CHAPTER 4:

Preservation : concepts and techniques -

Preservation means keeping an object away from harmful effects like loss, damage, destruction, mutilation and prolonging its life to whatever extent possible by maintaining it in a reasonably sound condition for present and future use. Without preservation, the knowledge cannot be transmitted to future generations. Preservation system includes determination of the causes of deterioration of documents, to adopt some administrative policy regarding preservation work and implementation of appropriate preservation techniques to maintain the usable condition of the documents.

4.1. Documents in college and university libraries of West Bengal -

Generally, college and university libraries’ collection includes different kinds of materials; mainly paper documents, for example text books, reference books, newspapers, maps, charts, atlases, etc and other kinds of non-book materials – manuscripts, photographic materials, globes, sound recordings, electronic materials, micro-documents etc. The rate of deterioration of these documents depends directly with the climatic condition of that particular area.
4.2. Factors responsible for deterioration of library documents-

Paper documents, itself, deteriorate due to some internal causes – the quality of ingredients used to compose the materials, the methods and techniques followed in the processing of the ingredients for papermaking. By nature, it is a perishable material. It can be burned, decayed and attacked by any organic agent and it is degraded or destroyed by chemical reactions with many materials.

Paper is a thin tissue of any fibrous material. Cellulose fibres are the chief source of fibrous materials for paper-making. Only a few special quality papers include fibres of other compositions. Cellulose is a high polymer, that is, it is made up of many single, relatively simple units combined chemically into very large molecules. The individual units are composed of molecules of glucose, combined with loss of one molecule of water from each glucose unit, and added into long linear chains.

The chemical formula of glucose is –

\[
\begin{array}{c}
\text{CH}_2\text{OH} \\
\text{H} & \text{O} & \text{H} \\
\text{H} & \text{H} & \text{H} \\
\text{OH} & \text{OH} & \text{OH}
\end{array}
\]
A glucose unit in the cellulose chain molecule is given below -

The linear chains of glucose units in cellulose are very long.

The quality of paper depends on the quality of fibres, from which it is made of. Paper can be divided according to the sources of the fibres, from which it is manufactured. For example, cotton group papers are of high quality, strong and stable and wood group papers are subject to early deterioration.

The factors which cause the deterioration of paper or which influence the permanence of papers may be divided into two groups – (i) internal factors and (ii) external factors. Internal factors affect the decaying of papers at the time of processing – that depends on the profound effects of sources and nature of fibres, of the response of fibres during processing and stock preparation, of variables during the complicated processes of sheet formation, pressing and drying on the paper machine. Paper deterioration also depends on the materials involved in sizing, filling, coating and impurities present in these materials. External factors are determined by conditions during storage and use, e.g. climatic factors and the existence of biological agents.
Paper permanence also deteriorates due to some chemical reactions – oxidation, hydrolysis and photochemical reactions. Cellulose is oxidized by atmospheric oxygen, although the rate of oxidation reaction is slow, but in adverse climatic condition, this rate accelerates. Oxidation leads to formation of carboxyl groups at one or more locations in the glucose units, which comprise the cellulose chain molecule. Oxidation also results in formation of peroxides, which contribute to further oxidation and side reaction. Ozone in the atmosphere, even in minute concentration, is a very active deteriorating agent. The hydrolysis of cellulose by acid attack leads to decrease in length of the polymeric chain molecule through random scission of the chains. For this, the strength of the fibre decreases. If the process continues, the fibres become very weak and brittle and finally, turn to fine powder. Deterioration may cause due to hydrolysis at the time of manufacturing process for the presence of acids. Deterioration of cellulose occurs more rapidly due to increase in temperature and hydrolysis and oxidation proceed more rapidly in humid condition.

Deterioration process is also promoted by the presence of many metallic salts, particularly, iron and copper, which are introduced at the time of manufacturing.

Photochemical degradation of cellulose is also a common phenomenon, and lignin plays a special role in this decay process. Lignin is easily oxidized and causes secure colour damage and lignin-containing papers discolour other papers in contact with them.
Climatologically, the factors, which play a major role in deterioration of library materials, are grouped into the following three categories –

(a) Factors, directly related to climatic condition –

- Climatic factors
  - Temperature
  - Relative humidity
  - Rainfall

(b) Factors, indirectly related to climatic condition -

- Environmental pollutants
  - Dust, dirt etc
  - Various toxic gases

- Radiant factors
  - Light
  - Darkness

- Biological factors
  Micro-biological agents - Fungi, Bacteria etc.
  Macro-biological agents - Insects, Rodents etc.
• Natural disasters
  . Flood
  . Earthquake
  . Storm

(c) Factors, not related to climatic condition -

• Accidental factor
  . Fire

• Other deteriorating factors
  . Improper shelving
  . Improper handling of documents etc.

a.1. Climatic factors –

a.11. Temperature –

The fluctuation of temperature has an adverse effect on library documents. Generally, college and university libraries collections are mainly based on paper documents. Paper is a mixture of organic and inorganic materials. In tropical climatic zone, like West Bengal, high temperature in weather causes physical deterioration of library materials. High temperature generates heat and heat accelerates the deterioration of library materials. If the temperature in the stack areas is increased, paper becomes yellowish and
brittle. It causes dehydration and for this decay the strength of the paper is decreased. In hot climatic condition, the cellulose and all other inorganic materials like starch, gelatin (sizing materials), starts to decay. High power electric bulbs may also increase the room temperature and this heat in damping condition makes the paper soggy and creates an environment, which accelerates the growth of biological enemies. Higher temperature will accelerate the decay processes and cooler temperature will slow them.

According to Library of Congress preservation recommendations, an ideal environment for books is 12.8°C in storage areas and not more than 23.9°C in reading room. In summer, when temperature rises at a higher degree (max. 40°C–42°C approx.), books deteriorate rapidly due to heat, which accelerates photolysis, hydrolysis and oxidation process. It also causes buckling of edge on the film and tape as well as embrittlement and curling of films and tapes as well as non-book materials.

a.12. Humidity –

Humidity is the biggest enemy of library materials. It plays a significant role in the deterioration of books, manuscripts and other library materials. In tropical place like West Bengal, the relative humidity is the most important environmental factor, which causes physical deterioration of library materials. In rainy season, the relative humidity remains very high and this type of climatic condition (maximum moisture) is the most dangerous and destructive for all kinds of library materials. Moisture itself causes physical
deterioration and enhances the growth of biological agents. It makes the paper soggy and thus weakens the tissues of paper.

