UNIT I

Metal Casting Processes

Metal Casting Processes

✓ Centrifugal casting

- *Centrifugal casting is also known as* ***rotocasting,*** is a casting technique that is typically used to cast thin-walled cylinders. It is noted for the high quality of the results attainable, particularly for precise control of their metallurgy and crystal structure. Unlike most other casting techniques, centrifugal casting is chiefly used to manufacture stock materials in standard sizes for further machining, rather than shaped parts tailored to a particular end-use.
- *Centrifugal casting was the invention of* ***Alfred Krupp****, who used it to manufacture cast steel tyres for railway wheels in 1852.*

How is centrifugal casting done?

- *In centrifugal casting, a permanent mold is rotated continuously about its axis at high speeds (300 to 3000 rpm) as the molten metal is poured. The molten metal is centrifugally thrown towards the inside mold wall, where it solidifies after cooling.*
- *The casting is usually a fine-grained casting with a very fine-grained outer diameter, owing to chilling against the mould surface. Impurities and inclusions are thrown to the surface of the inside diameter, which can be machined away.*
- *Casting machines may be either horizontal or vertical-axis. Horizontal axis machines are preferred for long, thin cylinders, vertical machines for rings.*

- *Most castings are solidified from the outside first. This may be used to encourage directional solidification of the casting, and thus give useful metallurgical properties to it. Often the inner and outer layers are discarded and only the intermediary columnar zone is used.*

Features of centrifugal casting:

- *Castings can be made in almost any length, thickness and diameter.*

- Different wall thicknesses can be produced from the same size mold.

- *Mechanical properties of centrifugal castings are excellent.*
- Only cylindrical shapes can be produced with this process.
- *Size limits are up to 3 m (10 feet) diameter and 15 m (50 feet) length.*
- Wall thickness range from 2.5 mm to 125 mm (0.1 - 5.0 in).

BENEFITS

- *Cylinders and shapes with rotational symmetry are most commonly cast by this technique*
- *Thin-walled cylinders are difficult to cast by other means, but centrifugal casting is particularly suited to them. To the rotation radius, these are effectively shallow flat castings and are thus simple.*

The following factors affect the choice of a pattern.

(i) Number of Castings to be produced.

(ii) Size and complexity of the shape and size of casting

(iii) Type of molding and castings method to be used.

(iv) Machining operation

(v) Characteristics of castings

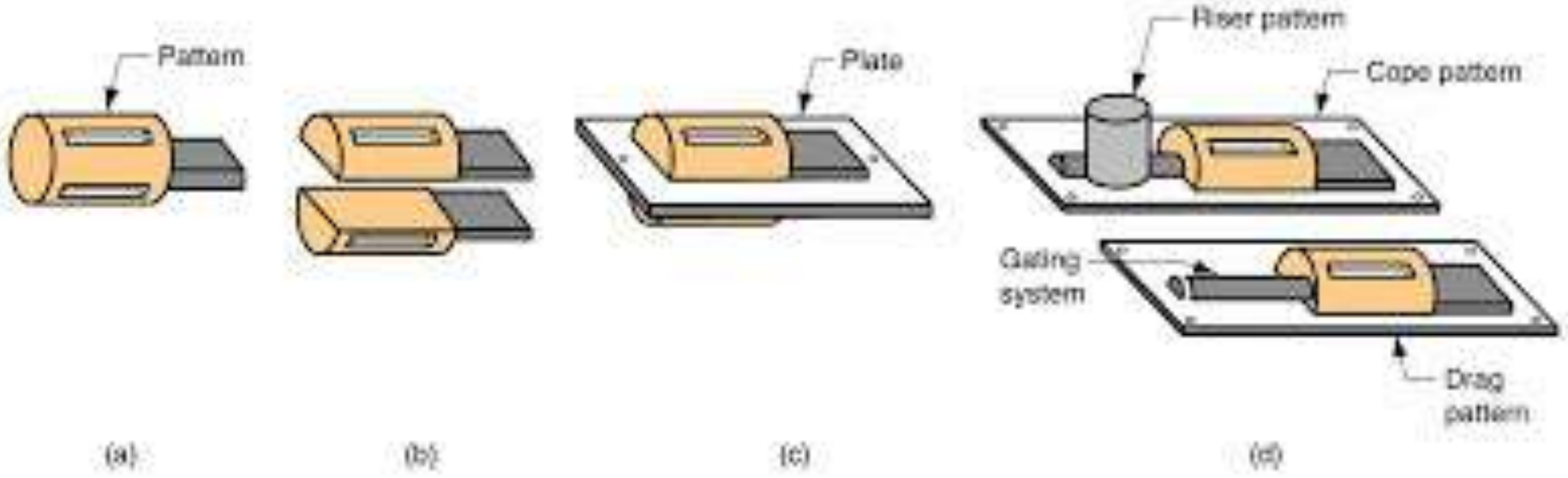
Different types of patterns:

The common types of patterns are:

1) Single piece pattern
2) Split piece pattern
3) Loose piece pattern
4) Gated pattern
5) Match pattern
6) Sweep pattern
7) Cope and drag pattern
8) Skeleton pattern
9) Shell pattern
10) Follow board pattern

Single piece pattern:

This is the simplest type of pattern, exactly like the desired casting. For making a mould, the pattern is accommodated either in cope or drag.
Used for producing a few large castings, for example, stuffing box of steam engine.

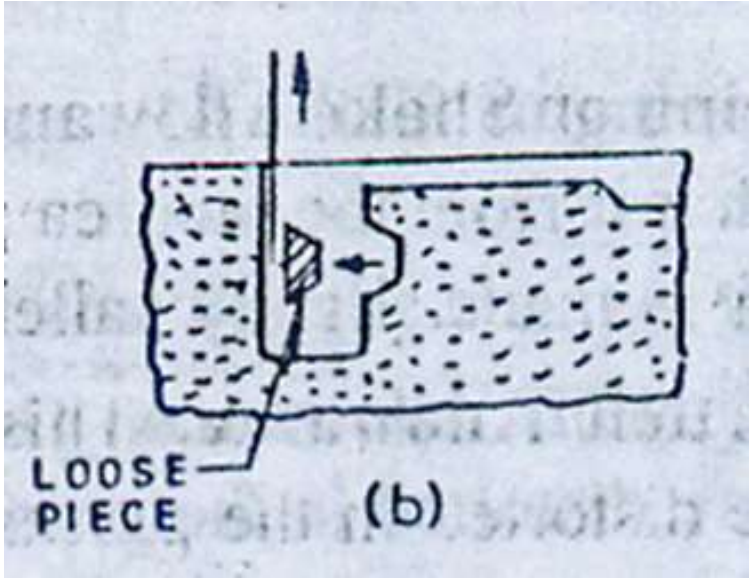


Split pattern:

These patterns are split along the parting plane (which may be flat or irregular surface) to facilitatethe extraction of the patternout of the mould before the pouring operation. For a more complex casting, the pattern may be split in more than two parts.

Loose piece pattern:

