UNIT 4 VARIOUS PRINTING PROCESSES AND IMPOSITION

Structure

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4.0 AIMS

In this unit we would be discussing the various printing processes used in book production. We would also be discussing the Imposition of pages while printing. This would help the publisher to decide the mode of printing which would be most economical to adopt for any particular job he undertakes. The understanding of the imposition scheme would make the publisher wise enough to plan the pages in a form to give a pleasant look to the book, economically.

4.1 INTRODUCTION

Before we deal with the various printing processes, we should understand what production is all about. Production is nothing but reproduction of a document in multiple copies. Reproduction does not mean preparing the second copy of the same document all over again as even if you do the second copy all over again manually, it cannot be the same as it was made at the first instance. There would always be some difference even though it may not be visible by naked eye. Thus, what are the various processes of reproduction you can think of which can provide you the replica of the original? Some of the most common processes which can be thought of and also used in every household are carbon copy, rubber stamp, stencil, photography, photocopy, cyclostyling, etc. These are the processes when you require a limited number of copies for your personal use and not for commercial purpose. In this unit, we would not be dealing with such processes but with the reproduction processes which are used for commercial purposes.

4.2 MAJOR PRINTING PROCESSES

The major printing processes can broadly be divided into two basic categories: the Direct Printing Process and the Indirect Printing Process. The Direct printing process as is evident from the term, is transferred directly from the print image to the substrate, say paper or any other material. The substrate directly comes in contact with print image for the transfer of image. The print image therefore has a negative image and as it comes in contact with the substrate for transfer of
image, it gets a positive image. The printing processes under this category are mainly the Letterpress Process, Lithography, Gravure Process, Silk Screen Process etc.

In the Indirect Process, the substrate does not come in contact with the print image at any stage. In this process, the image is transferred to an intermediary that comes in contact with the substrate for the transfer of image. Therefore in this process, the print image is a positive image which gets transferred to the intermediary to get a negative image and the same is transferred to the substrate as a positive image.

The major printing processes are illustrated below:

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### 4.3 RELIEF PRINTING

From the above illustration, it can be seen that the main three processes which comes under the category of **Relief Printing** are Letterpress, Dry Offset and Flexography. In the Relief Printing Process, the image area stands out in ‘relief’ (raised above the surface of non image area) which receives the ink and then transfers the ink onto the paper. The different printing processes in this category are discussed below:

a. **Letterpress**: Letterpress is the oldest method of printing where image is printed by the “relief” type printing surface. In this process the image area or the printing area are raised above the non-printing areas. When the ink is applied on the printing surface, the ink is received only by the raised areas and not by the depressed areas which are the non printing areas. When the substrate comes in contact with the printing surface, the image on the raised areas get transferred into it. The print image is the mirror or negative image on the printing surface which becomes positive image on transfer. The following illustration would help you in better understanding the process.
Letterpress printing is meant for printing text comprising of not only letters but also other visuals such as borders, rules, and illustrations in black and white or colour. The term *letterpress* has become popular as the early attempts were focused only on printing of letters. Since letters are cast separately for letterpress printing, other visuals can also be made separately, and then arranged together on a page or pages.

There are mainly three types of machines involved in letterpress printing, i.e., Platen, Flatbed cylinder and Rotary. The operations of inking, paper-feeding, printing, and delivery are common to all these machines.

**Platen letterpress:** This press consists of two plane surfaces, one of which is used for placing the paper for printing and the other is used to carry the image. The arranged image (forme) is locked firmly on this plane and is called image carrier. The inking is done by ink rollers, which pick up ink from a revolving disc fixed above the machine, and then pass it across the forme. The paper is fed by inserting it between the two flat surfaces. These two surfaces are then pressed together to print the required image. This output is taken out in the form of printed paper when the two surfaces are open or separated. The feeding and the delivery system may be manual or automatic.

Platen press is slow but is ideal for printing letterheads, cards, and other short run jobs. It can also be used for embossing, die cutting, creasing, and hot-foil stamping etc.

