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Internal Assessment Test 2 – May 2025									
Sub:	**CONSUMER ELECTRONICS**					Sub Code:	**BEC654B**	Branch:	[CSE, ISE, AIML, AIDS, CSE-AIML]
Date:	27-05-2025	Duration:	90 minutes	Max Marks:	50	Sem/Sec:	6th [CSE, ISE, AIML, AIDS, CSE-AIML]		OBE

	ANSWER ANY 5 FULL QUESTIONS	MARKS	CO	RBT
1	**Explain Digital Television (DTV) and High Definition Television (HDTV) with suitable block diagram.**	10	CO3	L2
2	**a) How can the number of pixels on a TV screen be determined? Find this number for 53cm TV size and 3m viewing distance.** **b) A colour TV has a screen of 53 cm size. Take standard value of aspect ratio. Find height and width of TV.**	7 + 3	CO3	L3
3	**Explain a Digital Watch in detail with suitable diagrams.**	10	CO4	L3
4	**Explain an Electronic Calculator in detail with block diagram of its architecture and sample of operations.**	10	CO4	L3
5	**Explain Cellular Telephone and architecture of GSM with suitable diagrams.**	10	CO5	L3
6	**Explain Microwave Oven in detail with suitable diagrams.**	10	CO5	L3
7	**Explain with suitable diagrams the Electronic Ignition System for Automobiles.**	10	CO5	L3

Course Instructor **Chief Course Instructor** **HOD**

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Q1) Solution :

Black and white television services were started in UK in 1936 and in USA in 1939.
In early fifties standards for colour TV were set.
The National Television system committee (NTSC), then phase-alternation by line (PAL) and finally sequential colour avec memoire (secam) systems came into being and colour TV transmission and reception started.
All these are analog systems.
Now, the era of digital television (also called high definition television) has started and it is possible that analog TV becomes obsolete in about 10 years time.

The initial signal (video and audio) and the final reception are both analog.
To transmit an analog signal in digital form, the analog signal has to be digitized by a device called encoder.
This process is called sampling.
In sampling, a snapshot of the input analog waveform is taken thousands of times each second.
The samples are high frequency samples for the quantizing process.
At the receiver the digital signal is converted back to analog using a decoder.
The present day TV sets can receive digital TV signals by adding a set top box.

Analog problems include dropout noise and ghosting.
The vestigial side band (VSB) transmission being used now-a-days tries to eliminate some of these problems.
Digital TV also uses VSB.
But digital VSB signal is an RF modulated digital signal.
Modulating an RF carrier by a digital signal does not degrade the signal as it does with analog modulation.
In digital TV, there is difference between brightness and colour components.
Luminance is filtered from the chroma components.
Each is sampled and digitized separately.

The digital imaging standard includes combination of picture information comprised of six profiles and four levels.
Each profile consists of specific data packets defined in the standard as B, P and I frames.
Large amount of information is compressed into data packets by removing redundant information.
The B, P, I frames are the bidirectional predictive picture, predictive coded picture and intra coded pictures respectively.
In digital TV, the video signal consists of about two million pixels (picture elements) which is about 6 times that in the currently popular analog systems.
Progressive Scanning provides a temporal resolution of 60 full frames per second (which is twice the resolution of analog systems).
The motion seen will be smooth enough for sports fans and computer graphic experts.
The picture will be presented in a panoramic horizontal to vertical aspect ratio of 16:9 as in the movies which is a big improvement on the 4:3 aspect ratio of present day televisions.

Fig. 14.26 shows a simple block diagram of digital television (HDTV).
A television system must interface the different source input formats including films, magnetic and optical media etc.
The different video source formats are covered using multiple transmission (scanning) formats.
The video and audio signals are compressed by respective encoders.
The output of encoders is a string of binary digits (i.e., 1s and 0s) representing video and audio signal.
A multiplexer combines video, audio and other data.

All this information is fed to modulator for transmission over a VHF/UHF channel by transmitter.
At the receiver end, the signal is demodulated and turned back into a string of binary digits.
These binary digits are demultiplexed into video, audio and other data.
Decoders convert these bits into analog video, audio and other d ata and feed to the receiver.
Applications and uses of DTV/HDTV include live and recorded sound, sports, movies, news, comedies, business promotion, cataloging (on HD tape), security systems (through CCTV) etc.

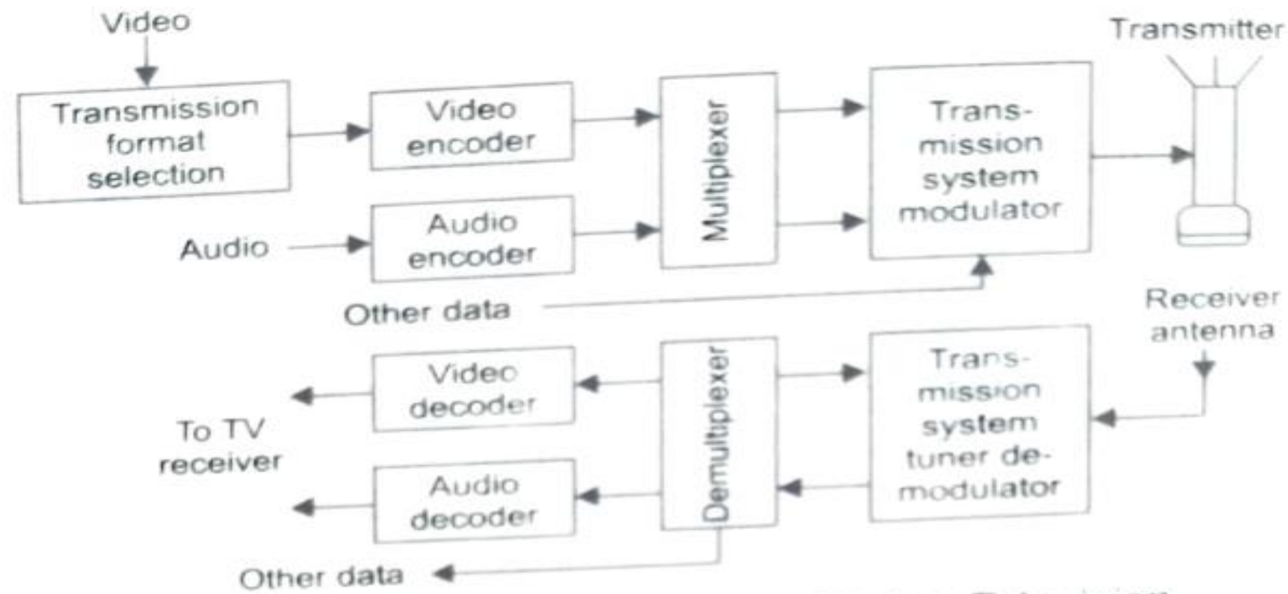

Fig. 14.26: *Block diagram of Digital Television*

Throughout the world, governments have started thinking of converting analog television system to digital television system.
In many countries the process has already started and complete switch over is expected in the next 10 years or so.
USA was the first country to initiate the process in 1998.
Federal Communication Commission (USA) loaned each TV broad caster a second channel in the 54 to 806 MHz.
Interspersed among the broadcast channels are some spectrum gaps which minimize interference between them.
The digital channels with their low interference characteristics can be packed into less bandwidth ie. 54 to 698 MHz.
This releases 108 MHz (i.e., 806-698) of spectrum.
Thus the number of channels can be increased.
This released bandwidth can also be used to send video and audio programmes to cell phones.
This bandwidth or a part of it can also be used to public safety communication plans.