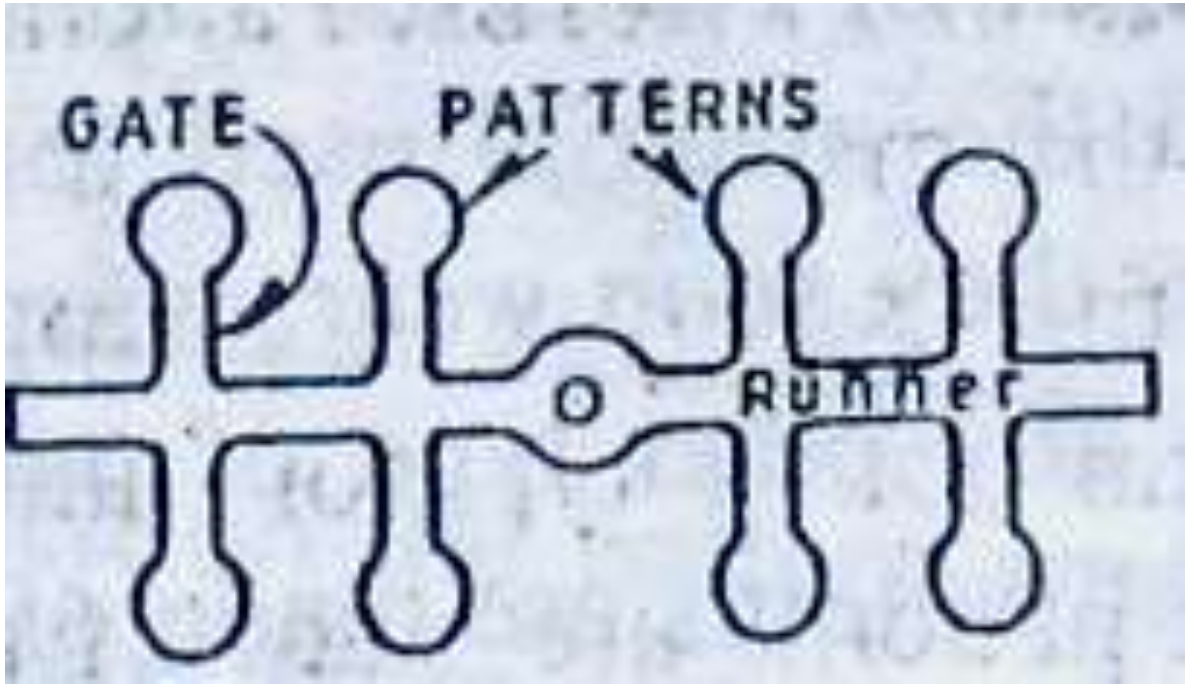
When a one piece solid pattern has projections or back drafts which lie above or below the parting plane, it is impossible to with drawit from the mould. With such patterns, the projections are made with the help of loose pieces. One drawback of loose feces is that their shifting is possible during ramming.



Gated pattern:

A gated pattern is simply one or more loose patterns having attached gates and runners.

Because of their higher cost, these patterns are used for producing small castings in mass production systems and on molding machines.