**Flatbed cylinder letterpress:** In the platen press, there are two plane surfaces, one for holding the paper and one for holding the image. In flat-bed cylinder press, while the image carrier remains a plane surface, the paper carrier (impression cylinder) is cylindrical. The ink rollers rotate over the flat surface, which carries the image, and the cylinder is used to roll over and press the paper against it. Since there is a revolving impression cylinder and the machine is automatic, the printing speed is quite high. This press brought a revolution in the printing industry and the machine was efficient enough to print considerably longer run jobs and much bigger paper sizes.
Rotary letterpress: Letterpress process of printing improved further when both the surfaces were made cylindrical. The type forme (image carrier) was converted into a cylindrical plate, another cylinder is rolled against it, and paper passes between both the cylinders. In this process, the flat image carrier had to be converted into a half cylinder for rotary printing. To achieve this, the arranged pages in the flat image carrier is transferred to flexible flongs made of papier mâché by applying high pressure against the metal types. The depressed image in the paper flong is fed into a casting box where it is converted into a lead version called a stereo, which is half-cylindrical in shape. The stereo plates are then fitted to the cylinders of the rotary machine and thus the cylindrical image carrier is ready for printing.

This process of letterpress printing was very popular for newspaper printing industry until the 1980s.

b. Flexography: Flexography is a rotary relief printing process. Here the images are made in relief on a rubber plate molded from an intervening matrix plate or photopolymer plate exposed to ultraviolet light. The plate is thin and mounted onto the plate cylinder as in a rotary press. A thin and fast drying ink is applied to the plate with the help of a metal roller, known as anilox roller. This hard surfaced roller is etched to create a number of tiny cells of equal size and depth. The ink is filled in these cells of the roller while revolving into the ink drum and the excess ink is wiped off by a doctor’s blade. The function of the depressed surface of the roller is to distribute the ink evenly to the plate. The inked plate then makes an impression onto the substrate.

Originally, flexo printing was of very low quality. However since the 1980s, great advances have been made, including improvements to the plate material and the method of plate creation by photographic exposure followed by chemical etching.
and laser engraving. The laser etched anilox rolls also play a part in the improvement of the print quality. This process of printing is mainly used for the printing of flexible packaging material, corrugated boxes, retail and shopping bags, food and hygienic bags, self adhesive labels, flexible PVC and film and wall paper etc.

![Flexography process of printing](image)

**c. Dry Offset:** Dry offset is also called letterpress or indirect relief printing. This is a printing process where the characteristics of letterpress process combine with the offset process of printing. In this process, a special plate prints directly onto the blanket of an offset press and the blanket then offsets the image onto the paper. The process is called dry offset because the plate is not dampened as it would be in the offset lithography process.

The dry offset process is generally used for printing on paper, plastics, metals, security printing and air tickets etc.

### 4.4 PLANOGRAPHY

Planography is the process of printing from a flat surface, unlike the printing from a raised surface as in relief printing. In this process of printing, the image area (printing area) and the non-printing area both are on the same surface. It is based on the principle that water does not mix with oil. This process is used to produce lithographs or offset lithographs by applying a greasy substance to a metallic plate or stone.

**Lithography:** *Litho* means ‘stone’ and *grapho* means ‘write’. In this process a flat limestone is used as an image carrier and the printing process is based on the principle that grease and water do not mix. This is also a direct process of printing where the mirror image (negative image) is printed with greasy ink or crayon on a flat smooth surface of the stone slab. The fine-grained limestone has an excellent capacity to absorb water. The stone surface is thus dampened with water and then inked by an ink roller. The grease based image areas will accept oil-based ink but the non-image areas will repel the ink because of water. After being inked and watered, the paper is laid on the top of the thick stone and pressed against the inked stone and the readable image is printed on the paper. This lithographic process of printing has now advanced to the offset lithography process of printing.