Government and manufacturers will be the biggest gainers of this change-over.
The government stands to get huge money (upto a billion) by auctioning this bandwidth.
The manufacturers will offer new equipments, new services and new technology.
The consumers will have new and better services, better audio and video reception.
The additional services will include some within the traditional broadcast channels and some more in the released 108 MHz bandwidth.

Q2) a) Solution :

Example 14.6 How can the number of pixels on a TV screen be determined? Find this number for 53 cm TV size and 3 m viewing distance.

Solution. Number of pixels is determined from the consideration as regards ability of eye to distinguish between two objects. Human eye can distinguish between two object if they subtend a minimum angle of 1 minute (i.e. 1/60°) at eye. This angle, in turn, depends on distance between objects and distance between eye and object as seen in Fig. 14.27.

P and Q are the objects. *X* is distance between objects and *Y* is distance of eye from object. $\angle\theta$ should be at least 1/60°.

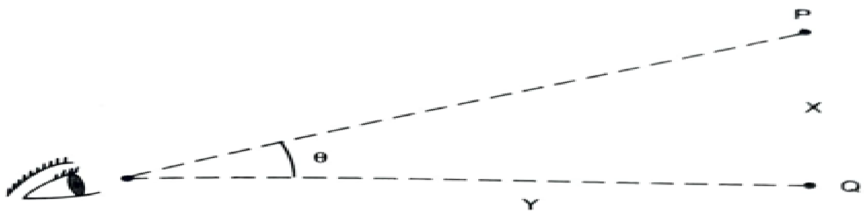

Fig. 14.27.

Since *Q* is very small, tan θ = θ radians

Therefore $\theta = \frac{1°}{60} = \frac{1}{60} \times \frac{\pi}{180}$ radians

or $\frac{X}{Y} = \frac{\pi}{60 \times 180}$

Y is the viewing distance and is 3 m in this case.

Distance between pixels $= x = \frac{3\pi}{60 \times 180} = 0.8727 \times 10^{-3}$ m

$= 0.08727$ cm

For 53 cm TV, height = 31.8 cm and width is 42.4 cm as found in example 14.5

Number of pixels in width $= \frac{42.4}{0.08727} \simeq 486$

Number of pixels in height $= \frac{31.8}{0.08727} \simeq 364$

Total number of pixels = 486 × 364 = 176904

Q2) b) Solution :

Total number of pixels = $486 \times 364 = 176904$

Example 14.7 Find the vertical and horizontal resolution for TV system in India. Assume $K = 0.7$ and that 20 lines are lost per field.

Solution. Total number of lines = 625

$$\text{Lines lost} = 2 \times 20 = 40$$

$$\text{Vertical Resolution} = (625 - 40)(0.7) = 409.5$$

$$\text{Horizontal resolution} = (409.5)\left(\frac{4}{3}\right) = 546$$

Example 14.8 Fi...

Q3) Solution :

A digital watch displays time (hour and minute).
It consists of a quartz crystal oscillator, Iogic circuit, digit driver, segment driver and display.
Fig. 17.1 shows a block diagram.
It is powered by a special cell whose life is about one year.
Many digital watches have additional facilities of: stop watch, alarm, date etc.

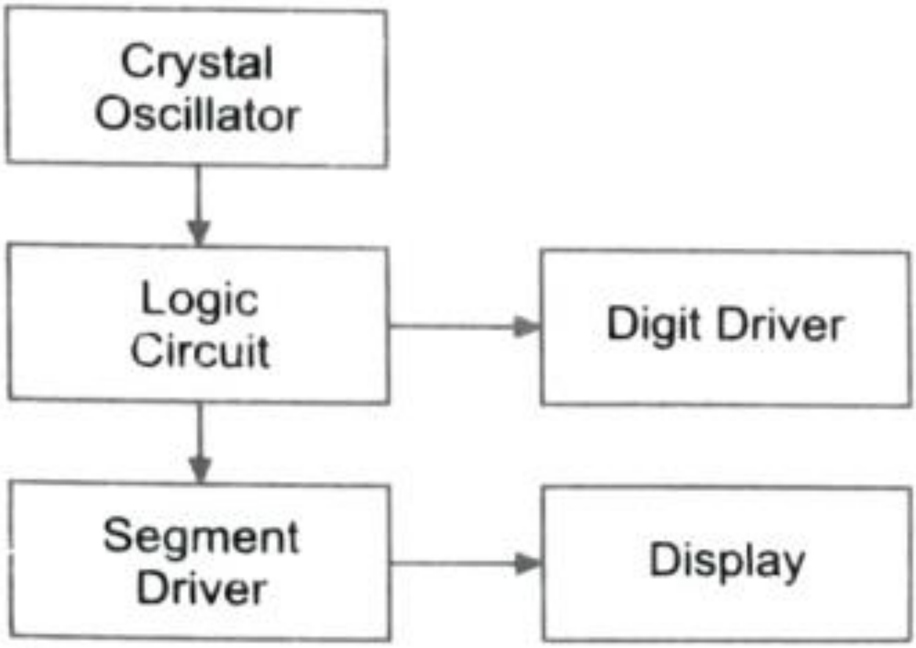

Fig. 17.1: *Block Diagram of Digital Watch*

The quartz crystal oscillator generates a high frequency signal (about 32 kHz).
The signal is counted and processed by electronic components.
The processed signal is decoded to generate the drive signals in the form of digits.
Fig. 17.2 (a) shows an arrangement of 7 light emitting diodes to display the decimal numbers 0 to 9.
In a light emitting diode (LED) an electric current causes the injection of minority carriers into regions of crystal where they can recombine with majority carriers resulting in emission of light.

In Fig. 17.2 (a) each LED is called a segment because it is a part of the number to be displayed.
Fig. 17.2 (b) is the schematic diagram.
The function of series resistors is to limit the current through LED.
By earthing one or more terminals (a to g) we can display any digit from 0 to 9 e.g. earthing be a, b, c, d and g, LEDs in these paths will be turned on and digit 3 will displayed.
If all terminals are earthed, digit 8 is displayed.
Liquid Crystal Display (LCD) is also used.
An LCD does not radiate any illumination.
It only reflects or transmits incident illumination.
Watches and clocks for indoors use LED whereas those for outdoors use either LED or LCD.
The working of a digital clock is exactly similar except that it displays time in hours, minutes and seconds.
It does not have any special facility like alarm etc.