According to Library of Congress, the relative humidity level should remain at 50%. Very low humidity can cause paper to deteriorate, while excessive humidity causes weakening of adhesives, staining of paper and encourages the growth of molds and mildews. It weakens the sizing materials, adhesives and makes the binding loose. Because, the cellulose fibres lose their strength, become disintegrated and unfit for handling. It causes spreading of ink.

Highly humid climatic condition causes softening of gelatin on film and sound tapes also. Rolled films, tapes, cassettes, and micro-documents can stick together while they are in contact in humid condition and damage the reading area recorded. The impurities present in the ingredients of paper, the contaminants, usually the oxides of carbon, nitrogen and sulphur, the acidic residue in paper ingredients, etc., while come under moisture, become active deteriorating agents and make paper discoloured and stained with coloured spots. It also accelerates the growth of micro-organisms. Excessive humid condition in weather helps in expansion and contraction of paper in different rates, thereby allowing paper to swell, pigment layer to develop cracks. And as a result, the longevity of paper reduces.
a.13. Rainfall —

Rainfall depends on the percentage of moisture in the air. It is the quantity of water, falls as rain. Excessive rainfall creates humid weather, which is noticed in monsoon season. This kind of atmospheric condition increases the dampness of the library building, by the by accelerates the growth of biological species that accelerates the decay process of library documents.

b.1. Environmental pollutants —

b.11. Dust, dirt and toxic gases —

Pollutants like dust, dirt, smoke etc. cause degradation of paper documents and other library materials. Normally, pollution enters into library building from outside, but, it can also be caused by construction materials, paints, untreated wood, particle board and plastics, which emit gases - sulphur-di-oxide, carbon monoxide, formaldehyde, and a wide variety of industrial gases. These are also harmful for papers. The impurities of air are sulphur-di-oxide, hydrogen sulphide, ammonia, ozone, aerosols and other chemical compounds. Sulphur-di-oxide, in presence of water converts to sulphuric acid, which destroys library materials. Ammonia released in air from various sources is also harmful for paper. Industrial aerosols contain ash, dirt, chemical particles. They absorb sulphur-di-oxide, hydrogen sulphide, iron and settle on library materials and start chemical reaction causing damage to the
materials. The polluted air causes decomposition of paper and binding materials. Dust and dirty substances are the sources of both physical and chemical deterioration. Dust hastens atmospheric acid reaction and attracts moisture to cause chemical degradation because they are hygroscopic in nature. In the air, smallest angular particle of dust can destroy the cellulose chain structure and results in brittleness of the paper, discolouration of the pages of books and increases the growth of micro-organisms. The combination of both dust and excessive humidity loose the strength of cellulose fibres of paper.

b.2. Radiant factors –

b.21. Light –

Light is an essential entity in our life, but, sometimes it becomes dangerous for library documents. Light may be of two kinds, natural and artificial, but, both kinds of light with high intensity are harmful to library materials. There are several kinds of rays present in the natural light. e.g., cosmic rays, gamma rays, x-ray, far ultra-violet rays, near ultra-violet rays, infra-red rays etc. All these rays are not harmful to papers. The ultra-violet rays, which comes directly from sun, cause damage to cellulose bonding by photolysis.
The modern ink, dyes, colour and pigments become fade and discolored by ultra-violet rays. The artificial lights e.g. fluorescent tubes also radiate high percentage of ultra-violet rays, but that light is rather cool. The incandescent lamps radiate minimum ultra-violet rays but generate heat. Heat and light deteriorate library materials loosing strength and oxidation of cellulose fibres. Though, direct sunlight and excessive light are harmful for library materials, but light is essential for stack areas or storage areas in any library. Because, heat (that radiates from light), absorbs moisture to some extent, which is very necessary to protect library materials from damage. Light hinders the growth of fungi absorbing moisture to some extent and keeps warm the library stacks, which helps to kill the insects.

b.22. Darkness –

Darkness can also damage library materials. Darkness creates a situation, which accelerates the growth of biological agents. So, filtered light is required in storage areas. Prolonged humidity and moisture, which are another deteriorating environmental agents for library documents, increases in dark areas causing physical, chemical and biological damage.
b.3. Biological factors –

Bio-deteriorating agents are the most destructive enemies and they cause maximum damage to library materials. The materials which are not used for a long period, the growth of those agents in that document increase rapidly, for this, they can destroy the materials completely or can put the materials in such a condition that the documents can never be used.

The climatic condition of West Bengal is hot and humid in most of the months in a year; this type of tropical zone is congenial to the growth of biological enemies. Most of the library materials are made up with paper. Paper and book binding elements are of organic origin and these are susceptible to be attacked by molds, or insects or both. If this type of attack starts, the damage is made very fast and more or less permanent.

Several kinds of bio-deteriorating agents, which make damage to library materials, are described below –

b.31. Micro-bio-deteriorating agents –

Micro-organisms, mainly the bacteria and bacteria like organisms, cause severe damage to library materials. They have the natural capacity to increase their growth due to the simplicity of their structure and the fastness to absorb the martinets. The most harmful agents are fungi, bacteria and yeast.
(i) **Fungi** - These are the most common damaging agents among all types of organic materials. These cannot be seen by naked eye. These are born and grown up in any organic matter and get carbohydrate food from these organic substances. The important characteristic is that their growth increases in darkness than in light. Excessive humidity, heat, etc. accelerates the growth of fungi. Generally, fungi grow in badly ventilated room, unused shelves, damp corners and on moisturized materials and affects book binding materials and reading surfaces. The ideal environment for the growth of fungi is - temperature between (24-30)°c and relative humidity above 70% along with slight acidic condition of paper. There are two types of fungi – molds and mildews, which obtain their food by sending root-like organs in organic tissues of paper and other materials. They also attack on starch and glue in paper, used as sizing material and ultimately break the molecular chain of cellulose. For this, paper loses its strength and disintegrated.