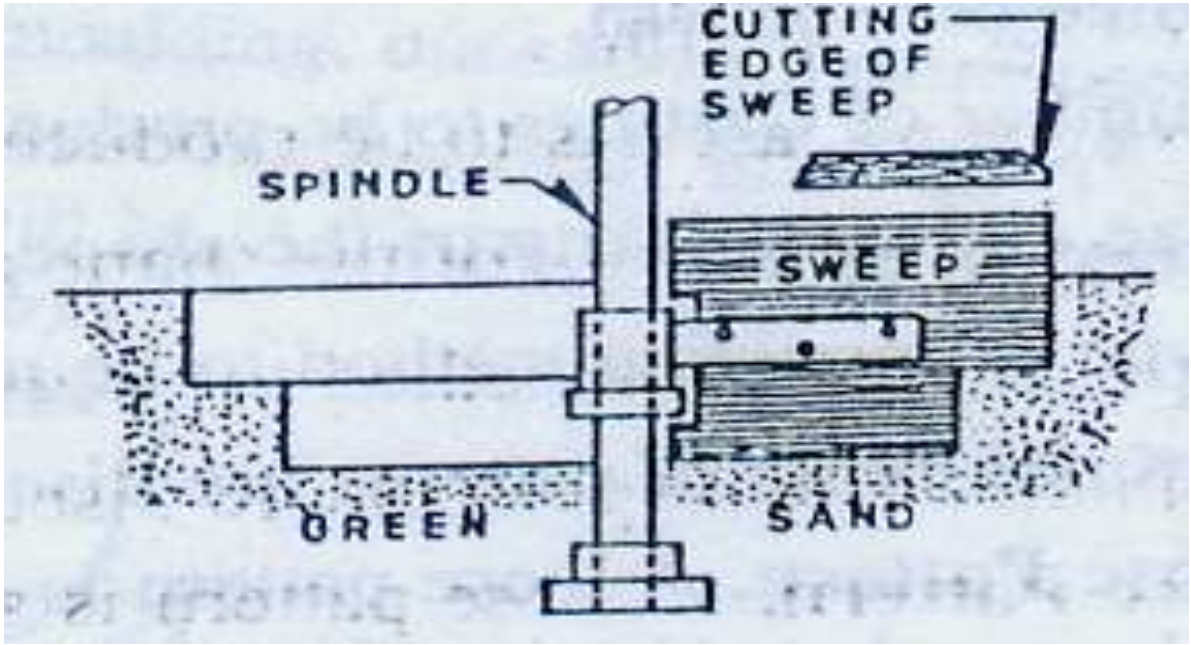


Match plate pattern:

A match plate pattern is a split pattern having the cope and drags portions mounted on opposite sides of a plate (usually metallic), called the "match plate" that conforms to the contour of the parting surface. The gates and runners are also mounted on the match plate, so that very little hand work is required. This results in higher productivity. This type of pattern is used for a large number of castings. Piston rings of I.C. engines are produced by this process.

Sweep pattern:

A sweep is a section or board (wooden) of proper contour that is rotated about one edge to shape
mold cavities having shapes of rotational symmetry. This type of pattern is used when a casting of large size is to be produced in a short time. Large kettles of C.I. are made by sweep patterns.

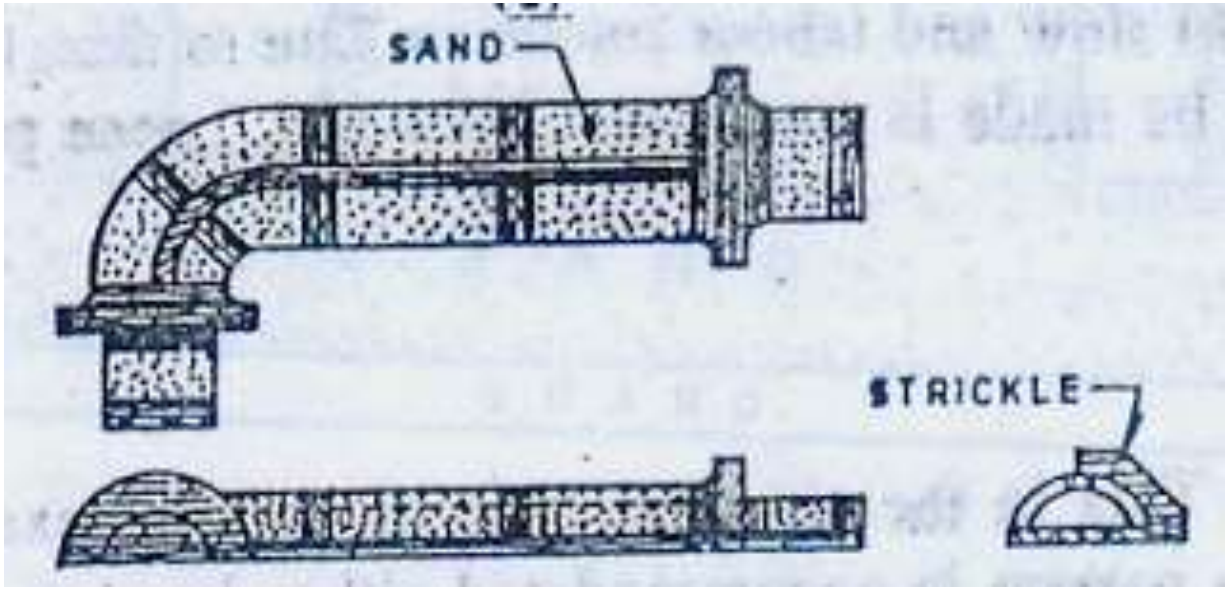


Cope and drag pattern:

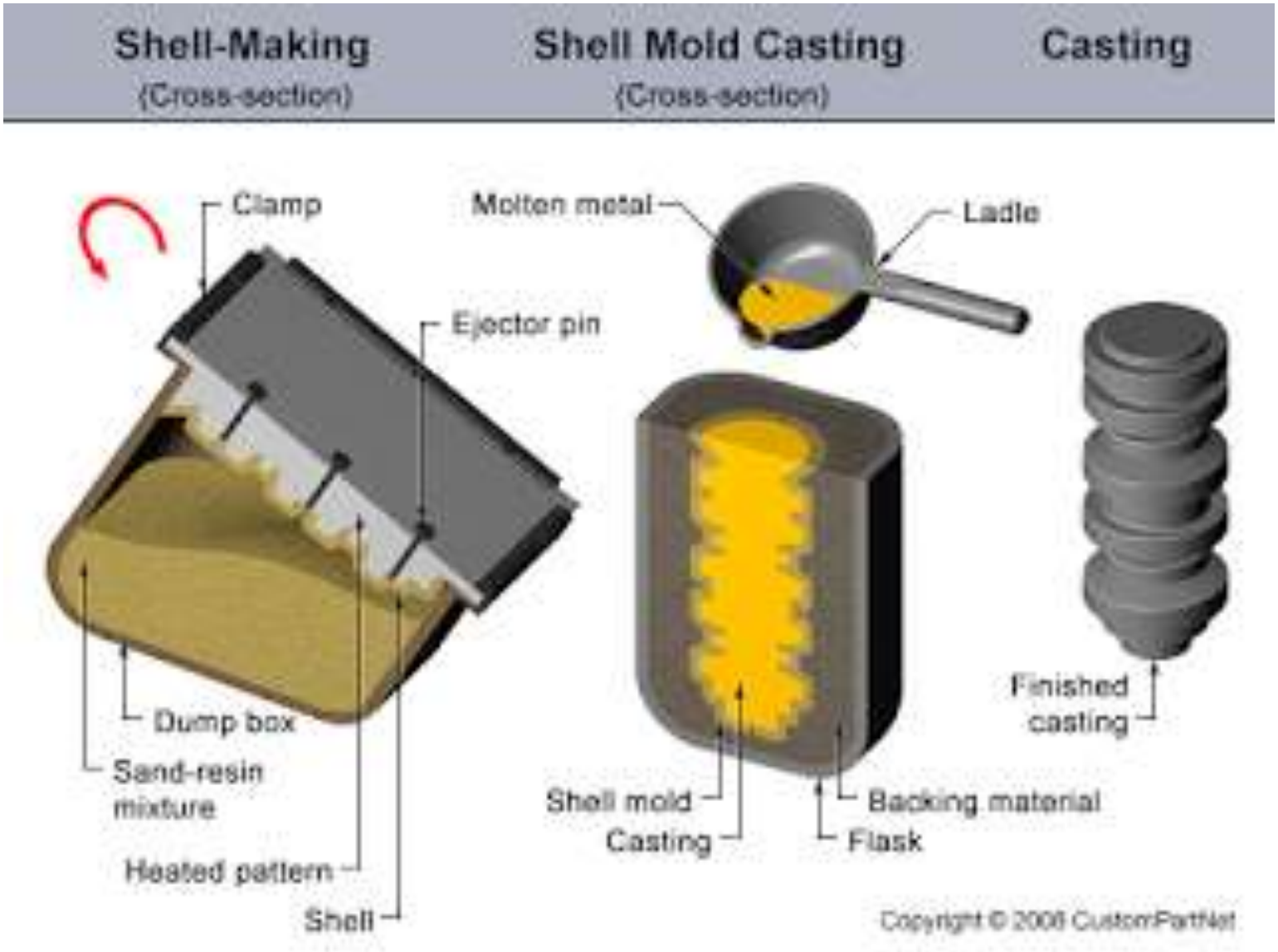
A cope and drag pattern is a split pattern having thecope and drag portions each mounted on separate match plates. These patterns are used when in the production of large castings; the complete moulds are too heavy and unwieldy to be handled by a single worker.

