WINTER– 15 EXAMINATION

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any
equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

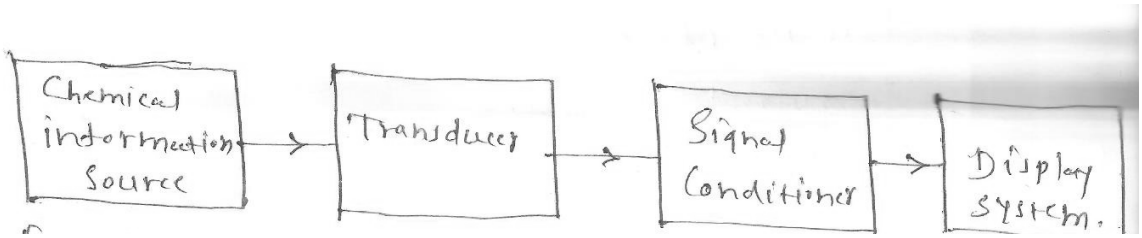
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. 1) A) Attempt any Three : **(12)**

a) Draw and explain block diagram of elements of analytical instrument. **(04)**

(Diagram = 2 marks , Explanation = 2 marks)

Ans :



characteristic module ←----------processing module--------- -----→

Fig: General Elements of an analytical instrumentation

1) Chemical information source—It generates a set of signal containing necessary information. It may be the sample itself.

2) Processing module- Transducer: It converts the signal to a one of the different nature. It is generally used to convert nonelectrical phenomenon associated with the analysis of the sample. for eg. Photodiode.

3) Signal Conditioner: It converts the o/p of transducer in to an electrical quantity suitable for operation of the display system.2)It also increases sensitivity of instrument by amplification of original signal.

4) Display System: It provide a visible presentation of quantity as a displacement of scale or chart or record.

b) List out any four safety precautions while handling centrifuge. **(04)**

(1 mark each)

Ans :

- Ensure that centrifuge bowls and tubes are dry.

- Ensure that the spindle is clean.

- Use matched sets of tubes, buckets and other equipment.

- Always use safety centrifuge cups to contain potential spills and prevent aerosols.

- Inspect tubes or containers for cracks or flaws before using them.

- Avoid overfilling tubes or other containers (e.g., in fixed angle rotors, centrifugal force may drive the solution up the side of the tube or container wall).

- Ensure that the rotor is properly seated on the drive shaft.

- Make sure that tubes or containers are properly balanced in the rotor.

- Only check O-rings on the rotor if you are properly trained.

- Apply vacuum grease in accord with the manufacturer's guidelines.

- Do not exceed the rotor's maximum run speed.

- Close the centrifuge lid during operation.

c) i) List application of blood gas analyser. (any 4)

ii) List its technical specifications (any 4) **(04)**

(Application = 2 marks , Technical Specifications = 2 marks)

Ans :

i)Application of blood gas analyser (any 4) : (1/2 mark each)

With special reference to human blood , Blood gas analyzer are used to measure :-

- pH,

- partial pressure of co_2 (pco_2) &

- oxygen (po2) of the body fluids and also measures

- Sodium ,

- Potassium ,

- Chloride , &

- Calcium.

ii) Technical specifications of blood gas analyser (any 4) : (1/2 mark each)

- Throughput : 65 samples / hour.

- Sample type : Whole blood , Serum , Plasma.

- Sample Application : Sample cup ,Capillary or Collection tube.

- Storage capacity : 1000 samples.

- Power : 110 ~ 230 V AC , 50 / 60 Hz.

- Dimensions : 452 (H) x 452 (W) x 500 (D) mm approx.

- Equipment weight : 15 Kg.

- Operating environment : 15° to 30°C.

d) List out different parts of electron microscope and give function of any two parts. (04)

(Different parts = 2 marks , Function of any two parts = 2 marks)

Ans :

Different parts : (Any four) (½ mark each)

1) Light Source.

2) Mirror Lenses.

3) Condenser System.

4) Diaphragm.

5) Eye piece.

6) Photomiographic System.

Function of different parts of Electron Microscope : (Any 2 parts , 1 mark each)

1) Light source : Light is provided by a lamp built into the microscope beneath stage. But in electron microscope object is scanned with high speed beam of electrons (instead of visible light) obtained from an electron gun.

2) Mirror lenses : The mirror reflects rays from light source on the object.

3) Condenser system : It focuses a nearly parallel beam of electrons on to the specimen placed beneath it.

4) Diaphragm : It is within condenser. It is used to reduce or increase amount of light by reducing or increasing angle.