Fungi are also responsible for foxing. The foxing stains are the result of the effects of the organic acids produced by the fungi and also in some cases due to the effect of the chemical action of iron impurities in the paper.

b.32. **Macro-bio-deteriorating agents**:

(i) **Insects** - Bookworms are dangerous for library materials. They are very fond of starch and gelatin. They cause damage in two ways. One way is that they make the tunnels through the pages of the book, eat up, making the pages of the paper almost breakable and unreadable. Other way is that they stick the pages together so firmly that these are badly damaged when pulled apart.
(ii) **Book lice** - Booklice are minute grey or white insects. They prefer to live in hot, dark and damp places. West Bengal's climatic condition is favourable for their growth. They eat the substances, organic in nature, e.g., glue, starch etc, cotton cloth, silk, synthetic fibre, leather and photo print. They damage the library materials in such a way that the condition becomes congenial to more harmful insects.

(iii) **Silver fish** - Silver fish is very dangerous for paper documents. It's size is half an inch with pearl grey colour and has three tails. It grows very quickly in dark and damp environment and very active at night. It eats the surface of the paper and very fond of eating sizing materials e.g. starch, gelatine and glue.

(iv) **Termite** - Termite is one of the most important cause of deterioration of library documents. They attack not only cellulosic materials but also wooden materials, racks, doors, windows etc. The growth of termites increase very fast in damp and dark environment.

(v) **Cockroaches** - They damage paper leaves, book binding material - leather, fabrics and other organic materials. They discolour the pages of the books. Their favourite food is paste and glue, which are present in book covers. These prefer hot and humid areas.
vi) **Rodents** - Rodents include mice, rats, squirrels, rabbits, and other species. They are occasional visitors to library but they are very harmful. They are voracious eaters and eat anything made of paper, textile, leather, paste, glue, starch, gelatin etc. They do not only eat and digest library materials, but, destroy the materials by cutting into pieces, which cannot be repaired and restored.

(vii) **Molds and Mildews** - These are another kinds of biological enemies. Molds and mildews are always present in weather and begin to grow in the environment like - warm temperature, relative humidity of 70% or higher, darkness and poor air circulation. They also damage paper, leather, photographs etc.

b.4. **Natural disasters** :

b.41. **Flood, Storm, Earthquake,** -

Sometimes, these factors may also deteriorate library materials drastically, but these incidents are not happened in every year.
c. Accidental factors:

c.1. Fire —

Libraries can also face some accidental damaging factors also e.g. fire, seepage of water from roof and walls, and so on. Amongst them, the great accidental agent is fire, this happens mainly due to short circuit of electric lines and smoking within the library building.

d.2. Other deteriorating factors:

d.21. Improper handling —

Improper handling of books and other documents causes damage to the pages as well as binding of books and Improper handling also causes damage to micro-documents e.g. micro-fishes, microfilms, CDs, floppies and other electronic materials.

d.22. Improper shelving —

Most of the college libraries of West Bengal suffer from lack of space. For this, the library documents, mainly books, are not properly shelved. The books are shelved tightly on racks, so, when users or library staffs are trying to pull them out from the shelf, the bindings become loose and their covers become torn.
Causes of deterioration of manuscripts -

The deterioration of manuscripts are caused in many ways -

- The damage may be physical or chemical.
- It may occur by different kinds of biological enemies e.g. fungi, insects etc.
- Improper storage.
- Excessive use.

Causes of deterioration for globes -

Globe is a special kind of library material. It's characteristic is totally different from other representatives present in library collection. Sharp changes in temperature and humidity has a detrimental effect on globes – cracking of varnishing and dilation of plaster and cardboard; while the accumulation of dust makes the paper dirty and map illegible. Light has also make a cause of damage. However, the shape of globe also led to damage such as caused by blows, which make holder in the cardboard structure, scratches caused by the rubbing of an off-centre sphere against the brass horizon table or meridian, or wearing away of the engraving due to finger pressure on a particular place. The join of the two cardboard hemispheres, glued around the equator, remains the weakest part and suffers the greatest damage.
4.3. Techniques of preservation –

Conservation work is the sum total of preservation and restoration work. The total conservation work can be divided into four steps.

1) Examination of the documents, 2) Preventive conservation, 3) Curative conservation and 4) Restorative conservation.

Examination of the documents is very important in the whole conservation process, because, the techniques involved in the whole conservation process depends on the degree of deterioration of the objects.

Preventive conservation is the most important stage of conservation. It can be applied on both damaged and undamaged materials. It involves any direct or indirect action aimed at preventing future risk of deterioration to object or a collection of objects.

Curative conservation is also an important process that aims at arresting the deterioration of documents applying chemical treatment. Presently, curative processes have proceeded to be effective by applying some non-chemical methods also.

Curative conservation method can arrest the process of deterioration of the documents, but it cannot retrieve the lost physical properties. So, in order to bring back such fragile documents to usable condition, some restorative measures are essential, e.g. pagination, ink testing, washing, and de-acidification.
To keep safe the books and non-book materials from the deteriorating agents, the following decaying factors should be controlled -

1) Climatic factors - temperature, humidity, etc.

2) Environmental pollutants;

3) Radiant factors;

4) Biological agents;

5) Natural disasters;

6) Accidental factors;

7) Other deteriorating factors.

To protect the documents from any kinds of hazards, the best possible solution is installation of air-conditioner. By this system, suspended aerosols are screened from air filtering. Sulphur-di-oxide can be partially removed from air by frequent re-circulation through activated charcoal filters.

But, air-conditioning system may not always be a feasible means of achieving acceptable climatic conditions in college and university libraries of West Bengal. It's costly installation may perhaps be possible only for a part of the libraries, such as, rare book collection or special materials' collection.

