of a spindle or "rotor" that has a contact arm or "spoke" which projects from its surface like a cam. It has an array of terminals, arranged in a circle around the rotor, each of which serves as a contact for the "spoke" through which any one of a number of different electrical circuits can be connected to the rotor. The switch is layered to allow the use of multiple poles; each layer is equivalent to one pole. Usually such a switch has a detent mechanism so it "clicks" from one active position to another rather than stalls in an intermediate position. Thus a rotary switch provides greater pole and throw capabilities than simpler switches do. ➢ Rotary switches were used as channel selectors on television receivers.	2 2
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