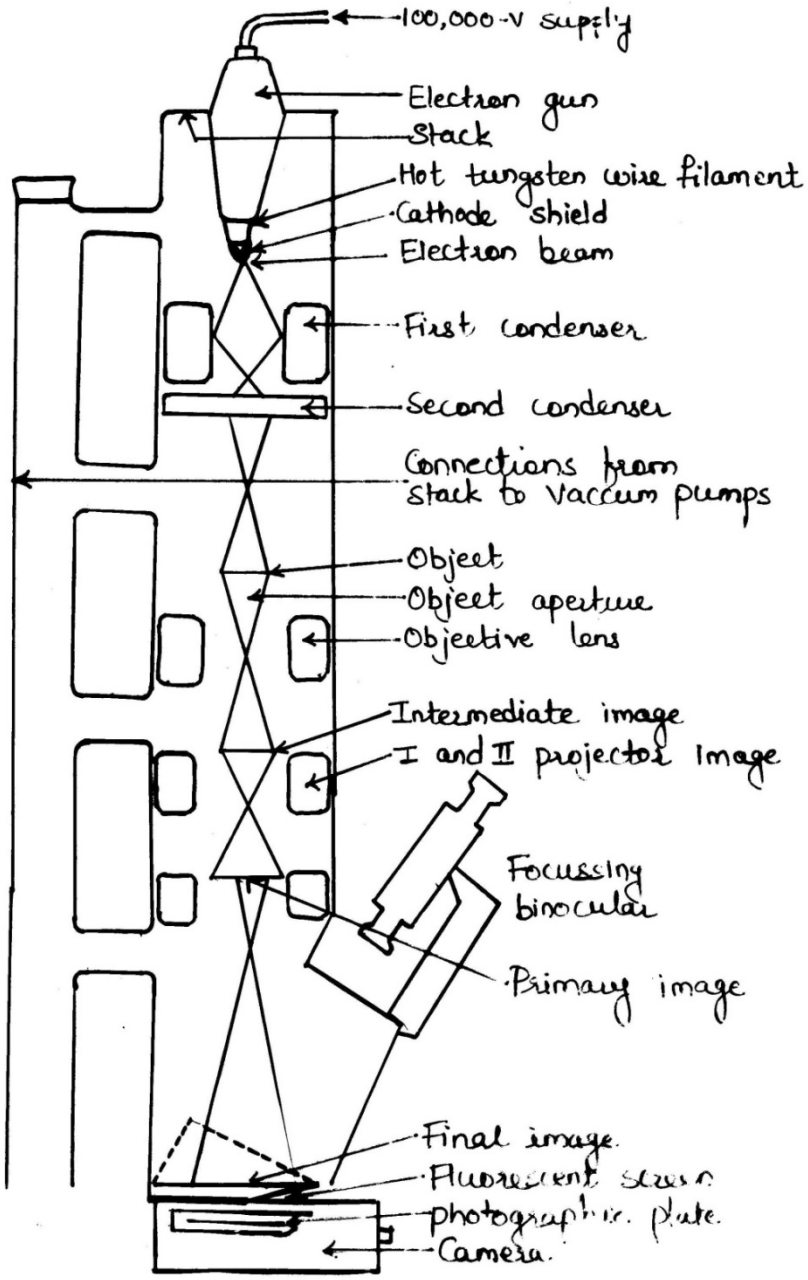
5) Eye Piece : Here the microscopist applies his eyes.

B) Attempt any one : (06)

a) With neat diagram describe working of transmission electron microscope. (06)

(Diagram = 3 marks , Description = 3 marks)

Ans :



The transmission electron microscope & its optical system are shown in above fig:

The electron microscope consists of column of stack at the top of which is mounted the source of illumination, the electron gun (as shown in fig. A) which emits electron from a not tungsten wire filament; beneath this filament cathode shield is placed. A high voltage which can be varied from 50-100Kv is applied to the anode. The life of tungsten filament is limited & it usually requires to be replaced after 15 hours of viewing.

A pencil beam of electron viewing on high velocity is projected through hole in the anode & onwards down the stack. The higher acceleration voltage used must be stabilized to insure uniform velocity of electrons. The stack is completely evacuated & vacuum is maintained. Focusing & magnification are achieved by electromagnetic lenses. There is a condenser lenses system, which bends the rays of electron so that a parallel beam is directed on to the object placed below it. the electrons are scattered to a degree i.e. proportional to the thickness & density of the various parts of the specimen an objective lens gathers the scattered electrons through a very small - & bring them to a focus were a real primary image is formed & is magnified about a 100 times two projector lenses, which have the functions the eye piece of the light microscope, magnify a part of primary image further 300 to 500 times. The focal length of the magnetic lenses can be changed by varying the current flowing through the lens & thus a continuously variable magnification is obtained.

The final image is observed on a fluorescent screen situated at the lower end of stack & is viewed through a glass window. The screen can be withdrawn by- to allow the electrons to impinge on a photographic plate or film held in a camera. As the power of a electron microscope, resolving. it is possible to take negative , at very high magnification.

The specimen to be examined is placed in special holder & then introduced into the stack between the condenser & the objective lenses through an air lock finally when a vacuum has been restore . it is lowered into position by a lever & its examination can be made.