West Bengal is a state, where the climate characteristic is tropical, a climate monitoring policy should follow. The important consideration is to record how the climate differs during the day and during the different months of a year. A long-term study at least for one year is essential for every library.
4.31. Controlling of climatic factors –

4.311. Temperature control:

According to Library of Congress preservation recommendations, an ideal environment for books or any paper documents in storage areas is 12.8°C and 21.1°C in reading areas. Temperature should not vary by more than two degrees in 24 hour day. For paper documents (20-22)°C or lower and micro documents (18 - 20)°C or lower should be maintained. By installing air-conditioner within the library building, it is possible to achieve this ideal condition through filtering and maintaining proper temperature. This system is able to prevent from deterioration of books and it should be kept in mind that air-conditioner should run 24 hours in a day without disruption. Besides this process, temperature can be controlled by taking the following other steps –

(a) By increasing air circulation taking advantage of breezes, especially to the south and north, keeping windows open by screening to prevent the entry of insects and birds, it can be controlled.

(b) One or two small windows close to the ceiling can be opened to stimulate the circulation of air through open windows. During summer months, by keeping the windows of the storage areas of the library closed, temperature can be controlled. If the windows are kept open, wet khas should be used.

(c) Electrical fans also decrease the temperature of the library by reducing heat from the library room.
d) Heat can be reduced by using reflective colours on roof surface and by constructing false ceiling beneath the roof.

(e) To control temperature, shade trees may be planted outside the library building.

(f) Exhaust fans are essential for the library stack room. High-speed air-circulators may also be used in the storage areas to keep away hot air from the library. After the sunset, the windows should be kept open till the closer of the library hours if these are closed during daytime.

4.3.1.2. Humidity control:

Relative humidity is the measurement of moisture in the air. Ideal relative humidity is - (45 - 50)% for paper documents, (30 - 40)% for micro-forms and (30 - 45)% for magnetic media and these should not vary by more than 2% in 24 hour period. This can be achieved by installing air-conditioner. For this, the continuous monitoring of temperature and relative humidity is very important. But, the installation cost of air-conditioner machine is very high.

Relative humidity can be monitored by hygrometer, thermo-hygrometer or hand-held electronic hygrometer. In such a situation, dehumidifier can be used to maintain the balance in the storage area of the library. If this arrangement is also impossible, then heaters may also be used.
to dry up the moisture inside the library premises to maintain optimum storage environment. To make this arrangement effective, windows should be tightly sealed and doorways should be fitted with automatically closing doors.

Chemical de-humidification using anhydrous calcium chloride or silica gel may also be used. Silica gel is a buffering substance, absorbing or releasing moisture into the environment to maintain an optimum level of relative humidity. However, seven pounds of silica gel dehumidify one thousand cubic feet of air by absorbing the moisture in it. When the gel is saturated, it can be made reusable by heating in an oven. Calcium chloride should be exposed in several locations in the room in wire cylinder 6 inch in diameters and 15 inches high, standing in shallow pans. At the time of use of dehumidifiers, all windows and doors (as far as possible) must be kept closed.

Another chemical namely "NIKKA PELLETS" has been found to be equally effective, as a humidity-buffering agent. If the moisture comes from outside wall where bookshelves are placed, a plastic sheet can put on the wall behind the bookshelves.
4.32. Precautionary measures for environmental pollutants -

Pollutants can be divided into three sub-groups – solid particulate pollutants, exterior gas pollutants and internal active pollutants. All these types of pollutants can be controlled through heating, ventilating and air-cooling systems. This system filters incoming air to remove particulates and gases. Materials and the contents of building play an important role in the absorption of pollutants e.g. stone, cement, concrete, woodwork and furnishings. Cement and lime plaster are considered as good deactivate agents of acidic gases and their use is desirable in the buildings. Air-conditioners through filtering process are able to remove polluting gases from the atmosphere where books are kept. Some simple measures may also be followed – wrapping of the books, manuscripts in cloth and placing them in book-boxes. Containers, coverings or enclosures for documents and manuscripts can be of several types. Some of these are –

- Matting of single document;
- Portfolios for single document, and small manuscripts;
- Wrapping by cloth;
- Slip book cases;
- Manuscript boxes.
If all the above methods are not acceptable by any library, they can follow an old fashioned technique. By placing books or book-like documents in glass-fronted bookcases where the air can be kept warm by lighting an electric bulb continuously – either a single large bulb on the bottom shelf, or a five-watt bulb on each shelf, they can minimise the deterioration caused by these pollutants. This method may be followed by all college and university libraries of West Bengal, because, it is a flexible method and not an expensive technique and can be applied throughout the year or need basis.

4.33. Controlling of Radiant factors  

4.331. Light –

There are two types of light inside the library – natural and artificial. Level of ultra-violet light should not allow to exceed 75 microwatts per lumen, stack lighting should not exceed 50 lux, exhibited materials by no more than 50 lux, while reading rooms can be permitted higher levels, up to 100 lux. Most of the libraries have no equipment to measure light levels. But, it can be reduced to some extent by taking the following steps –

- Glass panels may be used in the windows to cut off the UV rays.
- Direct sunlight may be avoided by planting shade trees outside the windows of the library.
- Skylights (if exists in the library stack room area) can be covered or white washed.
• Fluorescent light tubes should be fitted with diffusers and filters to exclude ultraviolet light.

• To control direct sunlight, curtains should be used.

4.332. Darkness –

Illuminating different areas in library building or rooms with sufficient appropriate lights, darkness can be minimised within the library building.

4.34. Combating biological enemies:

The total eradication of these agents is impossible, but, the attacking rate can be minimized from the library in the following ways –

• The air-conditioning system is the best possible solution because the air-conditioned area can maintain a uniform level of temperature and humidity (if the air-conditioning plant run for twenty four hours of a day). This environment reduces the possibility of growth of any kind of biological agent. But, this arrangement is very costly.
The alternative ways are -

- Trees should not be planted close to the library building and flowering species should be avoided.
- Climbing plants should be avoided from the walls or roofs.
- Fluorescent lights should not attach to the library building, as they will attract flying insects.
- All garbage and rubbish should be kept in a vermin-proof container away from the building.
- Birds and other animal nests should be removed from the library building.
- All holes in the library building made for electrical cables, water pipes, telephone connections and waste pipes should be sealed.
- Every opening in doors and windows should be fitted with insect screening.
- Installation of revolving door is must for every library.
- Rest rooms, toilets, pump rooms that are sources of water, should be segregated from collection areas.
- The building interior should be well maintained and kept clean as far as possible, because, dust and dirt provide nutrients for insects. Water spills should be immediately mopped up. At the time of washing of windows
and floors care must be taken that excess water does not penetrate the structure through cracks in the walls or floors.