**Offset lithography:** The letterpress process of printing has almost become obsolete and today offset lithography has become the most popular process of printing and most of the jobs are being printed by this process for commercial purposes.
In offset printing, the image area and the non-printing area, both are on the same plane of the surface of a thin metal plate. The difference between the printing and non-printing area is maintained chemically. The print area is made oil based ink receptive and the non-printing area is made water receptive. The printing is done from a plane surface that is neither raised nor depressed and there are three surfaces unlike two in other processes of printing. Here, the additional surface receives the image from the image carrier surface and then sets it off to the paper. This is the reason why this process of printing is termed as the 'Offset Process' of printing.

An offset press is also rotary. As it can be seen from the following illustration, it has three cylinders that are named as plate cylinder, blanket cylinder and impression cylinder. The plate cylinder is the image carrier which carries the plate with the image to be printed. The blanket cylinder carries a rubber sheet to which the image carrier transfers the image. The impression cylinder presses the paper against the blanket cylinder to transfer the impression to the paper.

The offset press also has an additional unit besides the feeding, inking, printing and delivery units. This unit is called the dampening unit, which applies water or the dampening solution to the plate.

In an offset printing machine, a thin metal sheet with a planographic image (positive image) is wrapped around the plate cylinder. The dampening rollers coat the plate with water or the dampening solution, the ink rollers inks the image area of the plate and the inked image is then transferred to the rubber blanket cylinder. The image on the rubber blanket cylinder is in reverse, which turns into a positive image when transferred onto the paper. The paper comes between the rubber blanket and the impression cylinder. The rubber blanket being water repellent protects the paper from distortion. The paper picks up the image as it passes between both the cylinders.
Since the plates for printing by offset process are made by photography, this process of printing is also called 'photo offset processes'. Here the printing is divided into three stages, that is, pre-press, press and post press. All these stages need a detailed discussion.

**Pre-press:** This stage involves all the processes, which are required to be executed before the job actually goes to the press for printing, i.e., typesetting, formatting the text pagination, arranging the pictures and graphics as per the requirement of the job, film outputting of formatted text and plate making.

The paginated films are pasted in their proper position in a flat plastic sheet to make it a forme of 4 or 8 or 16 pages depending on the size of the paper to be used and the size of the machine. The compositions of stripped negative or positives are called **flats**.

Various materials, such as zinc, paper, plastic and foil can be used for making the offset plates, but the most common one is aluminum. The plates are mechanically grained to hold the necessary moisture at the time of printing. They are then coated with a wipe-on solution that enables them to be imaged from either negative or a positive film. There are various types of plates which are used in offset printing which are:

**Surface or Helio Plates:** These plates are made from negatives. The plate is coated with a light-sensitive emulsion and then dried. The negative flat is placed over the plate and exposed under a high-intensity arc lamp. The light is through from the transparent (image) area of the negative which makes the plate coating hard and water repellent. The coating on the non-image area remains soft and is washed off by water and the image area which is hard remains on the plate. When the image is developed by the developing solution, it becomes visible and greasy. These types of plates are economical for short run jobs without halftone illustrations.
Preparing flats by negatives

Deep-etch Plates: Plates made from positives are called deep-etch plates. Here, the non-printing areas are exposed to light whereas the image area remains soft and is etched while developing the plate chemically. The etched area is filled with greasy ink in order to give the image area a receptive quality for the ink. Deep-etch plates are suitable for long run jobs with fine halftone and multi-coloured work.

Preparing flats by positives

Pre-sensitized Plates (PS plates): This is another variety of readymade coated plates which are now commonly used in offset printing. These plates can be exposed by passing light through either negatives or positives. Accordingly they are called negative working or positive working plates. These plates are developed by an automatic processor. The exposed emulsion of the positive working plate is removed by wiping it with a special developer and the unexposed area in the negative working plate is removed with a special developer and lacquer is rubbed on the plate to make the image area strong. The qualities of PS plates enable the offset press to be more efficient and clean. The PS plates are available in a wide
range depending on the print run of 1000 to 4 to 5 lakh impressions. (n.b. one lakh equals 100,000).