A lox binocular microscope is used to facilitate accurate focusing before taking photographs. The controls of the electron microscope are accommodated in panels on its desk. They include dials for variation of magnification, a mechanical stage to move the specimen, swithes & meters to control & check the voltage used vacuum gauges & controls for electron optimal alignment.

b) With neat diagram describe working of incinerator. List its application. (06)

(Diagram = 2 marks , Description = 2 marks , Application = 2 marks)

Ans :

Diagram : (2 marks)

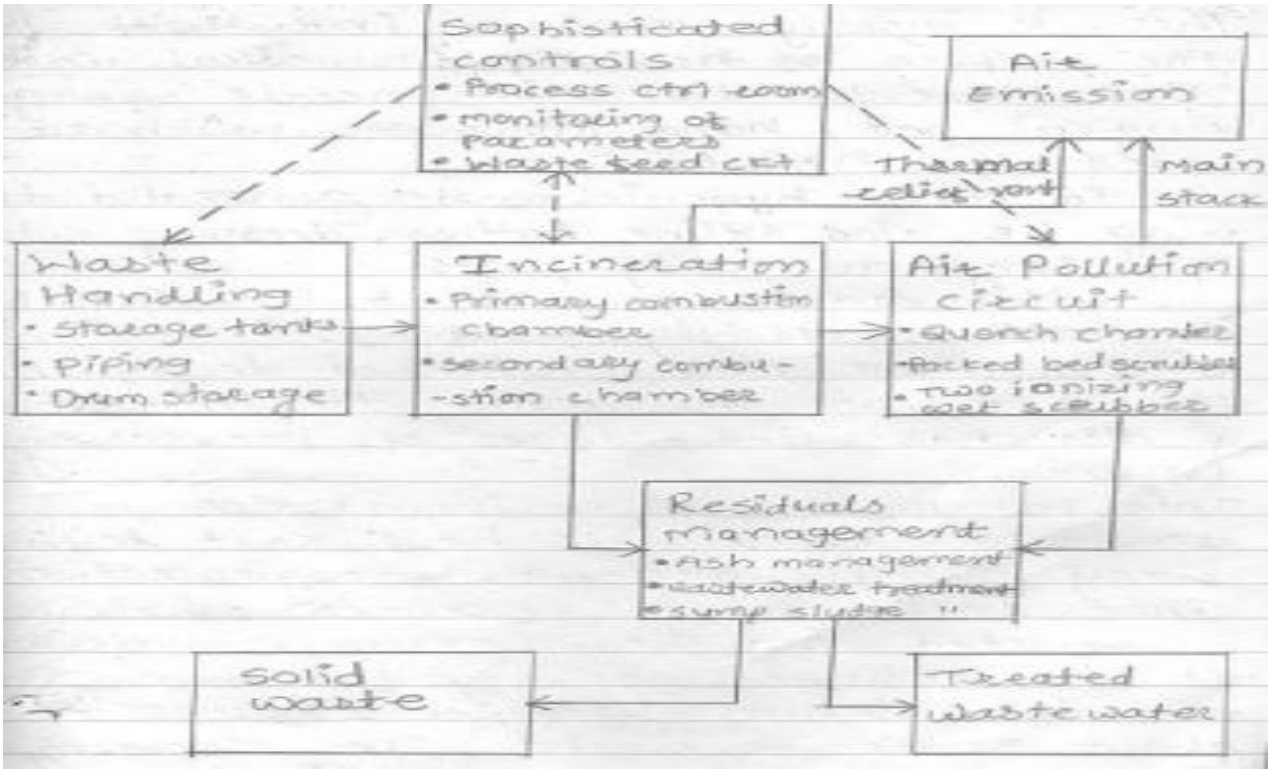


Fig : Block diagram of Incinerator

(Description = 2 marks)

Incinerator is an analytical equipment which is consist of lead which is an the consist of lead is in the upper surface of incinerator & at the bottom there is electrical circuit & ON/OFF panel.This is mostly used in industries for the purpose of burning biomedical waste like plasenta, disposable needle syringe, surgical pad, hand glows etc which are used in hospital.To burn hygienic waste generated daily may be also saline bottles,dressing cottons & dangerous body parts.

All this can be recycled but need to be disposed completely and sagely.Earlier, the part of burned deeply but this part are notdestroy the intected parts & also has disadvantages of increasing infection.This technique that is incinerator is developed which used heat, soit destroys everything (bacteria, u-organization).Incinerator is furnace which is constructed used heat resistive material.It has required capacity for burning the material such as 100 kg per 1 hour. Hear is about 3500^0C generated using electricity. The furnance has inserted to dispose of when the material burns their will be generation of gas & it is disposed of via chimney.

