QUESTION BANK

TWO MARK QUESTIONS

UNIT I - INTRODUCTION TO 3D PRINTING

1. What is 3D printing?

3D printing also known as additive manufacturing is a process of creating three dimensional physical objects from a computer model or digital file. The physical object is made from the printer nozzle laying down consecutive layers of material such as plastic filament until the entire part is fully formed. The technology makes It possible to create any geometry imaginable, taking your creativity to the next level.

2. What Are The Limitations Of 3d Printing?

Although it is already deeply implemented in the world of prototyping, 3D printing is still some years away from having a breakthrough in the world of manufacturing. This breakthrough would allow 3D printing to spread from just prototyping, with the exception of select components already being manufactured by 3D printers, to being widely implemented in everyday manufacturing processes all over the world.

The main aspect keeping this from happening sooner is the relatively long time it takes to 3D print something that can just as well be manufactured using traditional methods (and we all know that time means money).

3D printing is also limited by the size of the 3D printer. Although there are some pretty big units 3D printing with cement, for example, high-quality and precision parts are limited to smaller machines which can also be very expensive depending on what they are designed to be capable of.

3. What Types Of 3d Printing Filaments Are There?

There are many different kinds of 3D printing filaments. First of all, they come in two conventional diameters: 1.75mm and 3.00mm.

The most common materials used in FDM 3D printing are PLA and ABS. They are popular for their ease of use (ABS being a little more complicated to 3D print), and their affordability.

But as far as what materials you can print with are concerned, there are almost no limits. It is possible to print in pure metal, food and all sorts of thermoplastics whereby metal and food don't come in filament form for obvious reasons. But don't be confused, if you see a spool of filament that says metal on it. In this case, metal dust is mixed with thermoplastic material for use in desktop FDM 3D printers.

4. What are the benefits of 3D printing?

Like most emerging technologies, 3D printing offers benefits in a lot of areas. These include improvements in financial, logistical, healthcare, creative and environmental areas.

For one, the technology allows for endless customization with regards to design and material. One notable example of this benefit is in the healthcare sector. Complex prosthetic limbs can be produced precisely to individual needs for a much lower price.

In the area of aerospace, complex parts that take a long time to assemble can now be 3D printed in one go. This speeds up the assembly line and reduces the cost of the finished product. Also, mass production in higher numbers is made possible.

3D printing enables designers to rapid prototype, ultimately saving time in the design process. This allows new or improved products to hit the market much sooner than with conventional means.

3D printers are portable. That allows end products or components to be 3D printed where and when they are needed and thereby lowering or eliminating inventory needs. Satellites, for example, will most likely be 3D printed in space in the future.

Since 3D printing utilizes the concept of adding material rather than subtracting material, the process leaves behind little to no waste. Although materials used in conventional manufacturing methods are recyclable, the process of recycling materials costs money that can be saved with 3D printing.

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Another limitation is the fact that most 3D printers can only print in one material at a time. Multi-material 3D printers do exist, though, but are not very common yet.

6. What are the types of 3D printing technologies ?

3D printers use one of the following methods to build an object layer by layer:

3D PRINTING TECHNOLOGY #1: FUSED DEPOSITION MODELING (FDM)

This is the most common technology used in desktop 3D printers. Thermoplastic material is heated and extruded through a nozzle. The nozzle deposits the molten material layer by layer onto a build platform. Each layer sticks to the one beneath it.

3D PRINTING TECHNOLOGY #2: STEREOLITHOGRAPHY (SLA)

The build platform is lowered into a bath filled with a special liquid photopolymer resin. The resin is light-sensitive and becomes solid when exposed to a laser beam. Each cross section of the 3D model is traced onto the layer of cured resin that came before it. This is repeated layer by layer until the 3D object is completed.

In FDM the object is built from the bottom up, in SLA it's the other way round.

3D PRINTING TECHNOLOGY #3: SELECTIVE LASER SINTERING (SLS)

This process involves a laser beam fusing powdered material together. The first layer of powdered material is evenly rolled onto the build platform after which the layer of the 3D model is fused together by a laser. Next, the build platform is lowered by the width of one layer, and the next layer of powder is rolled into position. This process is repeated until the 3D object is finished. Since the object is surrounded by (unused) material throughout the duration of the build, support structures are not necessary like they sometimes are with the FDM process.