**Computer-to-Plate:** Computer-to-plate technology is a new addition in the modern printing technology. This technology eliminates one of the most important steps of plate making, i.e., the films. In this system, the computer systems allows digital data to guide lasers in the direct imaging of a flexible plate that is loaded in a dedicated plate exposure unit, commonly called as the plate setter. The quality of the plate made by this process is very high because it reduces the mechanical concerns of registration problems and dot gains as there is no generation loss between the media that makes the plate a high-quality one and ensures extremely accurate dot placement.

**Press:** This is a stage where the actual printing is done. An offset press can be of single colour to six colour machine. It can be a sheet-fed press, web-fed press or a press with perfection. These presses are capable of handling different sizes of paper. A single colour press, which has only one unit comprising of feeding, dampening, inking, printing and delivery units, can print one colour at one point of time. A two colour machine will have two such units and can print two colours simultaneously at one go. Similar is in the case of four, five and six colour machine. In sheet-fed offset, one sheet is fed to the machine at one time.

In web-fed offset press, a paper roll is fed in the feeder of the machine and it prints on a continuous roll of paper and operates at a higher speed than the sheet-fed press. Publications like newspapers, magazines and books with a high print run are generally printed on these machines.

In the offset press with perfection, both sides of the paper can be printed simultaneously at one go. In these machines, there are two plate cylinders, two blanket cylinders, one delivery cylinder and one registration cylinder. The press also has two sets of inking and dampening units. The lay out of the offset press with perfection is displayed in the illustration below.

**Post-press:** This stage deals with all the post press operations such as folding, binding, packing etc. The post press operations would be dealt separately in this block.

### 4.5 INTAGLIO PROCESS

The intaglio process, also known as the Gravure process of printing, is just opposite to the theory of the letter press process of printing. Unlike the letterpress process
where the image area is at a relief, here the image area is a sunken or depressed surface and the non-printing area is on a raised surface. In this process of printing, the image areas consist of honeycomb shaped cells or wells that are etched or engraved into a copper cylinder. The unetched areas of the cylinder represent the non-image areas. The cylinder rotates in bath of ink called pan. As the cylinder turns, the excess ink is wiped off the cylinder by a flexible steel blade (Doctor Blade). The ink remaining in the recessed cells forms the image by direct transfer to the substrate as it passes between the plate cylinder and the impression cylinder. The paper then goes through a dryer because it must be completely dry before going through the next colour unit and absorbing another coat of ink.

The advantages of this printing process are consistent quality, sharp and fine printing, useful for high speed long run printing, adaptable to less expensive paper. The disadvantages of this printing process are that this process is not feasible for short run jobs, since the plates are made of copper, it is very expensive, It is difficult to print thin line and fine text, specially in reverse by this process of printing.

### 4.6 SCREEN PRINTING

Also known as silk-screen printing or stencil printing id obtained by spreading and forcing ink through a stencil, screen or mesh of silk fabrics. It is a printing technique that creates a sharp edged image using a stencil.

Screen printing consists of three elements: the screen, which is the image carrier, the squeegee, and ink. In screen printing, the woven fabric is first stretched tightly. Then it is tacked or stapled on a wooden frame. The non-image parts of the cloth have to be blocked out by paper, adhesives or chemicals leaving the areas to be printed free so that the ink or colour can be spread and forced through them with a rubber squeegee.

![Screen Printing](image)

A stencil is produced on the screen either manually or photo-chemically. The stencil defines the image to be printed. Silk-screen printing ink is applied to the substrate by placing the screen over the material. Ink is placed onto the top of the screen and then forced through the fine mesh openings using the squeegee. The ink would pass through only in areas where no stencil is applied, thus forming an image on the printing substrate. The diameter of the threads and the thread count of the mesh will determine how much ink is deposited onto the substrate.