Various parts of incinerator

01. Primary combustion chamber.
02. Secondary.
03. Ash collection Chamber.
04. Venturl ejector
05. Primary burner.
06. Secondary burner.
07. Waste charging door.
08. Ash removal door
.09. Combustion air fan.
10. Ejector fan.
11. Combustion air control chamber.
12. Combustion air jacket
13. Waste
14. Ash
15. Grade bars.
16. Temperature probe.
17. Fix-castable.
18. Insulating Castable.
19. Fix brics
20. Steel-shell
21. Flue gas outlets.

Features of Incinerator:-

01. Equipped with sample no. of safety.
02. PLC based control panel.
03. Fully automation.
04. It is very safe & easy to use.
05. Auxillary feed option of air or gas. 06. Suitable for wide range of waster.

Application of Incinerator : (2 marks)

This is mostly used for the purpose of burning biomedical waste like
1. Burning of Placenta
2. Disposable needle syringes
3. Surgical pads
4. Hand glows etc which are used in hospital
5.To burn hygienic waste generated daily may be also saline bottles, dressing cottons & dangerous body parts.etc

Q.2) Attempt any four : (16)

a) Define : i) Chromatography (04)

ii) Electrophoresis

(2 marks each)

Ans :

i) Chromatography : (2 marks)

Chromatography is basically a group of methods for separating a mixture of substance into component parts. One phase is fixed liquid or solid and the other phase is mobile gas or liquid.

ii) Electrophoresis : (2 marks)

Electrophoresis is a method of analytical chemistry. Basically electrophoresis technique is to separate the molecules based on charge under the influence of an electric field.

Which is givien by fallowing equation,

F=qE
E=Intensity of electric field
q=Charge
F=Column's farce.

b) With neat diagram describe working of electro-conductive blood cell counter. (04)

(Diagram = 2 marks , Description = 02 Marks)

Ans :

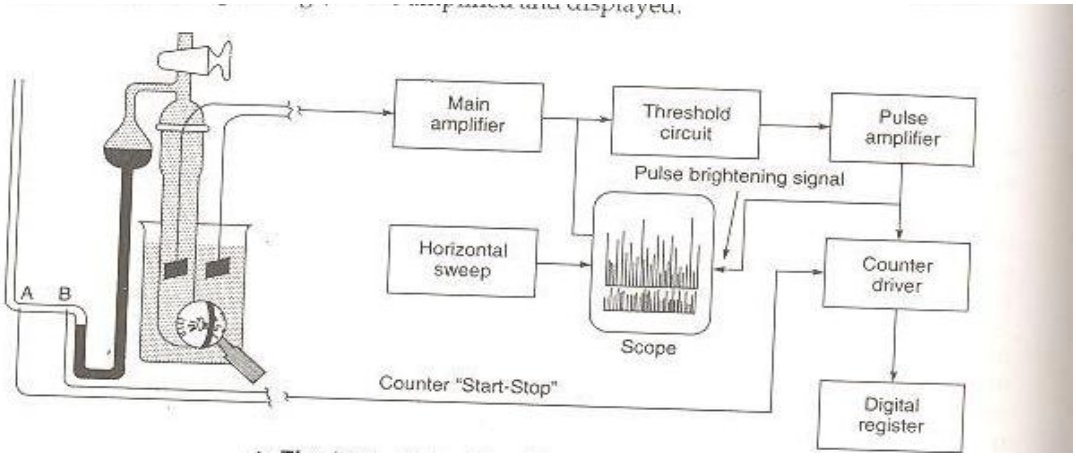


Diagram Electroconductive blood cell counter

Blood cell counters operating on the principle of conductivity change which occurs each time a cell passes through an orifice are generally known as coulter counters. The technique is extremely useful for determine the number and size of the particles suspended in an electrically conductive liquid.

The principle of the measurement is that blood is a poor conductor of electricity whereas certain diluents are good conductors. For a cell count, blood is diluted and the suspension is drawn through a small orifice. By means of a constant current source a direct current is maintained between two electrodes located on either side of the orifice. As a blood cell is carried through the orifice, it displaces some of the conductive fluid and increases the electrical resistance between the electrodes. A voltage pulse of magnitude proportional to the particle volume is thus produced. The resulting series of pulses are electronically amplified, scaled and displayed on a suitable display

c) Describe operation of hot air oven. (04)

(Operation = 2 marks , Diagram = 2marks)

Ans:

Operation of hot air oven:

Double walled, the motor fixed at the back / triple walled, ducted air flow type, the motor fixed at the top. The motorized forced air circulation to maintain uniform temperature inside the chamber.Inner chamber made of stainless steel.Outer chamber made of mild steel.Gasket Asbestos rope or Neoprene rubber (optional) gaskets for the door to avoid air leakage and temperature loss of hot air oven.Trays Two/ Three perforated removable stainless steel trays at the fixed distance.Front panel consists of mains ON/OFF rocker switch.

When electricity is passed through the heating coil electrical energy is converted to heat energy. The temperature is controlled by thermostat. It is most widely used method of dry sterilization by dry heat. The oven uses electrical as heat source. The oven is fitted with a fan to ensure adequate and even distribution of hot air in the chamber.