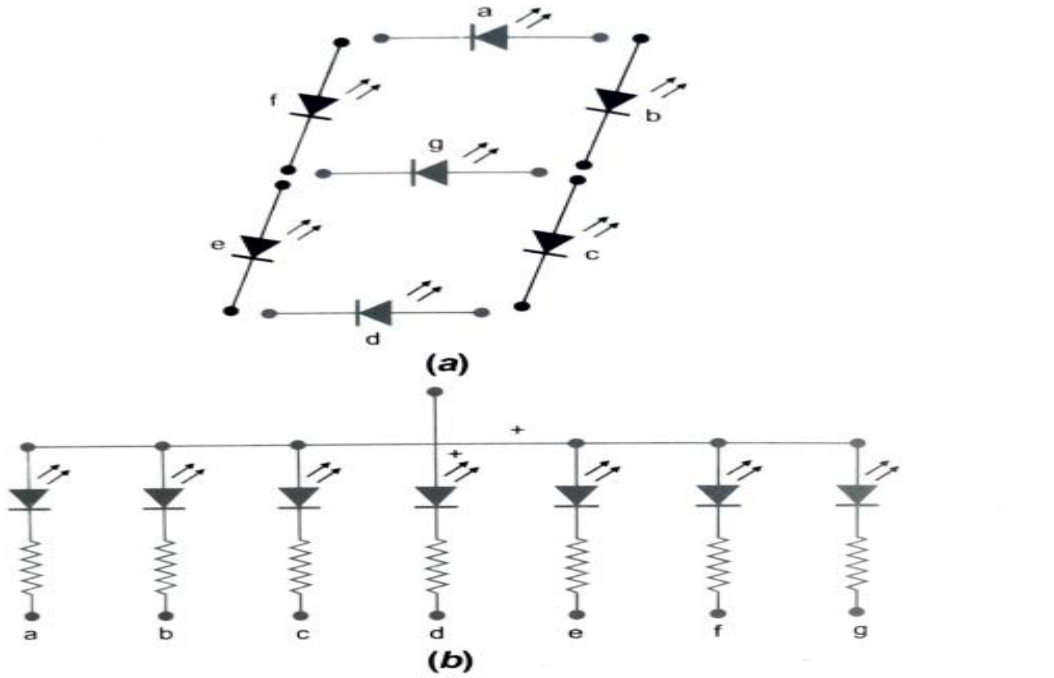

Fig. 17.2: *Seven Segment Display (a) Indicator (b) Schematic Diagram*

The digital circuit of a watch consists of electronic counters and decoder/driver.
A counter counts events or periods of time.
A counter also divides the frequency by any desired number.
The number by which a counter divides the input frequency is called modulus (or Mod.) of the counter.
A Mod. 10 counter (also called decade counter) divides the input frequency by 10 while a Mod. 6 counter divides the input frequency by 6.

Fig. 17.3. shows the block diagram of counter used as frequency divider in a digital clock.
The dc input (from cell) is first converted into ac.
This 1 Hz ac is directly suitable for counting seconds.
It is divided by two cascaded counters (one Mod. 10 and another Mod. 6 so as to give an overall Mod. 60 Counter) for counting minutes.
The output at this stage is suitable for counting minutes.
For counting hour this frequency is further divided by 60 (using cascaded Mod-10 and Mod-6 counters).

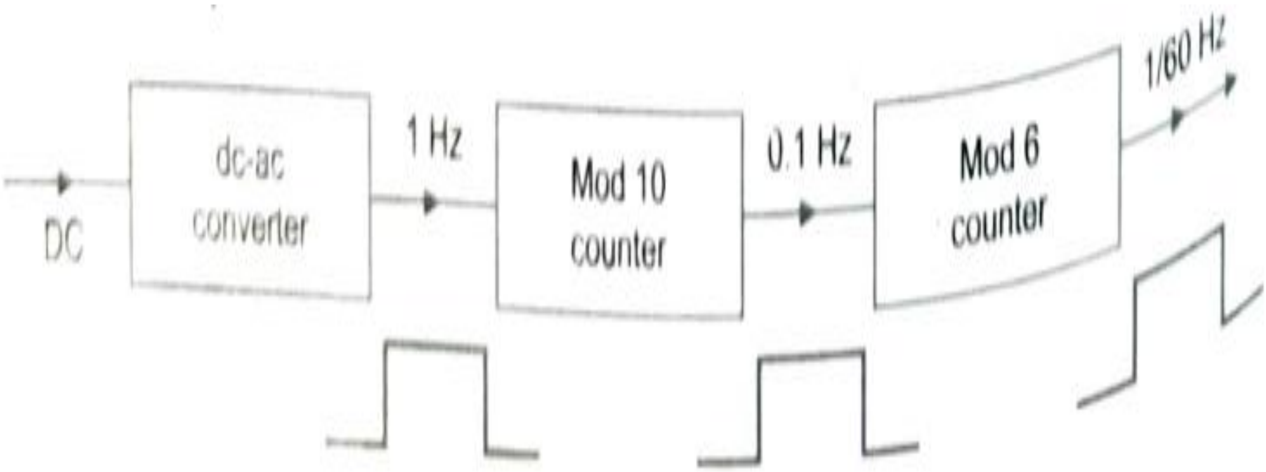

Fig. 17.3: *Divide by 60 counter*

Fig. 17.4. shows a detailed block diagram.
The dc input is first converted to 1 Hz ac which is the desired frequency for counting seconds.
This 1 pulse/second frequency goes to count accumulator for counting seconds.
The count accumulator is also a counter.
A 0-59 Counter is a mod-10 (i.e. decade counter) cascaded with a mod-6 counter.
The mod-10 counter drives the 1s place of the seconds display and mod-6 counter drives the 10s place of the seconds display.
The decoder/driver converts binary output of count accumulator into decimal digits and drives the second segment display.

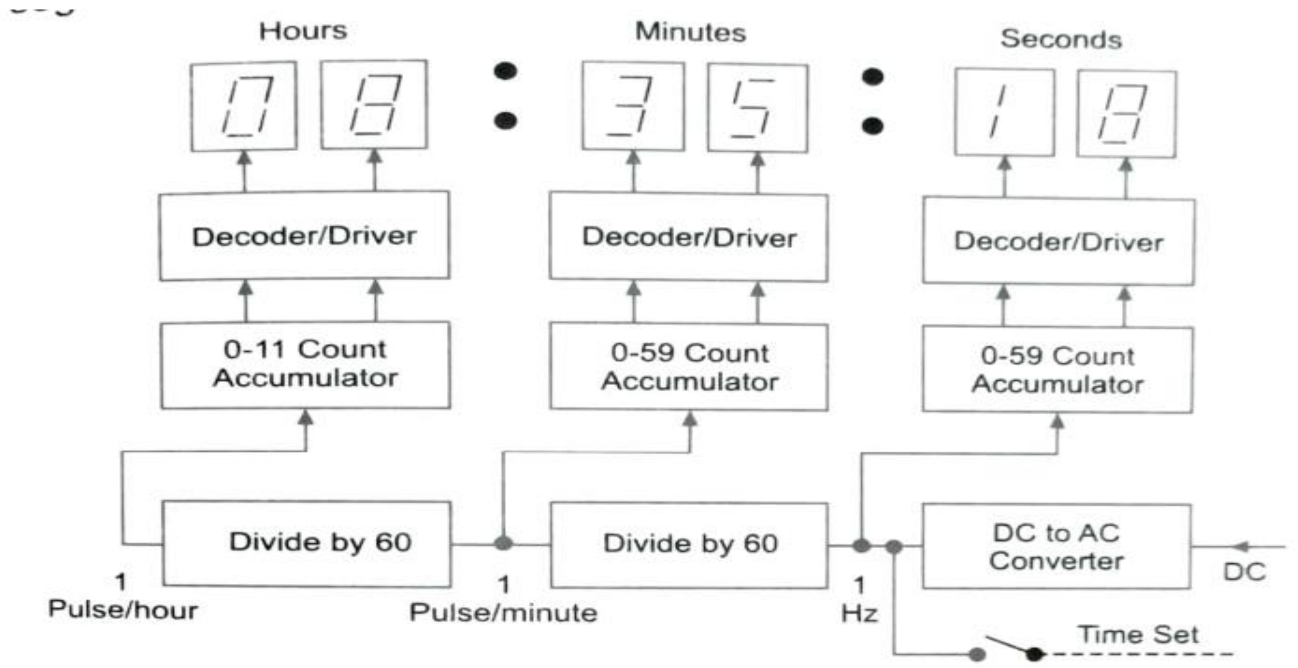

Fig. 17.4: *Block Diagram of Digital Watch/Clock*

For counting the minutes the 1 Hz pulse is divided by 60 (using cascaded mod-10 and mod-6 counters).
The 1 Hz/minute pulse goes to count accumulator for minutes.
This count accumulator for minutes along with decoder/driver and display is exactly similar to that of seconds counter and display except that the input is 1 pulse/minute pulse.