Many different materials can be used with this technology from plastics to metals.

3D PRINTING TECHNOLOGY #4: SELECTIVE LASER MELTING (SLM)

SLS works on the same principal as the SLS process but uses a higher intensity laser and only metal powder. In this process, the tiny metal particles are actually melted together to form a solid piece of metal as if machined from one solid block.

3D PRINTING TECHNOLOGY #5: BINDER JETTING

Binder Jetting also uses a powder bed as its source of material. But instead of a laser, the powder, e.g. metal, is first "glued" together using an adhesive binder after which the object is heat-treated in a kiln to set or fuse the material.

To get colored prints, you can add pigments to the binding materials.

7. Are 3D printed goods as good as those manufactured "traditionally"?

This depends on the product in question. Arguably, a 3D printed Japanese kitchen knife will not be as sharp as, or retain its edge as good as an authentic, carefully forged steel blade.

On the other hand, 3D printing has enabled certain products to be improved beyond the capabilities of traditional manufacturing processes like jet engine components.

But on a general level, it would be a subjective statement to suggest that a certain 3D printed product is better or worse than its traditional counterpart. Seen on an economic level, 3D printing is on its way to becoming a very efficient, resourceful, and cost effective means of production and will probably surpass conventional manufacturing processes in those aspects in the future.

8. What are 3D printing filaments? What do I need them for?

The word "filament" comes from the Latin word for "thread" which is "filum". It is used to describe anything that is thread-like in structure.

In 3D printing, filament is the name given to the material used by the 3D printer to print. In printers using FDM technology, the material comes in the form of a filament coiled around a small spool. The filament is then fed into the extruder through a guide tube. Usually, thermoplastics for 3D printers using the FDM method come in the shape of filaments.

Some 3D printers, mostly industrial ones, use material pellets instead of filaments. This brings down the cost of 3D printing material significantly. Other 3D printers, the SLA printer types, use liquid resin instead of strands of thermoplastics.

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10. Why do I need a slicing software for 3D Printing?

The slicing software prepares the 3D model for your 3D printer. It slices the 3D model into thin horizontal layers that the 3D printer can interpret and print. It also adds support structures that are necessary for printing overhanging structures. You can have the slicing software automatically add supports or place them manually.

The prepared 3D printing file is usually stored as a .gcode file.

The software also allows you to position the model on the print bed and resize it. It also gives you control over the print resolution, infill and printer settings like nozzle temperature and print speed.

11. What are the most common 3D printing file formats?

There are quite a few 3D printing file formats. Here are the most common ones.

- STL: This is the most popular 3D model format, all slicing tools support it. Here is a more detailed overview of the STL format and how it works.
- OBJ: Also important – and also supported by all major slicing tools – is the OBJ file format. In contrast to STL, OBJ is able to store color and texture profiles; we guess it will become more popular when multicolor printing takes off.
- PLY: PLY, the Polygon file format, was originally used for storing 3D scanned objects.
- 3MF: 3MF is a new file format developed by Microsoft, Autodesk, HP and Shapeways.

12. Which materials can be 3D printed?

Printing is possible with a lot of materials. Most commonly known, desktop 3D printers can print with any number of thermoplastic and thermoplastics mixed with other materials like wood fibers, metal powder, glow in the dark compounds and much more. But beyond that,

scientists are even experimenting printing with biomaterials in an effort to eventually be capable of 3D printing human orgas for transplants.

13. What are the benefits of 3D printing compared to injection molding?

One major benefit of 3D printing compared to injection molding is the cost advantage. Injection molding requires a mold to be manufactured or formed first, which is a costly and delicate process. However, since injection molding costs decrease with increasing production volumes, there usually comes a point where injection molding makes more sense.

14. Is there a Limitation to what shapes you can 3D print?

Traditional manufacturing methods rely on molds and cutting technologies to produce the desired shapes. Designing complex and intricate shapes with these methods can be difficult and expensive. 3D printing easily handles this challenge as you can print unlimited shapes and geometries imaginable depending on the size. Combined with an innovative software such as Generative Design, the sky is the limit.