Diagram of hot air oven:

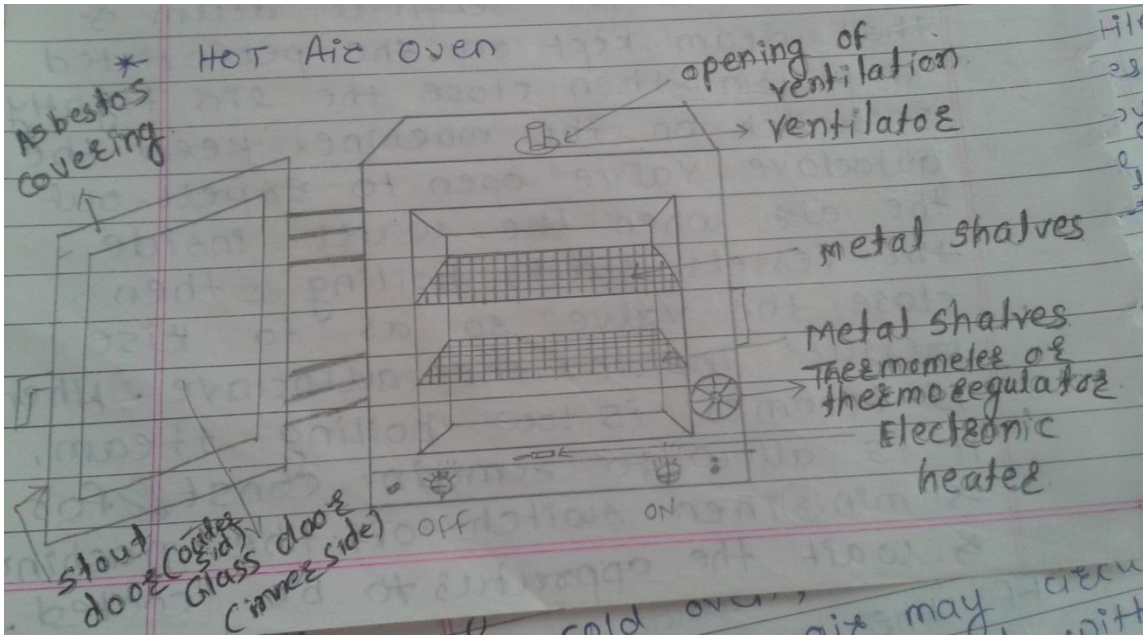


Fig : Hot air oven

d) List instruments based on Beer-Lamberts law (any 4). (04)

(1 mark each)

Ans:

Instruments based on Beer-Lamberts law:

- Spectrophotometers or photometers.
- Visual colour comparators.
- colorimeter.
- single beam spectrophotometer
- Double beam spectrophotometer.
- Flame photometer.
- Single beam colorimeter.
-Double beam colorimeter

e) Draw a neat labelled diagram of blood gas analyser. **(04)**

(Diagram = 4 marks)

Ans:

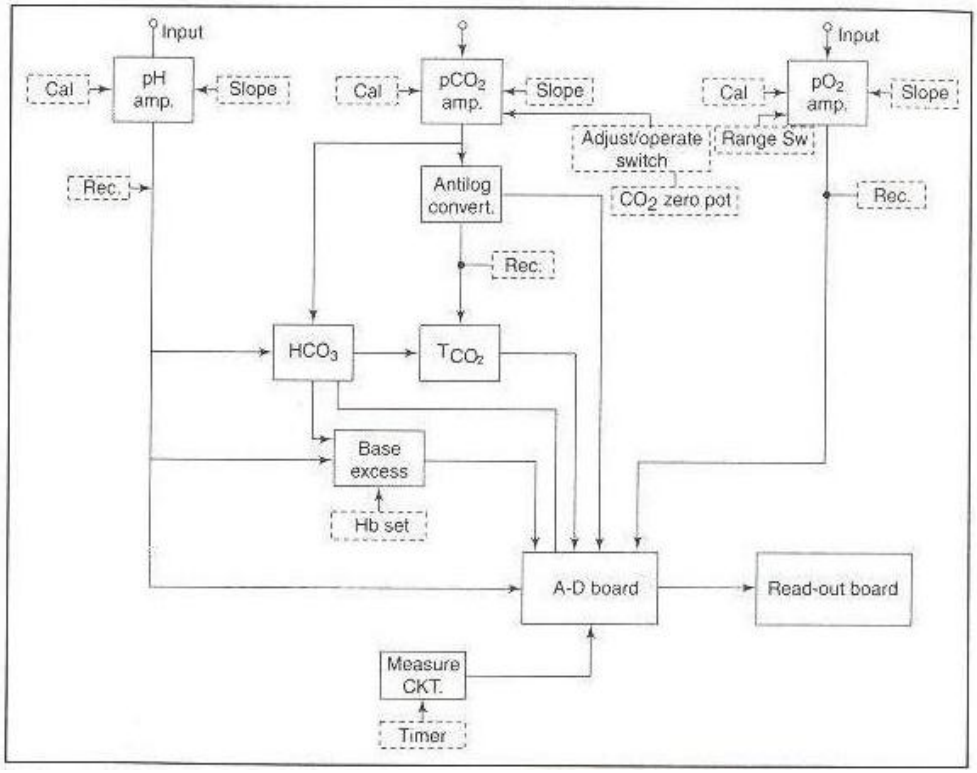


Fig: Blood Gas Analyser

f) With neat diagram explain working principle of gas chromatography. (04)