- Foods and drinks should not be allowed in the library premises.
- Refrigerators and appliances that combine heat and moisture are popular habitats for insects. Areas under and around appliances should be regularly cleaned and sticky traps placed if necessary.
- Exhibit cases and special storage cases should be fitted with gaskets to ensure tight-fitting seals.
- Biological enemies can be eradicated by spraying insecticidal solution e.g. D.D.T, pip and aldrine (59:1) using kerosene or phenyl as medium (oil-based) by Euro clean machine periodically to protect from termites, silverfishes etc. Some methods of poisoning may also be applied with the insecticidal solution to control insects and rodents. The methods of poisoning are discussed below –

i) Contact poison: When insects kill only by touch with poison, is called contact poisoning. These poisons are sprinkled in the surroundings of the insect infested books and shelves by different equipments. The insecticides kill the insect when one comes in contact with it. Pyrethrum and petroleum are used periodically as preventive measure from damages caused by silver fish, beetle, book lice, book-worm etc biological agents.
ii) Stomach poison: In this process insects are killed easily. Examples of this poisons are arsenic-tri-oxide, barium carbonate etc. Aldrine insecticide acts as a chain reaction in order to control termite out break. Zinc phosphate can also be used for eradication of rats, mice and molds.

ili) Respiratory poison: In this method, the fumes of some insecticides enter into the body of insects through spiracles, tracheae's, air sacs respiratory opening and directly affect the respiratory system of the insects e.g., ethylene oxide and carbon-di-oxide in the ratio (1 : 9), para-di-chloro benzene, carbon-di-sulphide and carbon-tetra-chloride in the ratio (1 : 3). This kind of poisoning happens in the fumigation chamber.

In the monsoon, the growth of fungi increases in some places of the library. To control fungi, the fungus-affected books should be treated with 5% thymol and above. In case of leather bound volume 35% para-nitrophenol in dilute aqueous or alcoholic solution can be used for fungus treatment.

After determining the nature of infestation and extent of damage of the infected library documents, the documents should be cleaned with care and caution following dry cleaning method or wet cleaning method. Manually, cleaning can be done either with cotton pad or with soft brash using formalin. Disinfectants should be used in all cleaning water. If the document is affected
much by fungus and other insects, sterilization method should follow, that means, a cotton swab soaked in 5% solution of thymol in methanol or 5% solution of ortho-phenyl-phenol, penta-chloro phenol in rectified spirit can be used. When insects are detected in a library, then vacuum cleaning of all books in the immediate vicinity of the contaminated one(s) to remove dust, dirt, eggs etc is necessary. The infested books should kept open under air or electrical fans.

Only cleaning process cannot destroy the fungi and insects, then eradication of those harmful factors can be done by fumigation method.

There are various types of fumigation. All fumigants and fumigation processes are not effective for all types of insects and fungi. The type of fumigant and period of fumigation will depend upon the condition of the document and the degree of damage. The mostly used fumigation processes are mentioned below.

i) Fumigation with para-di-chloro-benzene is followed in most of the college and university libraries. An almirah with perforated shelves is used for this purpose. Documents are kept open on shelves. Para-di-chloro-benzene crystals are put on glass pots or saucers in the lower shelves for about two weeks or more. These crystals are evaporated in normal temperature and passes through the pages of the documents. This is a very simple method.

ii) If insects infest the documents very badly, fumigation with a ratio of the mixture of ethylene dichloride and carbon tetrachloride (3:1) by volume may be applied. The inside temperature should be above 24°c and documents
should be fumigated for 24 hours or more depending on the damaging condition of the documents.

iii) Thymol fumigation is particularly used for fungi, mildew and mold eradication. It does not give permanent protection. A specially made cabinet with wire mesh and electric bulb is required for thymol fumigation. For every cubic meter of space inside the cabinet, 120 gms of thymol crystal should be used and duration of fumigation depends on the condition of infested documents.

ii) Formaldehyde fumigation is very effective for insect-infested documents. In this process also, a specially made cabinet with wire mesh nets in several tiers and heat (300°c) by Bunsen burner or spirit lamp is required. Formalin or 40% formaldehyde solution prepared with commercial formaldehyde solution and proportionate water can be used for fumigation. Book-lice, book-worms are destroyed by this process.

- Naphthalene bricks may also be used as a safeguard against other insects. These bricks should kept at remote corners of the shelves, so that, they do not come in direct contact with books and manuscripts.

- Another technique to protect documents from biological agents is to apply neem products or neem leaves, tobacco leaves, on paper or book shelves as repellents. The advantages of using neem leaves are that they do not pollute environment at all, it is not dangerous, it is abundantly available everywhere and most economical.
• In the tropical climate, where complete eradication of insects is almost impossible, the wax in different colours can be used in leather covers of books, which makes them insect repellent.

• Pyrethrum powder, camphor crystals, eucalyptus leaves, etc. can also be used to prevent library documents from insects.

• To destroy wood dwelling termites, hydrogen cyanide gas can be used. In this case, precaution is very necessary for safety. If hydrogen cyanide gas is used, the building will have to be sealed for 48 hours and then aired for 48 hours or more, before it is safe for human entry. If it is not feasible to close building for some days, methyl-bromide can be used for 24-hours.

• If the above two processes are impossible to implement, a temporary measure may be accepted. The wooden shelves can be moved away from the walls and stand them on plates of metal or in dishes of coal tar or creosote.

• Cockroaches, silverfishes, firebrats, bedbugs, mosquitoes and bookworms (in the beetle stage) can be controlled effectively by spraying the walls, woodworks, floors, ceilings, interiors of closets and cupboards with insecticides.

• Parathion, malathion and pyrethrum can be sprayed in this purpose. Pyrethrum and sodium fluoride may also be used.