For counting hours, the above frequency of 1 pulse/minute is further divided by 60 (using mod-10 and mod-6 counters in cascade).
The 1 pulse/hour wave goes to count accumulator for hours.
The hours count accumulator is a decade counter cascaded with a Mod 2 Counter.
The decade counter drives the 1s place in the hours display and the Mod 2 counter drives the 10s place in the hours display.
A time setting feature is always an essential aspect of digital clocks and watches.
Large scale integrated chips with all the above equipment i.e. frequency divider, count accumulators and decoders built in a single chip are used.
Many special features like calendar (day and date)., alarm etc. are also available in many chips.

Q4) Solution :

An electronic calculator is a very cheap and convenient device for making calculations.
A general purpose pocket calculator has the following functions: Arithmetic functions(+, -, x, /), percentage %, reciprocal, square and square root.
It has a memory unit with corresponding push buttons : M+ (Add to memory), M- (subtract from memory), RM (recall memory) and CM (clear memory).
Scientific calculators for use by scientists and engineers have, in addition to above, the following functions also: Trigonometric (sin, cos, tan, sin-1, cos-1, tan-1), exponential, logarithmic and antilogarithmic (both natural and base10), polar to rectangular coordinate conversion, degrees to radians etc.
Some scientific calculators have hyperbolic and inverse hyperbolic functions also.
Calculators used in shops and commercial establishments have display printer, sub total/grand total facilities.
Fig. 17.5 shows a simple block diagram of an electronic calculator.

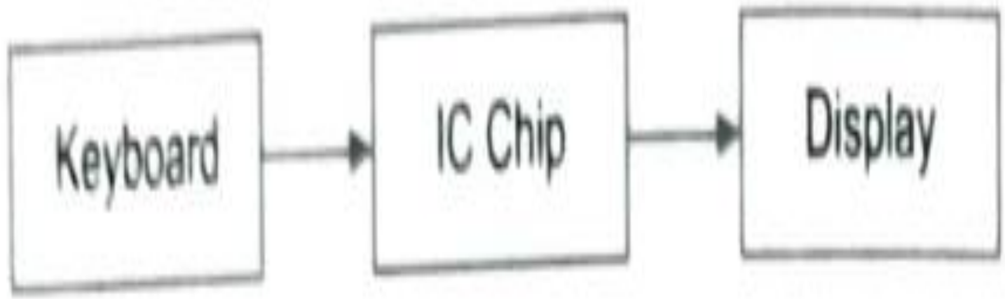

Fig. 17.5: Block Diagram of Electronic Calculator

The keyboard is the input device.
On the case are a number of press buttons for various digits and functions.
When a button is pressed, a corresponding signal is sent to the processing unit i.e. IC chip.
Processing unit consists of an integrated circuit chip.
The chip depends on the type of calculator (general purpose, scientific etc.).
It is the heart of the calculator.
All operations are performed by this unit.
The result of calculations is displayed on the display.
Most calculators use LED (light emitting diodes) for this purpose.
LCD is also used.
Calculators are powered by pencil cells.
Calculators with solar cells are also available.
Programmable calculators allow simple computer programs to be stored in its memory so that the program may be used when necessary.

Fig. 17.6 shows a block diagram illustrating the architecture of a calculator.
It has a keyboard (for input), display (for output) and an IC.
The IC has several subsystems whose functions are as under.

Clock : It sends constant frequency pulses to all the parts for synchronization of all operations. The clock frequency may range from 25 kHz to 500 kHz. When the calculator is turned on, the clock runs continuously and various circuits idle till a command comes from the key board.
Encoder : We work with decimal numbers. However, all computers and calculators use binary numbers in their operations. Encoder converts the decimal number into binary (or binary coded decimal i.e. BCD) numbers.
Decoder/Driver : The binary result is converted to decimal by the decoder. The driver drives the display unit.
Adder/Subtractor : The arithmetic operations are performed in this section.
Instruction Register : It contains the instructions necessary for bigger numbers with decimal points. The controller follows the directions in the instruction register.

ROM : Read only memory. The steps to be followed in the calculations are programmed into ROM. The memory size of ROM in a calculator is some thousands of bits.
Display register : It stores the latest numeral etc. which we input into the calculator.
Operand register : It stores the last but one numeral which we had put in the calculator.
Accumulator Register : The results of the arithmetic operation are stored in this register.
X Register (extra register) : It holds the sign of the arithmetic operation (e.g. +) in binary form.
Control Circuit : It controls all the operations in the calculator.

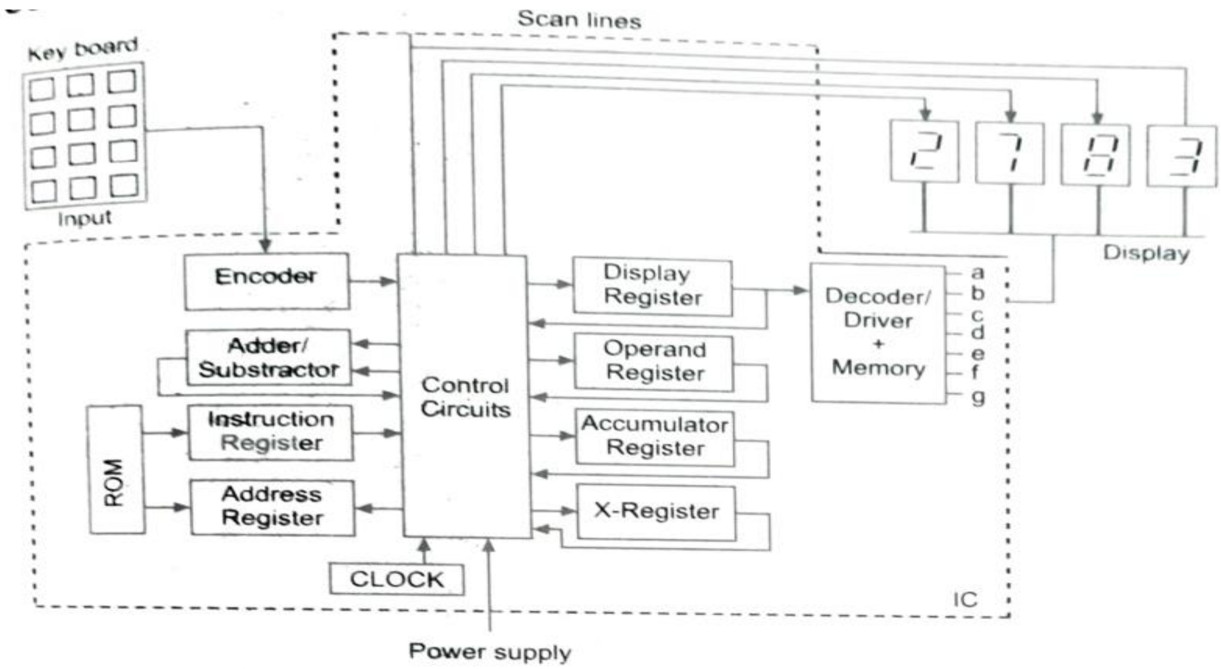

Fig. 17.6: *Architecture of Calculator*

To understand the working of calculator, let us see the process it follows in the operation 3 + 4.
Initially we press 3 on the key board.
The encoder converts decimal number 3 to BCD 0011.
The control circuit directs this number 0011 to the display register and it is stored in the display register.
The display register feeds this number to decoder/driver.
The lines a, b, c, d, g are activated and the number 3 is displayed (for decimal number 3 the lines a, b, c, d, g are activated as seen in the seven segment display in Fig. 17.2. (a).
Next we press + on the key board.
This sign is encoded and stored in X register in code form.