Skeleton pattern:

For large castings having simple geometrical shapes, skeleton patterns are used. Just like sweep patterns, these are simple wooden frames that outline the shape of the part to be cast and are also used as guides by the molder in the hand shaping of the mould.
This type of pattern is also used in pit or floor molding process.

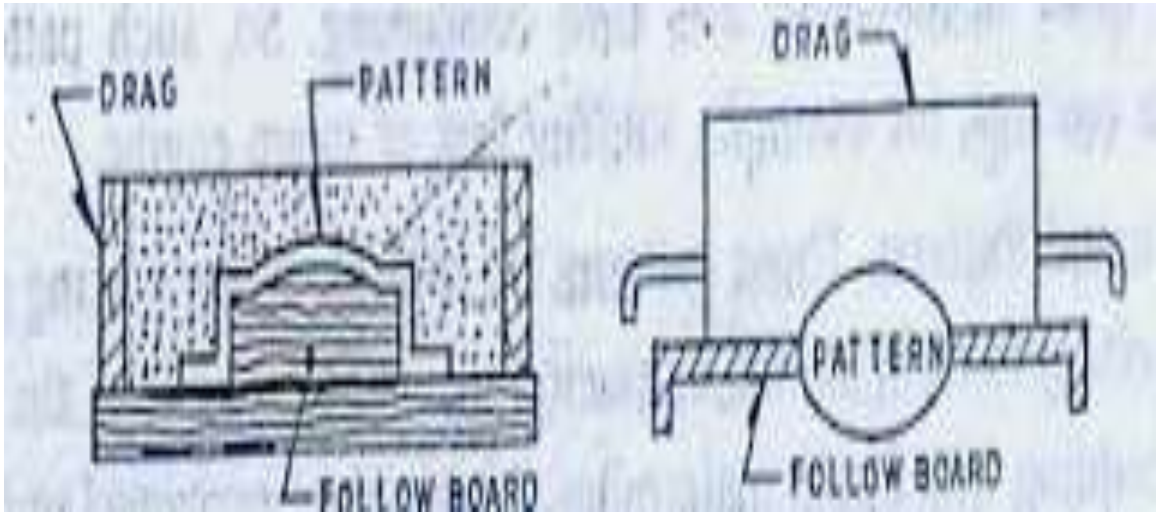


Shell pattern:



Follow board pattern:

A follow board is not a pattern but is a device (wooden board) used for various purposes.



References

1. Manufacturing Technology, Volume-I, Fourth Edition by PN RAO, McGraw Hill Education (India) Private Limited
2. Manufacturing Processes, Second Edition by H.N. Gupta, R.C. Gupta, Arun Mittal, New Age International (P) Ltd PublishersIbrahim Zaid (2006), Mastering CAD/CAM, 2nd Edition, Tata McGraw-Hill, ISBN: 978-0-070-63434-3.
3. Manufacturing Process Technology I & II, Course instructor: Prof. Shantanu Bhattacharya, Associate Professor, Department of Mechanical Engineering, Indian Institute of Technology, Kanpur.
4. Course url: https://onlinecourses.nptel.ac.in/noc17_me03
5. A Text Book of Manufacturing Technology (Manufacturing Processes) By RK Rajput, Laxmi Publications Private Limited
6. S. Jung, T. W. Simpson, New modularity indices for modularity and clustering of product architecture, Journal of Engineering (2017) 1–22. doi:10.1080/09544828.2016.1252835.

Thank you