3. 3 Scaffold Fabrication Technologies:
A number of scaffold fabrication technologies have been developed or adopted from other disciplines for tissue engineering. There are three basic categories: three-dimensional polymeric scaffold fabrication, fiber and textile fabrication.

1- Three-Dimensional Polymeric Scaffold Fabrication:
These techniques including many methods which proposed and utilized in fabricating three-dimensional scaffolds from polymeric materials.

a) The Stack Method:
The stack method is a very simple way to create a three-dimensional frame structure using small disks with notches, which allows for the stacking of the disks with each other into three-dimensional architectures. This method is similar to the children's building practice using toy bricks. The assembled structure fulfills the tensegrity concept very well and has good mechanical support in the early stages of application. However, the problem with this method is that it requires use of a large amount of polymer in order to form a stable three-dimensional object. The use of too much material with biodegradable polymers is not desirable because it may produce abundant acidic by-products, which may disturb the local environment and affect cell viability and function.

b) Solvent Casting:
Solvent casting is based on the evaporative property of some solvents in order to form scaffolds by one of two routes. One approach is to dip a mold into the polymer solution and allow sufficient time to draw off the solvent, which leads to the formation of a layer of polymeric membrane. The other way is to place the polymer solution in a mold, and allow sufficient time for the solvent to vaporize, which leaves behind a layer of membrane adhering to the mold. This technique is very simple, easy, and inexpensive and there is no need for specialized equipment and no large effects on the degradation behavior. However, it uses highly toxic solvents which can denature proteins and other incorporated molecules. There is also the possibility for retention of toxic solvent within the scaffold, although this can be overcome by allowing the scaffold to fully dry and by using a vacuum process to further remove any solvent. However, this is a very time consuming and labor intensive fabrication process. Some researchers have combined other techniques with solvent casting to obtain more features in the scaffold and avoid the disadvantages with solvent casting. For example, when combined with particle leaching techniques, scaffolds with 20% — 50% porosity can be obtained. However, this process only works for the construction of very thin scaffolds. Otherwise, it is very difficult to completely dissolve the soluble porogen particles.
from the core of the scaffolds. If the scaffolds are too thick, particles may remain in the scaffold. One method to overcome this problem may be to use the lamination principle to glue multiple thin porous sheets into a thick three-dimensional architecture. However, this is a very time consuming process.

c) Spin Casting or Spin Coating:
Spin casting or spin coating is based on the same principles as solvent casting. It can be classified as a sub-type of solvent casting. Briefly, the polymer to be deposited is dissolved in a solvent in order to make a polymer solution. The substrate, usually a glass cover slip or a silicon wafer, is held by vacuum on a chuck. The solution is then applied to the substrate, which is rotated at an adjustable high speed. The solution spreads over the surface under centrifugal forces, which also causes some of the solvent to evaporate. A thin film of polymer is formed on the substrate. By varying a number of fabrication parameters, such as rotation speed, acceleration, spinning time, solution viscosity, and solution density, films with different thicknesses can be fabricated. However, the thickness that can be obtained is very limited.

d) Particulate Leaching:
Leaching is one popular approach used in tissue engineering to fabricate porous scaffolds. Pores or channels are created using porogens, such as salt (NaCl), wax, or even sugar. Briefly, the polymer is dissolved in a solvent and porogens with the desired shape and size are placed into the mold with a previously determined arrangement. The solution is poured into the mold, which is filled with the porogen. Then the solvent is evaporated and the polymer/porogen composite is formed. The final step is leaching of the porogens by using an appropriate solvent. For example, water is used as the solvent to dissolve salt and sugar. By controlling the amount of porogen added and the shape and size of the porogens, scaffolds with different microstructures can be fabricated. Depending on the types of porogen used, there are three types of leaching techniques: particle leaching, ball leaching, and fiber leaching.

e) Supercritical Fluid Gassing Process:
This technique is adopted from other areas as it has been used for decades in both the packaging industry and in the pharmaceutical industry. This technique is based on the fact that polymers can be plasticized when employing high-pressure gas, such as nitrogen or carbon dioxide. The viscosity of the polymer will decrease when the gas diffuses into and becomes dissolved in the polymer. The biggest advantage of this technique is that polymers can be processed at normal body temperatures, which allows for the incorporation of heat-sensitive drugs and
biological agents. Another advantage is that a high porosity, of up to 90% with pore sizes ranging from 50 — 400 µm can be easily obtained. However, only polymers with a high amorphous fraction can be processed using this technique and only about 10% — 30% of the pores are interconnected, which may be overcome by combining this technique with particle leaching to gain a highly interconnected network.