Next we press 4 on keyboard.
The encoder converts this decimal number 4 into BCD 0100 and transfers it to the display register.
The decoder converts it back to decimal.
Lines f, g, b, c are activated and this number is displayed.
In the mean time the controller has moved the previous number 3 (i.e. BCD 0011) to the operand register.
Next we press = key.
The control circuit checks the X register to see what to do.
This X register contains add (+) sign.

The control circuit applies the contents of display register (i.e. 0100) and operand register (i.e. 0011) to the adder which does the addition.
The results of addition are stored in accumulator register.
The control circuit directs this result to the display register.
The decoder converts the result (i.e. 0111) to decimal 7.
Lines a, b, c of the seven segment display are activated and the result 7 is displayed.
When the operation is complex (e.g. exponential, logarithm, trigonometric operation etc.) the control circuit may have to follow hundreds of steps as programmed into the ROM.
However, each operation takes less than a μ second so that even these hundreds of steps are completed in less than a second.

Q5) Solution :

Cellular telephone is one of the fastest growing and demanding telecommunication applications.
The growth in the number of users of cellular telephones has been phenomenal in all parts of the world.
It has been estimated that in 2012 the number of cell phone users in the world is about 6 billion.
In many countries, the number of cell phones is more than the population of that country (because many users own more than one cell phone).
In India, the number of cell phones in 2012 has been estimated as 1000 million.

Cellular telephone began in USA in 1983 and the service was named advanced mobile phone service.
This standard was soon adopted in almost all countries.
Initially cellular telephones were analog.
The digital cellular technology was introduced in 1991.
GSM (global system for mobiles) was also introduced in 1991.

Cellular telephone service (also known as advanced mobile phone service or AMPS) splits the total area covered by an ordinary mobile service into a number of small cells.
Each cell is equipped with a transmitter, receiver and other equipment.
Each cell can transmit and receive calls from the mobile system.
The transmitter and receiver in each cell operate on a given channel.
It is possible to use the same channel in two cells situated away from each other.
Thus, the same channel is used for more than one simultaneous conversation.
Fig. 17.11 shows the splitting of an area into cells.
Fig. 17.12 shows a possible distribution of channels in two areas.

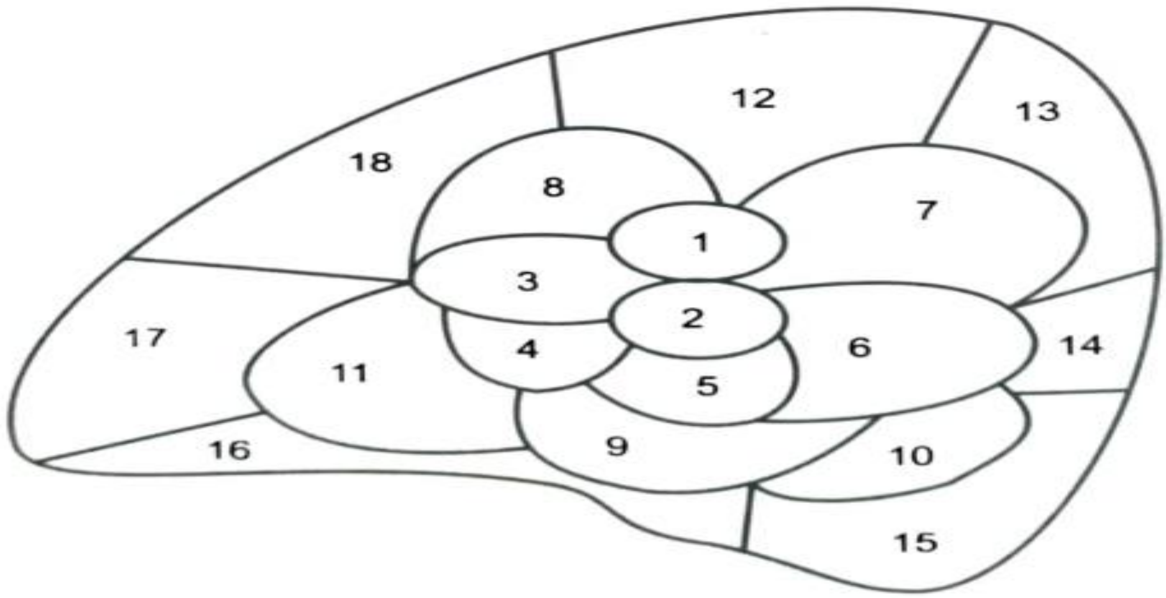

Fig. 17.11: *Splitting an Area into 18 cells*

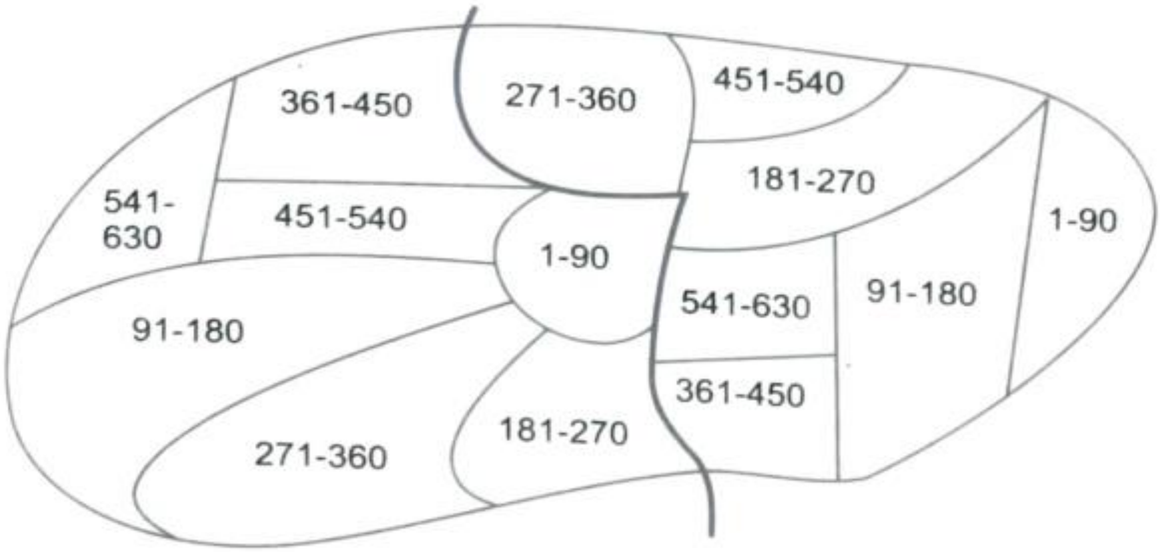

Fig. 17.12: *Channel Allocation to Cells in Two Areas*

Each cell is usually designed to handle 45 two-way conversations.
Thus each cell needs 90 frequencies (for duplex operation).
Cells located adjacent to each other in areas 1 and 2 use different frequencies to avoid interference.
However, cells far away in area 1 and 2 can use the same frequencies.
Thus, cellular telephones use the concept of cell splitting and frequency reuse.
This is shown in Fig. 17.11 and 17.12.

A central mobile telecommunication system interconnects and controls the operations in each cell.
It connects the cells to the telephone system of the area and also contains additional digital equipment programmed for effective coordination and control.
Cellular telephones have been assigned 666 channels (826 to 845 MHz and 870 to 890 range).
Each channel has a width of 30 kHz and duplex operation requires two channels.

Cellular telephones do not have a dial tone.
Availability of a channel is indicated by visual display on the set.
When cellular telephone is switched on, a request for service is automatically made to the cell site.
The cell site interprets the incoming call and sends digital signal to MTSO (mobile telecommunication switching office) which connects the caller to the destination.
The receipt of a call is opposite of the above process.
The central office acknowledges the caller and connects to the proper MTSO.
An available channel is seized and a voice link is established between the two parties.
The strength of cellular signals is monitored by MTSO every second.