(Diagram = 2 marks , Working = 2 marks)

Ans:

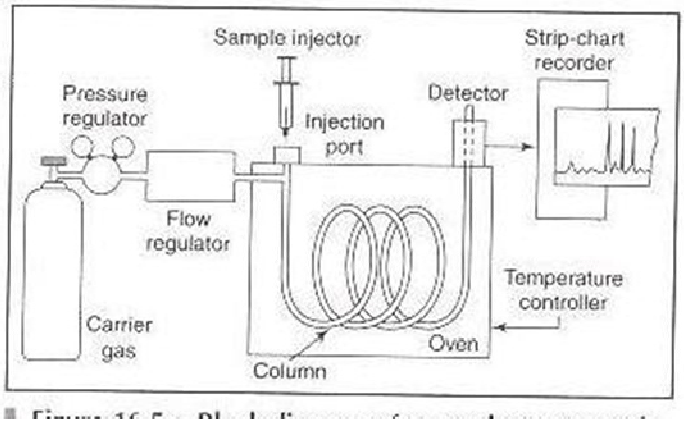


Fig : Gas Chromatography

Working principle of gas chromatography:

The basic parts of a gas chromatograph are shown in figure. It consists of the following parts.

- Carrier gas supply along with pressure regulator and flow monitor.

- Sample injection system.

- Chromatographic column

- Thermal compartment of thermostat

- The detection system

- The strip chart recorder

The carrier gas, normally N2, Ar or He is usually available in a compressed form in a cylinder fitted with a suitable pressure regulator. The gas is conducted from the cylinder through a flow regulator, to a sample injection port maintained at a certain temperature T1, which is such that it ensures rapid vaporization, but not thermal degradation of the solute. Gas and liquid samples are almost always injected by syringe through a self sealing silicon rubber diaphragm in the injection port. The solute vapor mixes almost instantaneously with the flowing carrier gas and is swept into the chromatographic column, which is the heart of the chromatography.

It is there that the different solutes in the vaporized sample are separated from each other, by virtue of their different interaction with the column packing. The column is maintained at another temperature T2. This temperature determines the time for the passage of the solutes and to some extent, the resolution and efficiency obtained with a particular column. At the end of the column the solutes emerging individually enter the detector which produces an electrical signal corresponding to the quantity of solute leaving the column. The detector signal is supplied to a potentiometer recorder and a plot of the time signal amplitude called chromatogram is obtained.

Q.3) Attempt any four **(16)**

a) List different procedural step to find out concentration of solution with the help of colorimetric measurement. **(04)**

(Procedural step 4 marks)

Ans:

Step to find out concentration of solution with the help of colorimetric measurement:

Colorimeter is a filter photometer that measures the color concentration of the substance in the solution. This is done by detecting intensity of color light passing through a sample.

- Select appropriate filter.

- Switch ON shutter.

- Insert test tube with blank solution in the test tube holder.

- Set 00 on display by adjusting knob.

- Replace blank with test tube holder.

- Read output value on display.

b) What is centrifuge? Write working of analytical ultracentrifuge. **(04)**

(Centrifuge = 2 marks , Working of Ultracentrifuge = 2 marks)

Ans:

Centrifuge:

A centrifuge is a laboratory device that is used for the separation of fluids, gas, or liquid based on density. Separation is achieved by spinning a vessel containing material at high speed , the centrifugal force pushes heavier materials to the outside of the vessel. It is a device that spins liquid sample at a high speed &create a strong centripetal force causing the denser material to travels towards bottom of centrifuge tube more rapidly than gravitational force.

The basic idea behind centrifuge is the sedimentation process & it is depend on the applied centrifugal force.

Working of analytical Ultracentrifuge :

The ultra centrifuge are operating at a forces 6 lak cm/ square and with a temperature control with in approximately 0.1 degree Celsius.Mainly it consist of rotor and an optical system for recording the distribution of sample in the ultracentrifuge cell.The rotor is kept in on evacuated on pulled chamber. The tip of the rotor contains a thermister for measuring the temperature. The thermister makes electrical contact with the control circuit by means of pull of mercury.The rotor chamber contains an upper condensing lenses.The lower lens

allows the passage of the light so that sample is illuminated.The upper lens and camera lens focus the light on the film.