15. What is not suitable for 3D printing?

When it comes to 3D printing, a lot is possible – but even more still isn't possible. Using an FDM 3D printer, you can not achieve an industrial-grade polished surface. This has to be post-processed.

- Using an FDM 3D printer, you can not achieve an industrial-grade polished surface. This has to be post-processed.
- Now on a hypothetical level, it is not yet possible to 3D print a functional, complex electro-mechanical machine or product (like a car) in one go, even though individual parts can be 3D printed no problem. But researchers are already working on "production 3D printers".
- Also, bioprinting is not advanced enough yet to 3D print fully functional customized human organs on more than an experimental basis. That technology may still be some years off.

UNIT II - DESIGN SKETCHING FOR 3D PRINTING

1.What is meant by sketch?

- **a rough drawing representing the** chief features of an object or scene and often made as a preliminary study.
- a tentative draft
- a brief description or outline.

2. Why do we sketch?

- To document
- To think
- To experiment
- To find the right design
- To explain and communicate

3. What is the importance of sketching?

- **Rapid Concept Development**
- **Basic Composition or Layout**
- **Client Communication and Approval**
- **Visual Exploration**
- **Refining Visual Solutions**

4.What are the important tools in skectchbook?

- Brush puck
- Colour wheel
- Lagoon
- Symmetry
- Guides
- Brush management
- Gradient fill
- Distort
- Flipbook
- Perspective tools

5.What is the use of brush puck and where it is located in sketchbook ?

Brush Puck - Use it to change brush opacity and size without having to open **Brush Properties**

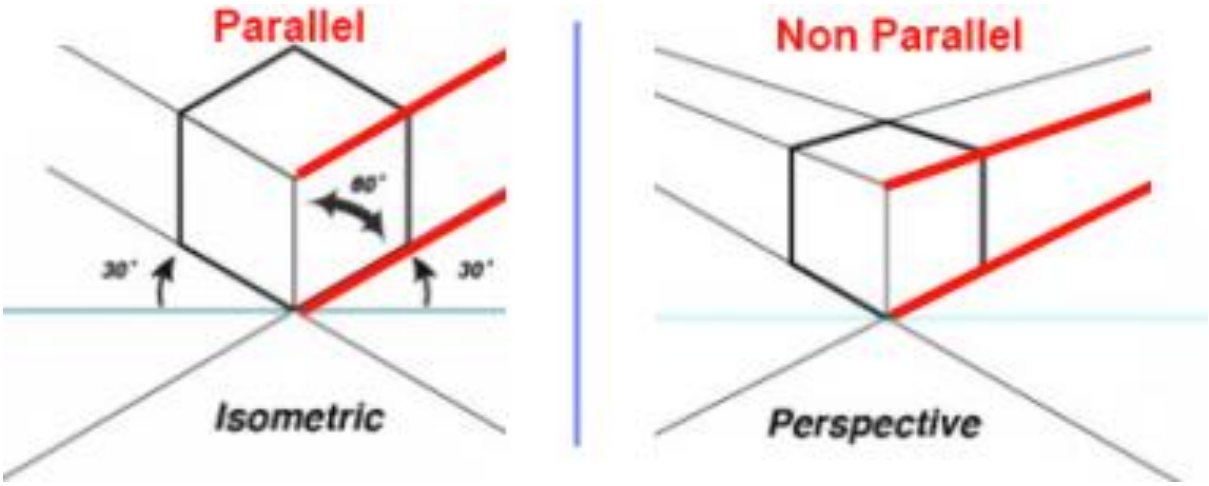
- In the menu bar along the top, select **Window** > **Brush Puck**.

- To close the puck, tap the circle at the top right of it.

Changing brush opacity with the Brush Puck

Use the **O** key to change the amount of paint applied by a brush. Tap a brush, then press-hold the **O** key, as you drag up to increase a brush's opacity or down to decrease it.