A Cellular telephone can be used every where.
All users keep the cellular handset in their pockets for handy use.
The handset of a cellular telephone should be very rugged and strong because it is likely to be dropped to the ground etc.
Each mobile unit has a 10 digit number similar to any other telephone number.
GSM specification define the functions and interface requirements in detail.
Some of these are as under :
Frequency band 1850 -1990 MHz (mobile station to base station)
Duplex distance : It is the difference between uplink and down link frequencies. In GSM, it is 80 MHz.
Channel Separation i.e the separation between adjacent carrier frequencies. In GSM, it is 200KHz.
Transmission rate : In GSM, the bitrate is 270 kb/sec.

Access Method - Time division multiple access (TDMA) : In this technique, several different calls share the same carrier.
Each call is allotted a particular time slot.
Speech Coder : GSM uses linear predictive coding (LPC).
The purpose of LPC is to reduce the bit rate.
The signal passes through a filter leaving behind a residual signal.
Speech is encoded at 13 kb/sec.
Fig.17.13 shows architecture of GSM.

It consists of mobile station, base station subsystem and network subsystem.

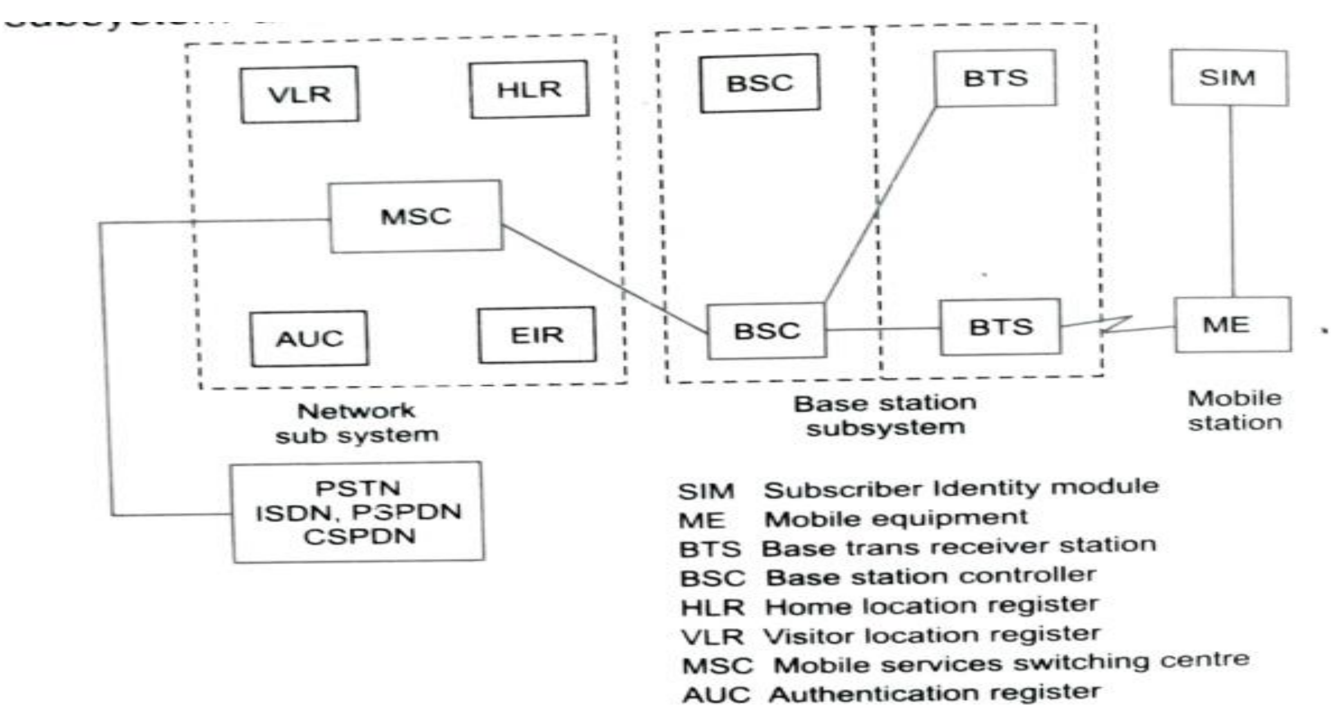

Fig 17.13: *Architecture of GSM*

Mobile station: It consists of mobile equipment (called cell) and SIM (subscriber identity module).
SIM is a smart card and provides personal mobility so that the user can have access to subscribed services irrespective of the cell he is using.
By inserting SIM in the cell, the user can make/receive calls and avail other services.
SIM card can be protected against unauthorised use by a password or PIN (personal identity number).

Base station Subsystem: It consists of base transreceiver station (BTS) and base station controller (BSC).
They communicate across standard interface so that the equipments (cell) by different manufacturers can be used.
BTS houses radio receivers that define a cell and handles radio link protocols within the mobile station.
A large urban area may have many BTS.
The base station controller (BSC) manages the radio resources for one or more BTS.
It handles radio channel setup.
It is a connection between mobile station and mobile service switching centre (MSC).

Network Sub System : The central Component in Network sub system is mobile service switching centre (MSC).
It acts like a node of PSTN or ISDN and in addition provides services like registration, authentication, location updating, cell routing and roaming capabilities of GSM.
Information about each subscriber along with current location of mobile is contained in HLR.
VLR contains selected information from HLR.
HLR and VLR are used for authentication and security purposes.
EIR (equipment identity register) contains list of all valid mobile equipment in the network.
Each cell is identified by international mobile equipment identity (IMEI).
The authentication centre (AUC) register is a protected data base which stores a copy of the secret key stored in each subscriber's SIM card.

Another protocol used in mobile communication is CDMA (Code division multiple access).
In CDMA, the audio input is digitized (using Analog to digital converter) and the frequency of transmitted signal is varied according to a defined pattern.
CDMA channel is 1.23 MHz wide.
CDMA allows several users to share a band of frequencies using spread spectrum technology.
Multiple users can be multiplexed over the same physical channel.
Spread spectrum technology spreads bandwidth of data uniformly for the same power.
Each user uses a different code to modulate the signal.
CDMA is categorised into two categories - synchronous and asynchronous.
In USA only GSM is used.
In India both GSM and CDMA are used.
Some companies use GSM while others use CDMA.

Q6) Solution :

Heating through microwaves has the following advantages over conventional electrical heating systems.
1. Penetration of heat into the material is much more than in conventional systems. This results in quicker heating.
2. System is very clean.
3. System can be combined with a conventional heating process (e.g. microwave pre-heating combined with conventional heating).
Microwave oven is a very suitable device for heating, baking and cooking.
It was invented by Dr. Percy spencer during world war II (1930-1945).
He got the idea from Radars used during this war.
The microwave tube magnetron was used in Radars in this war and Dr. Spencer used this magnetron for microwave cooking.
The first microwave oven appeared in market in 1947.
Since then, the design has been improved many times.
Now-a-days microwave ovens use power electronic devices and micro-controller.

(a) Principle :
Microwave oven is based on the principle of dielectric heating.
Every dielectric behaves as an imperfect capacitor.
When a voltage is applied to a dielectric the current leads the voltage by an angle less than 90° (In a perfect capacitor the currents leads the voltage by exact 90°).
The dielectric loss is given by

$$P_d = V^2 \omega c \tan \delta$$

where

P_d = dielectric loss watts
v = applied voltage, volts
ω = angular frequency rad/sec
c = Capacitance, Farads
δ = loss angle of dielectric = $90 - \theta$

where θ is the angle by which current in imperfect capacitor is leading the voltage.