• To control silverfish, sodium fluoride mixed with wheat flour can be used.

• To protect documents from micro-biological agents like mildew, gamma-radiation, ultraviolet light, high frequency currents and ultrasonic vibrations can be applied.
• The non-toxic deep-freezing method can also be followed to eradicate insects from the library. A freezer set at or below (-20°C) can be used to kill insects, and should be exposed for 3 to 4 days. Books should be placed in plastic bags and, on removal from the freezer, conditioned under a constant air current from a fan. This is the best possible measure for occasional use, not for routine treatment. Heat can also be used to kill insects in an inexpensive way. In tropical areas, infested books can be placed in a metal container wrapped in black plastic and left in direct sunlight for a few hours.

• A new technology, use of low oxygen level, may be followed for the control of insects. In this method, insects can be controlled at low relative humidity level (30-40%) and low oxygen level (below 2%). Low oxygen level can be obtained by replacing oxygen with nitrogen gas. For this treatment, a vacuum fumigation chamber or even plastic bags, in which nitrogen is introduced, are effective to kill insects. Nitrogen mixed with carbon-di-oxide can also be used to decrease the duration of the treatment and to improve the efficiency of the treatment.

4.35. Prevention from natural disasters –

4.351. Flood -

To prevent documents from this kind of natural disaster, library building or library rooms should not be situated in the ground floor of an institution.
4.352. Earthquakes -

This natural phenomena happens rare in our state, only the places situated in super-humid area may face this kind of disaster sometimes in a year. To protect library documents from this type of hazard, the following measures may be considered.

- Heavy objects should not be placed on lower shelves and shelves should be fastened securely to the walls.
- Pesticides and other insect killers and any flammable products should kept in closed cabinets and placed on bottom shelves.

4.36. Protection from accidental factors -

4.361. Fire –

To prevent library building and library documents from fire, some preventive measures should be taken up. Fire doors can be installed. Some precautionary steps should be taken at the time of installation of electrical wiring and electrical services. Ducting should not pass through storage areas of the library. Materials and equipments should be non-inflammable. Regular checking and maintenance of the building, fire detection
and suppression equipment are essential. Potential sources of fire, viz, electrical wiring, lighting and power connections, chemical stores etc. should be frequently checked. Portable and fixed fire extinguishers should be essentially installed and all staff should be instructed on a regular basis in its use. The extinguishers should be re-filled regularly. Automatic fire detection and fire alarming systems should also be fitted. Smoking in any part of a library should be banned strictly. Currently thinking about fire suppression devices for libraries favours the use of automatic sprinkler systems. Besides these, no part of the library premises should be allowed for make-shift of canteen or tea-room. Furthermore, some boards like “NO SMOKING” should be displayed in prominent places of the library building to draw attention of the users visiting the library.

4.37. Preservation methods for other deteriorating factors –

Besides the above controlling factors, some precautionary measures in the field of shelving and handling of library materials are stated below -

a) Books should always be carefully taken off the shelf, so that they do not fall on the floor.

a) Book-trolley should always be used to transport books within the library.

b) Shelves should be smooth without sharp edges to avoid damage to books.

d) Shelved books should stand upright and be supported on both sides.
e) Shelves should be partially filled to allow for expansion, tightly packed shelves cause abrasion and damage. Shelf height should be adjusted to accommodate tall books. If it is not possible, then tall or oversized books should be stored flat on shelves.

f) When books, manuscripts and other materials are handled, hands should be clean and dry.

g) To handle special materials, films negatives, photographs, white cotton gloves should be used. Laser cleaning is a newly accepted technique in the field of conservation.

h) To handle oversized materials such as maps, posters, architectural drawings, special care is necessary. Oversized materials should properly house in chemically stable folders, inside enclosures or steel flat files and the materials are transported to readers with care, generally inside a folder.

i) When rare books are used, cradles should always be used to support the rare books.

j) Staples, paper clips, rubber bands etc. should not be used to handle library documents.

k) Important library materials should not be repaired with household glue, pressure sensitive tape etc.

l) At the time of purchase, the books should be selected made of best quality paper. Because, preventive preservation is more cost-effective than application of preservation techniques to solve the problems.
m) Weeding out of old and unused library materials should be pursued boldly at a fixed time interval and used as a means of preservation.

n) Shelf-reading by library staff is very essential. Because, any kind of damage in library materials will be noticed quickly.

o) Proper preservation training for library staff and users are very important and everyone should realize that preservation is every one's job and should maintain at all time.

p) Paintings should be kept in between two mat-boards for their protection.

4.4. Preservation techniques for non-book materials–

4.41. Electronic and micro documents –

To protect electronic and micro documents from any kind of deterioration, the following measures should be taken up—

- Back-up of regular works in computer tapes and disks must be maintained.

- Master microform off-site should be stored in climate controlled secured storage.
Old brittle and rare documents can be preserved in microforms. Some special techniques should be followed to store this type of microdocuments. The ideal method of storage of microfilms is a series of individual pigeonholes with some form of covering to prevent dust from accumulating. This can be achieved by the use of shallow drawers in a cabinet and each drawer is divided into square pigeonholes capable of holding individual films and their containers within the minimum movement. If the special equipment is not available, these can also be stored in two rows on ordinary octavo shelving.

Filmstrips are usually stored in metal containers. These containers should be filed on shallow boxes or drawers, fitted with partitions. e.g. a six-drawer cabinet, 12 inches deep, 13 inches high and 15 inches wide, will hold 336 film strips in 1½ inch individual holders.

4.42. Maps, atlases and charts:

Maps and charts are graphic representation. The characteristics are different from books and periodicals. As a non-book material on paper-print media, maps serve an important role in recording and disseminating information.