Screen printing is simple and is a very cost effective process. The image can be transferred to almost any surface, whether flat or odd-shaped. Any colour whether opaque or, transparent glossy or matt enamel paints, plastic colour, fluorescent paint or textile colour can be used in this printing process. The printed image looks like original because of its high relief quality and brilliant colours. This is the only process where over-printing by light colours is also possible.
The screen printing also has some limitations. It cannot achieve fine details and print halftones. The use of photographic systems has brought some degree of screen but not the quality achieved by other process of printing.

### 4.7 IMPOSITION

When printing is done, each individual page is not printed separately. It is always printed in groups of pages known as a forme. Imposition is the operation of arranging the pages in a form in such a way that on folding the forme, the pages appear in a chronological sequence. There are many different ways of arranging pages for printing, planning for imposition and subsequently printing. The imposition scheme to be followed always depends on the type of folding and also the requirements of a particular folding machine. The pages must be so spaced and arranged that they would come in the right order and also have the right margins after the sheet is folded to a page size.

The method of binding to be adopted also has an important bearing on the margin and arrangement of pages at the time of imposing. The person doing the imposition should have a sound knowledge of the marginal terms. Before the different schemes of imposition are discussed, we should understand the marginal terms used in imposition.

**Marginal Terms:** The spaces between the pages, which when printed, folded and trimmed appear in correct position as planned on the forme, are the margins. These margins are known by the following terms:

- **Heads**: The space between pages which are placed head-to-head are called head margins.
- **Back**: The space between two pages, when folded forms the back of the book is called back margins.
- **Tails**: The space between pages placed foot to foot keeping the trimming space is called tail margins.
- **Gutter**: The space between the sides of the sheet is called gutter margin. This space is kept taking into account the requirement of the machine which it requires for picking the paper and forwarding it for printing. This margin varies from machine to machine.
- **Fore-edges**: The fore-edge margin, if the margins are allocated properly, is generally half of the gutter margin.

The imposition scheme is different for each working. It is different for Sheet-work, Half-sheet work, and Work and twist working. These are being discussed now:

**Sheet work:** In this imposition scheme, two formes (Plates) are printed in one sheet of paper, i.e., one forme on each side is printed. In this process after printing both the sides, one complete section is printed.
Half-sheet work for 16 pages forme

**Half-sheet work:** This method is also known as *Work and Turn* method. In this method, both sides of the paper are printed by the same plate. After printing, the sheets are cut into half to get a section.

**Work and Twist:** A method used quite often for jobs with diagonal workings. Jobs are composed in two sections. For example the down rules would be made up as a separate section. The two sections however would be imposed in one chase in such a manner that after the first working the stock is turned round and fed in again but to the opposite edges. Thus the job is completed by printing twice from the same forme on the same side of the sheet but using different edges. The horizontal rule section being over printed by the down rules and two completed copies produced on each sheet. Normally, the pages rules are contained in one half of the forme and the vertical rules of the pages are contained in the other half. The stock must be accurately trimmed dead square before printing and should be twice the size of the finished job.

All the imposition schemes discussed here were meant for section sewing /perfect binding or side stitching jobs. For centre stitched jobs, the imposition scheme would be entirely different.

**Centre Stitched Imposition Work:** In a centre stitched job, the first pages and the last pages are printed in the same sheet of paper. In a book containing 24 pages, the following pages would make an 8 pages forme:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24</td>
<td>23</td>
<td>22</td>
<td>21</td>
<td>20</td>
<td>19</td>
<td>18</td>
<td>17</td>
</tr>
</tbody>
</table>
The imposition schemes of different working as discussed in earlier sections are also applicable in centre stitched binding books, i.e., Sheet-work, Half-sheet work, and Work and twist working.

### 4.8 SUMMING UP

In this unit, we have discussed different processes of printing. We have discussed in detail about the letter press process, offset process, gravure process and silk screen process of printing in detail. We have discussed about what is an imposition. We have also discussed different methods of imposition schemes for both section sewing and centre stitched books.