The dielectric loss is converted to heat.
In microwave oven the food item behaves as dielectric.
Since the loss depends on voltage and frequency, a high voltage and high frequency is needed.
The frequency used in microwave ovens is 2.45 GHz (wave length 122 mm).
When nonionizing microwave radiation is impressed on the food item, the water, food and other substances absorb energy through dielectric heating.
Many molecules become electric dipoles with partial positive charge at one end and partial negative charge at the other end.
As these electric dipoles tend to align with the ac field (due to applied voltage), they rotate, collide with each other and dissipate energy which is converted to heat.
Typical rating of a microwaves oven is 1100 W.
Out of this power about 700 W is used for heating.
Thus the efficiency is about 64%.
The remaining 400 W is the power loss in different parts.

Fig 17.30 shows a block diagram of microwave oven.
As seen the different components are HV transformer, diode rectifier and filter, magnetron, wave guide, cooking chamber, control circuit using micro controller, timer, motor, LED for display numeric buttons for entering cooking time etc.
The functions of different parts are as under
1. HV transformer: It converts 230 V ac supply to high voltage.

2. Rectifier and filter: The rectifier converts ac to dc. Generally diode rectifier bridge is used. The filter is a high voltage capacitor which smoothen the wave shape.
3. Cavity Magnetron: It is the source of microwaves. Its operation is based on the interaction of electromagnetic fields with electrons moving in static electric and magnetic fields oriented at 90° with respect to each other. A cavity magnetron has a number of cavities in the interaction region.

4. Wave Guide: At microwave frequencies it is more convenient to use wave guide as transmission line to carry high frequency ac from magnetron to cooking chamber. The advantages of using wave guide include lesser attenuation and higher power capacity. Generally cylindrical and rectangular wave guides are used.
5. Triac : The functions of triac is voltage control. A change in firing angle changes the output voltage.
6. Motor : The food items have to be stirred slowly to ensure even heating. A single phase low speed induction motor is used along with a stirrer.
7. Control circuits : These include microcontroller, timer (to adjust cooking time), interlock switches (for safety). The interlock switch ensures that magnetron will be switched on only when door of oven is closed.
Fig 17.31 shows another simple diagram of microwave oven.
Some new models of microwave oven use power electronic inverter (for generating high frequency) with pulse width modulation.

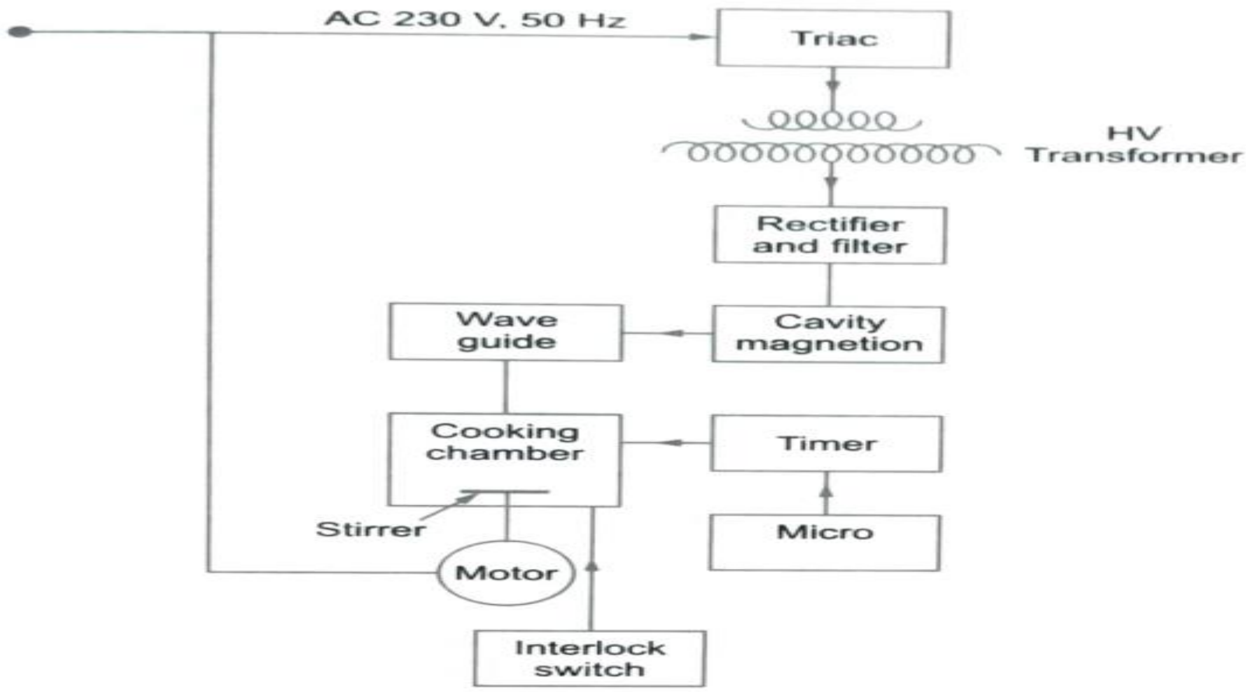

Fig. 17.30: *Block diagram of Microwave oven*

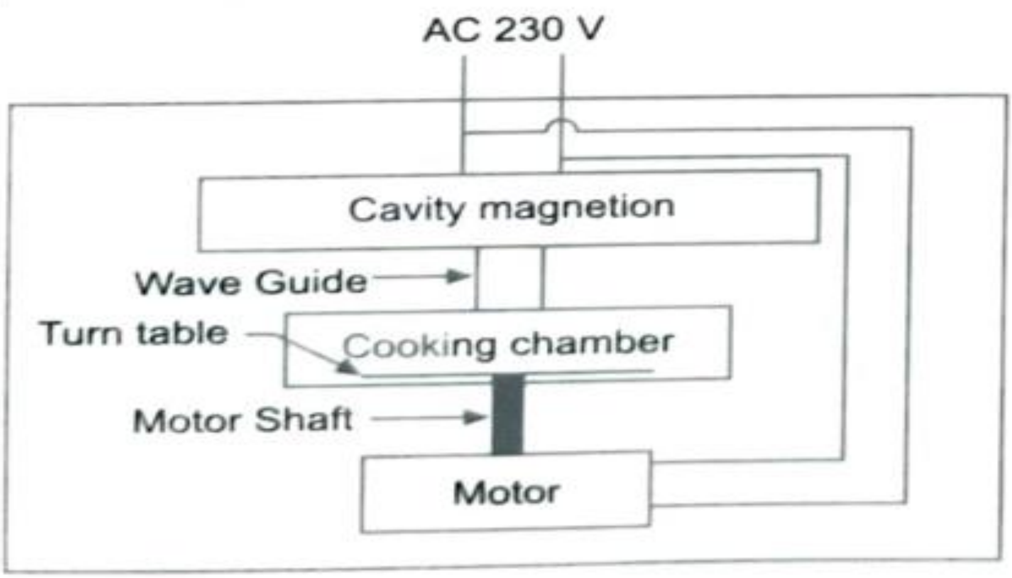

Fig. 17.31: *Microwave Oven*

(c) Uses: Microwave ovens can be used for cooking, heating and baking a variety of food items.
The cooking/heating times are as under :

Rice (Pulao. Biryani)	15–20 minutes
Mutton, Chicken	15–35 minutes
Fish	7–15 minutes
Vegetables	7–15 minutes
Dals	25–35 minutes
Sweets	15–20 minutes
Snacks and cakes	15–20 minutes

Microwave oven cannot be used to make chapattis.
Also, it cannot be used for deep frying.
The flavour, colour and taste of food is preserved better than conventional cooking.
The food material should be placed in ceramic, porcelain glass or thermoplastic container.