The technique of preservation of maps and charts are different from other paper documents like books, periodicals etc. These can be preserved following the procedures like – Handling, Flattening, Stamping, Filing and Photocopying or Digitization.
i) Handling -

Preservation of maps should start at the moment, when they get entry into the library. Maps have been received in different roles, envelops, packages, containers etc. At first, these should be unwrapped with special care, so that no damage is done. Any extraneous materials like paper clips, staples and rubber bands should be removed from the map.

ii) Flattening -

After unwrapping, maps should be flattened by weighting the maps, curl-side down, for a few days. Very tightly rolled maps must be counter rolled first and then put under weight for flattening.

iii) Stamping -

Every library generally put its ownership stamp on the map, the stamping should be done in blank space of lower right or left hand corner on the verso of the map. Care should be taken at the time of drying of the stamping ink.

iv) Filing -

Fold weaken maps are predispose to tearing, so maps should be stored as flat as possible. Most commonly used map filing equipments are horizontal and vertical steel cases. The size of the cases varies from library to library depending upon the available wall and floor space. The horizontal steel drawer cases have been preferred for map storage, wooden drawer should be avoided to protect maps from attacking of different kinds of biological enemies.
Acid free folder should be used to file maps inside the map cases. Maps should be filed accurately and carefully. Map drawers should be kept tightly closed, when not in use, to keep out of dust and should be no more than half to three quarters full. Large maps may be suspended from the ceiling or on walls, being unrolled by cords hanging at eye-level. The better system is to store them rolled up in vertical containers, rather like large umbrella-stands, or to file them horizontally in deep shelves in cupboard.

v) Photocopying / Digitization -

Damaged or brittle maps can be preserved applying photocopying technique. Digitization can be preferred as modern and special preservation technique. At first, maps, charts etc. library materials have been scanned by scanners and after filtering process, these can be digitized into an electronic forms, preferably CDs. Applying this procedure, damaged maps and charts can also be preserved and presented in usable condition to users.

Ordinary small atlases can be kept on covered bookshelves, but atlases of folio or greater size should preferably be filed horizontally, and on deep shelving of the roller type to facilitate withdrawal and replacement.

4.43. Globes -

To preserve globes, regular cleaning is very necessary. It can be cleaned using a dust exhauster or a jet of compressed air and a soft brush.
4.44. Newspapers -

Daily newspapers are very valuable property to give proper information to the society. It is necessary to preserve the newspapers for a long-time, but due to high costs, the application of the techniques should restrict to very special items in a collection that has high intrinsic value. The most economical option is to preserve the intellectual content of the publications through reformatting.

- Selected newspapers and newspaper clipping files can be preserved by microfilming and photocopying.

- Care should be taken to assure that micro-films are stored in alkaline, non-photo reactive boxes, and that machines used for reading and printing film are kept clean and properly maintained.

- Digitization of newspaper on microfilm is a modern technique for preservation. This is expensive but accessibility is much greater than original newspaper reading. For microfilming or digitization of newspaper, some appropriate methods should be followed –

  i) Housing - The newspapers should stack neatly, organized in chronological sequence and a finding aid should be prepared that lists titles and issues held, to prevent excessive handling of the issues themselves. Then, the newspapers should kept in flat boxes, with lids the same depth as the
base. The ideal box is buffered custom boxes (standard sizes – 18 x 24 x 2.5 inches or 24 x 30 x 2.5 inches). The box level should contain the title(s) and range of dates contained in the box, with a list of missing issues attached with the box lid for easy reference. These boxes will protect the newspapers from light, dust and insect.

ii) Wrapping :- Flat storage of newspapers should be bundled and wrapped with a sheet of alkaline paper. Binding boards must be kept and used as an extra support outside the alkaline paper wrapped bundle, with an additional wrapping of ordinary craft paper as an outer protection. For tying the bundles, a flat cord may be used but cautions should be taken that cord cannot cut into the newspapers.

iii) Storage environments - The newspapers should be stored above the floor, to avoid damage from unexpected water.

4.45. Manuscripts -

Manuscripts are some special type of documents, that means anything written by hand. The speciality of manuscripts lies in the types of medium on which something had been written and the quality of ink. The preservation techniques of manuscripts are different from the techniques of books. These are not marketable articles. Mostly, the medium of writings of manuscripts are palm-leafs, birch-bark etc.
The techniques of preservation can be divided into two categories.

a) Preventive measures and
b) Curative measures.

The preventive measures can be categorized into the following types -

- Regular dusting and cleaning,
- Scientific storage and shelving of materials.
- Controlling of environmental factors – temperature, relative humidity, light, atmospheric pollutants.
- Proper lighting and air circulation.
- Preventive care against living organisms.
- Digitization technique.

The curative measures be the following techniques :-

- De-acidification of manuscripts
- Repairing and restoration of manuscripts.
- Lamination and
- Encapsulation.
Besides the above solutions, some other preventive steps are discussed below –

- Improper storage problem can be solved by increasing space between the stacks and inside the stack. They should not be kept one on the other.
- Documents should not store in wooden racks, they should store on steel racks.
- The best possible solution, implementation of air conditioner, is not possible for most of the college libraries of West Bengal. For university libraries, it is quite possible. In such a situation, each of the manuscript should be wrapped with an acid free paper. This paper can protect the manuscripts from natural de-acidification that grows from the atmosphere. Traditionally, manuscripts are wrapped with red coloured shaloo (cloth) to protect them from worms, insects etc. Now-a-days, manuscripts remain more safe in acid free thymol coated red boxes of different sizes.

- Air pollutants present in the air e.g. sulphur-di-oxide form sulphuric acid after reaction with humidity, absorb by palm leave manuscripts and made the papers yellow, weaker and brittle. These types of papers need de-acidification treatment. This treatment may be done by lime water and after completion of this process, these are cleaned with soft cotton balls mixed with a pinch of citronila oil or camphor oil with rectified spirit in a proportion of 3:2. Then the palm leaves should be lightly rubbed with graphite powder and citronila oil to make the inscribed letters prominent and legible. The oil increases the flexibility and durability of manuscripts. Before deacidification process, ink-testing is very necessary. If the ink is soluble, ink-fixing procedure should be followed.
• Fumigation is another process of preservation of the manuscripts to eradicate the biological enemies. In fumigation chamber, mostly used chemicals are para-di-chloro-benzene and thymol solutions.

• Manuscripts should use either in a restricted way or banned to use, otherwise the deterioration for mishandling of documents cannot be controlled.