Mainly three types of optical system are available for ultra sound

i)Ultraviolet light absorption system

ii)Chill range optical system

iii)Relay high interference system

In ultraviolet system light of suitable wavelength is passed through the moving analytical cell containing the solution under analysis The intensity of transmitted light is recorded on the photographic paper.

c) Give brief classification of chromatography. Draw neat diagram for liquid chromatography. (04)

(Classification = 2marks , Diagram = 2 marks)

Ans:

Classification of Chromatography :

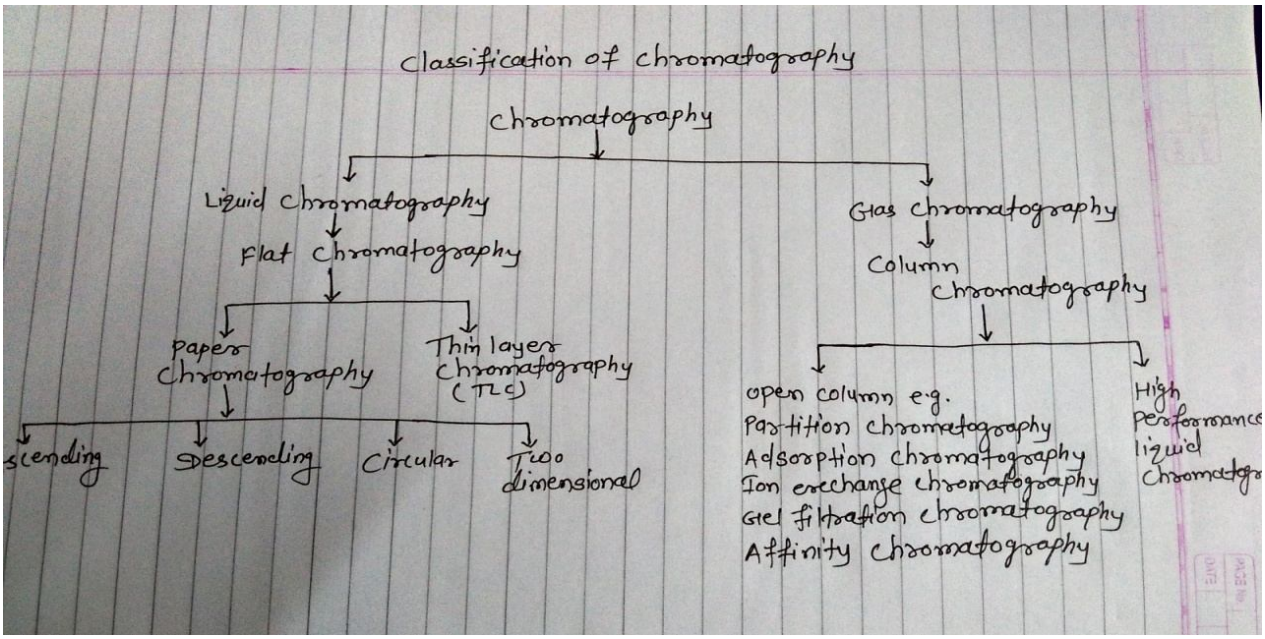


Fig : Classification of Chromatography

Diagram for liquid chromatography:

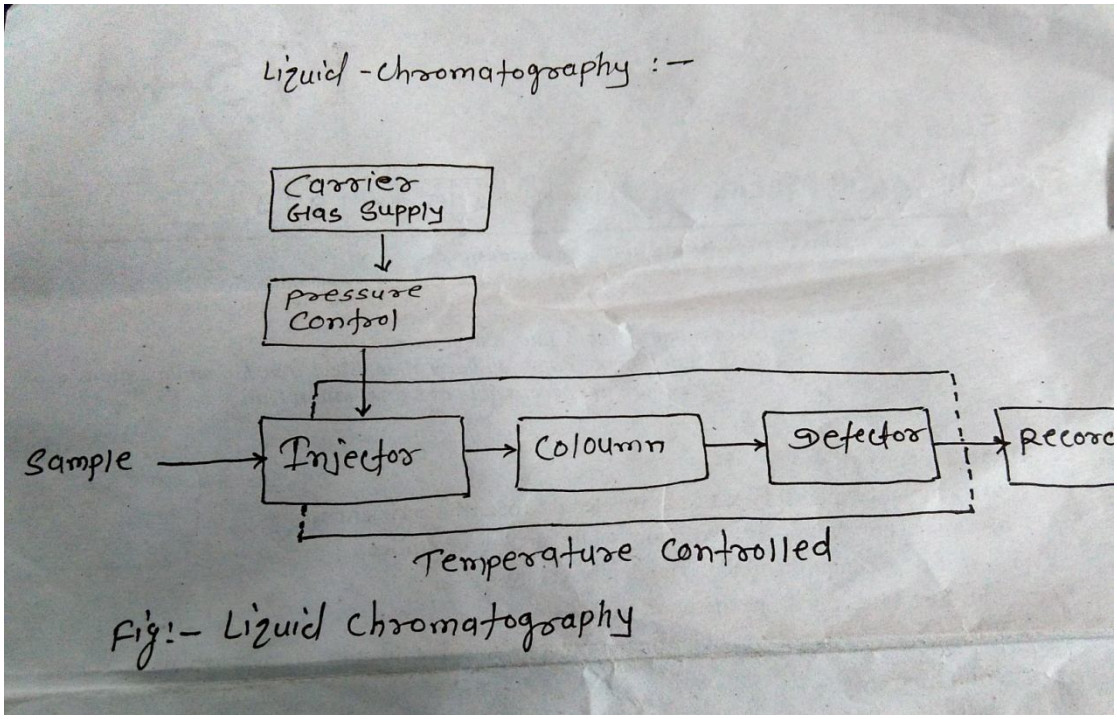


Fig: Gas-Liquid chromatography

d) State Beer's- Lambert's law. Give its mathematical expression. **(04)**

(Statement = 2 marks , Mathematical Expression = 2marks)

Ans:

Statement of Beer's-Lambert's law :

A combination of the two laws, known jointly as the Beer Lambert law, defines the relationship between absorbance (A) and transmittance (T). It states that the concentration of a substance in solution is directly proportional to the 'absorbance'. A, of the solution.

Mathematical Expression:

Absorbance A= £ cb,

Where

A= absorbance (no unit of measurement)

£ = molar absorptivity (dm3 mol-1 cm-1)

c= molar concentration (mol dm-3)

b= path length (cm).

It may be noted that £ is a function of wavelength. so, the Beer Lambert Law is true only for light of a single wavelength or monochromatic light.

e) What is auto analyser? Describe with help of neat diagram. (04)

(Auto Analyser = 1 mark , Description = 1 mark , Diagram = 2marks)

Ans:

Auto Analyser :

The auto analyser is a device used in testing the chemical properties of various substances . The machine creates a report in the fraction of the time once necessary to perform multiple tests. It is able to measure dozens of fluid samples an hour for a variety of markers such as cholesterol , phosphate levels & proteins . This machine valuable tool in hospitals &clinics. It is also used for test the composition of various compounds.

The auto-analyser sequentially measures blood chemistry and displays this on a graphic readout.

Description of auto analyser :

1)Sampler:- It fits the sample into analyser in a particular time sequence.

2)Proper pump:-It is basically a simple peristaltic pump working simultaneously on a number of with certain ratio of diameter is used to meter the sample & regent.

3)Mixing: - mixing is achieved by injecting air bubbles the mixture is incubated while flowing through heated coils. The air bubbles are removed & the solution finally throw the Cavite of colorimeter or is aspired in to flame photometer.

4)Recorder:- An electronic ratio recorder compares the output the reference & sample photocell. The recording shows the individual samples as peak s of a continuous transmittance or absorbance recording. T

The samples of a “run” are preceded by a number of standards that cover the useful concentration range of the test. The concentration of the samples is determined from the recording by comparing the peak o f the samples

with the peaks of the standards. n this way the effects of errors are eliminated because they affect standards and samples in the same way. The smallest models of the Autoanalyzer performs a single test at a rate up to 120 samples per hour. Large later models performs u[12 different tests on each of 90 samples per hour.

Diagram of auto analyser:

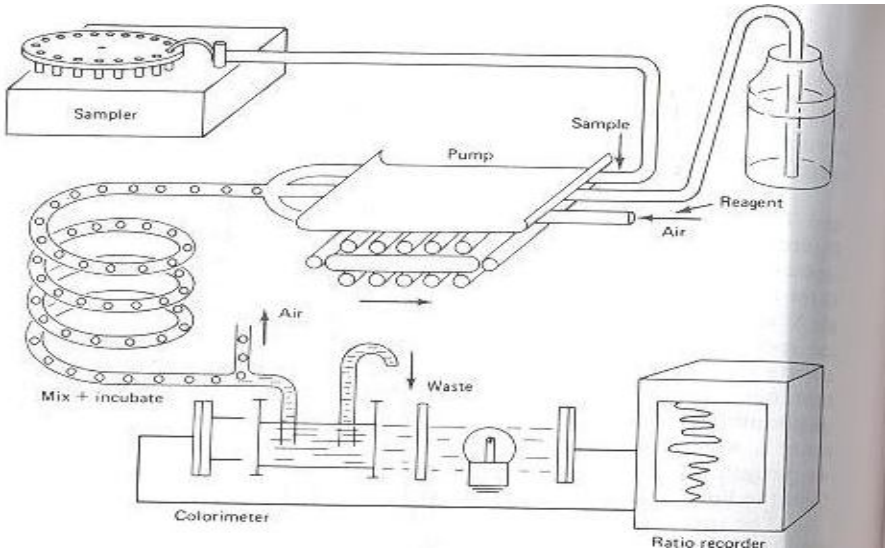


Fig: Auto analyser