(d) Hazards :
lt is necessary to ensure proper use of microwave oven to avoid mishaps. Some hazards associated with microwave ovens are as under.
1. Superheating : Liquids may superheat and eject from the container. Superheating may cause fire, explosion etc.
2. Some magnetrons use ceramic insulator. This insulator contains berrilium oxide which is a chemical hazard. Broken pieces of this insulator can be toxic.
3. If the container has some metal trimmings and pointed metal pieces, arcing may occur. The cutlery items if put in container can cause dangerous arcing.
4. Direct exposure to malfunctioning microwave oven can cause burns.

Q7) Solution :

Automobiles use multi cylinder engines.
The conventional ignition system has a battery, ignition switch, ignition coil, distributor, spark plugs and contact breaker.
The battery supplies the power.
The ignition switch is used to switch on the engine.
To ignite the petrol air mixture a spark is needed.
This spark is provided by the ignition coil through contact breaker and distributor.
The ignition coil is a transformer with a large number of turns in secondary.
When the primary circuit is opened by the contact breaker, a high voltage is induced in the secondary.
The distributor supplies this high voltage to the various spark plugs turn by turn.
This high voltage creates a spark between the contacts of the spark plug.
Generally, the primary and secondary are connected in auto transformer configuration.
The secondary has about 60 times the number of turns in the primary.
The dynamo is also driven from the engine and charges the battery.

1. The ignition is not as per specifications as the speed is varied.
2. Wear at contacts, cam and erosion of contact surface, contact bounce.
3. Frequent servicing.

Previously a high voltage of about 10-15 kV was used.
Modern engines use 15-30 kV to ignite the weak petrol air mixtures needed to give good economy and proper emissions.

The system uses a mechanical contact breaker to drive a transistor which controls the current in the primary circuit.
The mechanical breaker handles only small current.
Therefore, erosion of contacts is reduced.
Accurate spark tunings can be achieved for a longer period.
Fig. 17.33 shows the circuit of ignition system with transistor assisted contacts.
The transistor performs the duty of the contact breaker of conventional system.
The transistor acts as a power switch to make and break the primary circuit.
The transistor is operated by the current supplied by cam operated contact breaker.

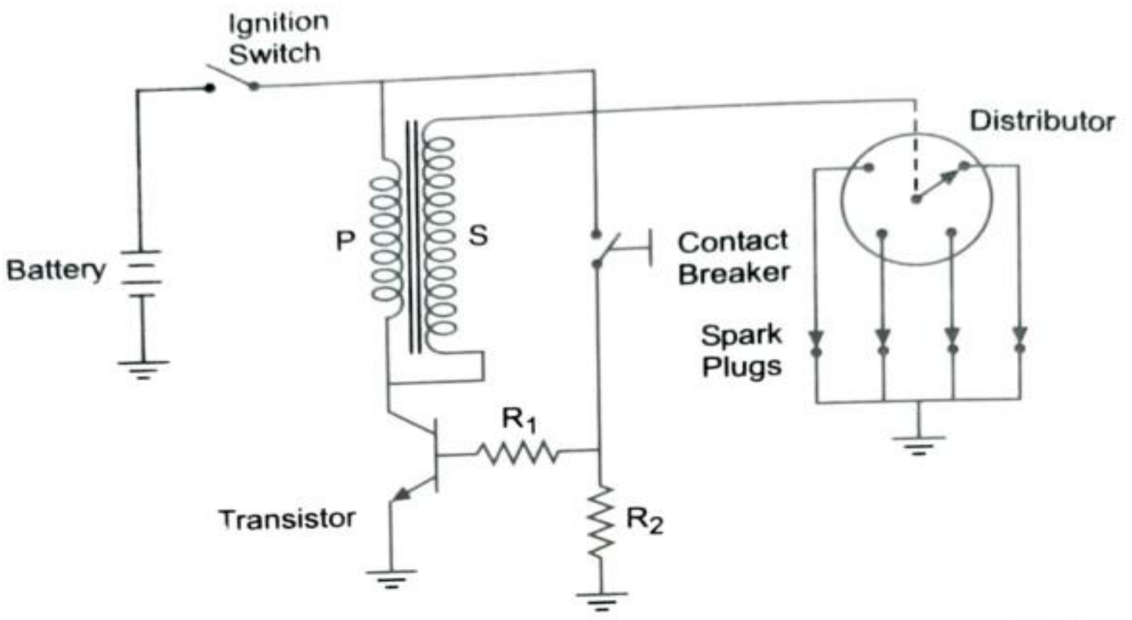

Fig. 17.33: *Transistor Assisted Contact System for Ignition*

When contact breaker is closed, a small current passes through the base emitter circuit of the transistor.
The transistor is turned on and allows current flow in the primary winding to energise the coil .
The base current is controlled by resistors R1 and R2 and is about 0.3 A.
When spark is needed, the cam opens the contact breaker and the base current is interrupted.
The transistor switches off.
The primary circuit is broken and a high voltage is induced in the secondary.
This high voltage is applied to the proper spark plug, through the distributor, and causes ignition.
The sequence is repeated to give the required number of sparks per cam revolution.
The circuit of Fig. 17.33 is only the basic circuit.

In actual practice refinements are needed to protect the transistor from overload.
These refinements require the use of additional transistor and associated circuitry.

Fig. 17.34 shows an electronic ignition system which eliminates the use of breaker completely.
The distributor ignition coil, spark plugs are the same as in conventional system.
The contact breaker is replaced by a pulse generator.
This pulse generator generates an electric pulse to signal the requirement of spark.
The control module makes and breaks the primary circuit of the ignition coil electronically.
For this purpose, it amplifies the signal received from the pulse generator.
The functions of control module are:
1. Switching duty.
2 It senses the engine speed and uses this information to vary the tuning so as to suit the engine speed.
Pulse generator may be an inductive circuit, a hall generator or an optical device.

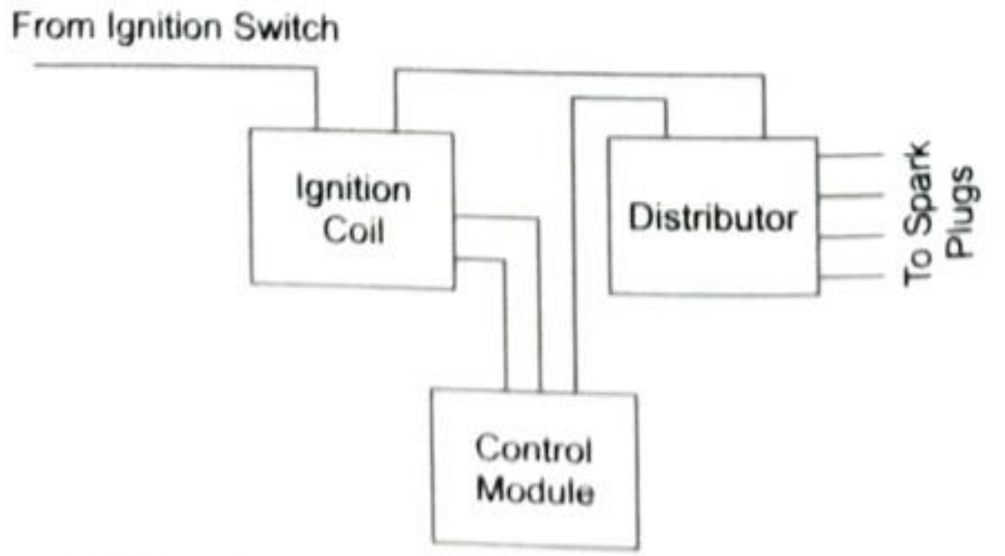

Fig. 17.34: *Breakerless Electronic Ignition System*

END