• The most recent technique of preserving the manuscripts is 'digitization'. The whole content matter of the manuscript through scanning and filtering can be converted to metadata and the output can be seen in any electronic or micro form.

4.46. Digitized collections:

Digitized information can be stored in different kinds of storage media, such as, CDs, floppy disks etc. Digital preservation will require a continuous program of monitoring and migration which means transferring digital records to each new generation of technology. There is currently no digital storage medium that can be expected to last indefinite period. Because, how long different storage media will last depends upon many factors, such as, how they are made, what they are made of and how they are stored. The safest storage media is hard disk and removable media, it is recordable Compact Discs (CD-R). For long term storage CD-RW is less secured media than CD-R. CD-Rs that use a gold metal reflective layer and phthalocyanine (THAL-O-Cy-a-neen) – based dyes (so-called gold / gold discs), have the greatest life span than the other mentioned storage media.
After digitization in electronic forms, some special care is necessary to store, handle and cleaning them.

Storing technique:

- CDs should be stored in a stable, dust and smoke-free environment with temperature between (4.4-20)°C and relative humidity (20-55)%. These should be kept away from water lines and out of direct sunlight and it must be kept in mind that it should not be placed in hot attic, damp basement and in direct sunlight.

- The CDs and floppies should be stored in rigid jewel cases to give greater physical protection than paper sleeves, and the jewel cases should be placed vertically, like a book.

- These should be open just before use and check the disc surface before recording. The CDs should be spot checked after recording.

- The discs should be checked once a year (minimum.) to identify any visible signs of damage or deterioration.

- The existing files should be copied onto newer, fresh storage media once in a year.
Techniques of handling:

- Handle them as minimum as possible.
- Put them back in their jewel cases when not in use.
- Handle them by the edges or the centre hole.
- Don't touch the top or the bottom.
- Don't bend the discs, remove them from their jewel cases by pressing down on the hub of the case while holding the outer edge of the disc and lifting.

Method of cleaning:

- The CDs should always be cleaned only the non-label side of them and wipe from centre to edge, not in a spiral, with a lint-free cloth when absolutely necessary. Rubbing alcohol (isopropyl alcohol) may also be used when the CDs become very dirty.
- For long term preservation of CDs, encryption may be used to make sure that information is read and/or used only by authorized users.
4.5. Restoration techniques for library materials -

When the library documents are already damaged (fully or partly), to keep all the documents in usable condition, some restoration works are needed. This work can be divided into five divisions - a) Primary treatment, i.e. chemical treatment; b) Mending the damaged portions; c) Reinforcement; d) Binding; and e) Transferring the contents into reprographic media.

a) Chemical treatment -

- Firstly, the pH-value of the damaged paper has to be tested. Then, the washing process has to be followed to remove all soluble acidity from the paper. To handle wet fibres, wax papers should be used as carrier. This washing period depends on the nature of effectiveness of fibers. It must be noted that a lengthy period of immersion damages the paper. Very few papers contain soluble acidity, therefore, only to wash the paper in water is not sufficient in most of the cases. In these cases, de-acidification procedure should be followed.

- For aqueous de-acidification, calcium hydroxide solution is used. The affected papers are dipped into the solution for 20 minutes, then again dipped into calcium bicarbonate solution.

- For non-aqueous de-acidification process, barium hydroxide and methanol solution (1.81%) are used. Very brittle documents should not be put into aqueous solution and such documents are only brushed with the above chemicals.
b) **Mending** -

This is a process to restore the document in usable condition by repairing broken pieces or torn corners or rounded page ends or cut to a required shape. In mending a document, the major work is to provide reinforcement to the damaged sheets with tissue paper, attach jack net cloth to the stitched portion with glue. Likewise, the other works are re-stitching, sewing and binding / rebinding.

c) **Reinforcement** -

The de-acidification process stabilizes paper, but it cannot restore the lost physical properties. For this, it needs reinforcement. Lamination and encapsulation both are the processes to save the documents from future deterioration.

i) **Lamination** :- There are three types of lamination, which can increase the strength of the document.

- **Tissue lamination** :- In this method, documents are sandwiched between tissues with C.M.C. (Carboxyl Methyl Cellulose) paste.

- **Solvent lamination** :- In this process, one tissue paper is placed on the glass top table, over which a cellulose acetate foil is put, then over it the document, which is covered with another foil and tissue paper sticks with a piece of cotton dipped in acetone and the tissue paper is rubbed. Acetone dissolves the foil and the tissue and sticks together with the document.
- Machine lamination - The procedure is same as solvent lamination procedure, instead of acetone, machine is used to dissolve the foil by heat and pressure.

ii) Encapsulation - Encapsulation is a modern technique by which the brittle paper is provided reinforcement. In this process, two sheets of a clear inert material (polyester or poly pop nine) sealed or fastened or bound by the edges, a vacuum is created inside the capsule, where in the printed page or sheet is arrested. As a result, the paper in whatever condition remains as it is.

d) Binding -

The strength or longevity of a document can be increased through binding. There are four kinds of binding -

i) Full leather / cloth / rexine binding;
ii) Half leather / cloth / rexine binding;
iii) Hard binding ; and
iv) Paper binding.

The different stages of binding works are gathering and guarding, stiching, back rounding and backing, fixing boards and covering etc.

e) Transferring the contents into reprographic media :

If the condition of the document is too brittle or severely damaged, it is better to make a copy in electronic form or micro form.
FLOW CHART OF PRESERVATION SYSTEM

Preservation Policy at the managerial level

Should this document necessary to retain in this library?

Is the condition of the document damaged or not?

Restorative measures

Does the text portion have artifactual value?

Is the condition is brittle and has historical value?

Deacidify individual leaves and reconstruct book

Ready for binding.

Preserve in preservation box

In-house treatment

Kept in preservation box

Preventive measures

Repairing

Mending work

Minor

No

No

Yes

Yes

Mending work

Preserve documents by microfilming or using digitization technique

Purchase reprint of the document Or Photocopy of the text and binding

Preserve in preservation box

Weed out

FLOW CHART OF PRESERVATION SYSTEM

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