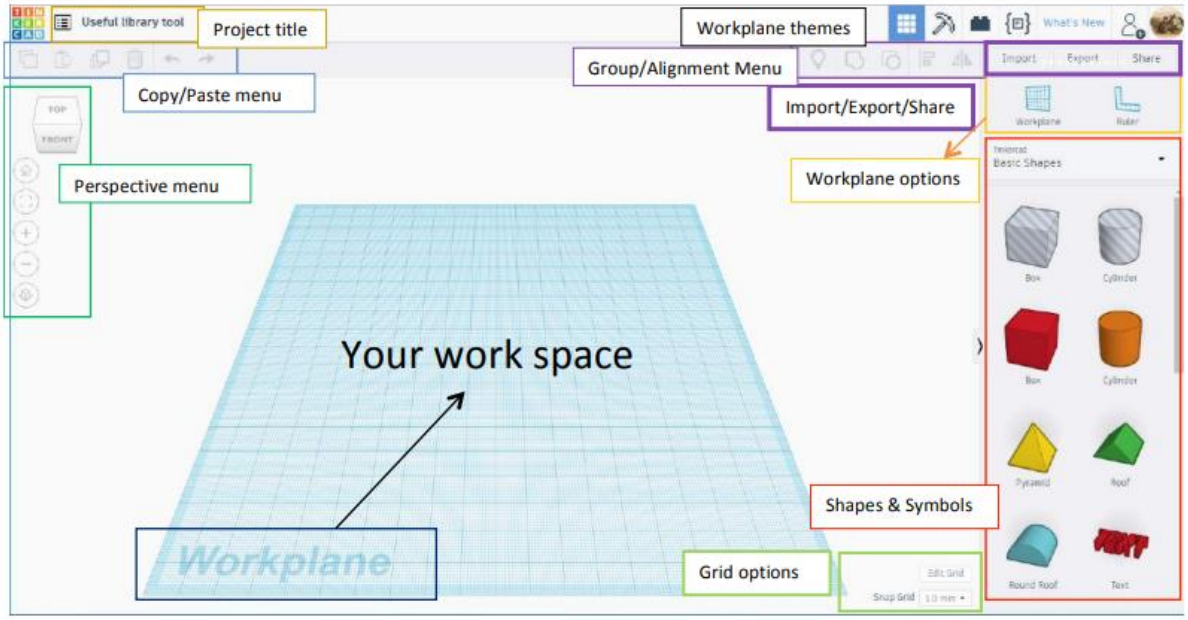
6. Draw the cube in perspective view and isometric view and highlight the difference between both.



7. Why do we need 3D Printing Technology?

- Traditional method of teaching can be converted in practical oriented approach through 3D Printing Technology in the institution where pupils and scholars gets a better understanding of the basics and concepts of different subjects.
- It enhances hands-on learning and learning by doing. Using this prototyping technology, students will be able to produce realistic 3 dimensional mini-models (great for engineering, architecture, and multi- media arts students).
- Empowers the students to convert their designs into products: Text book oriented concepts could be utilized to create models in the class rooms.
- Opens up inspiring possibilities and opportunities: Its like the ability to produce a fully functional "machine" in one print that meets the requirements and constraints.
- 3D printers enables you to Hold, Evaluate, Test and use your own ideas!

8. Draw the tinkercad workspace overview.



9. What Are .STL and .OBJ File Formats for 3D Printing? When you will prefer these file format?

.STL - STL format is one of the most commonly used file formats for 3D printing. This is due to the fact that most CAD software has the feature of exporting models in .STL format and most 3D printers support it. Specifically, it is a file which "slices" a 3D model into a series of very thin 2D "layers." This output is then used to drive a stereolithography (or similar) machine which produces physical prototypes through layer by layer deposition the file generates the surface geometry of the modeled object only.

.OBJ - OBJ format is considered to be more complex than .STL file for the fact that it is capable of representing texture, color and other CAD attributes of the three dimensional object. .OBJ is also easily exported from most CAD tools and is supported by 3D printers.

Which to choose?

.STL seems to hold a top spot in the list of preference of file formats for 3D printing. The main reason is that this type of file is simpler to use and most mesh repair tools work better with STL files than .OBJ. On the other hand, if you are willing to print a multicolor 3D model, you would want to choose .OBJ file format.

10. What are the limitations of tinkercad?

What is difficult to do in Tinkercad

- Drawings — You can't free draw your project. You are limited to the shapes provided by Tinkercad.
- There are limited shapes to select from. Pre-loaded shapes can be limiting for complex parts.
- Due to its popularity in the education system, the website often slows down to a crawl during US school hours
- You will outgrow it very quickly.

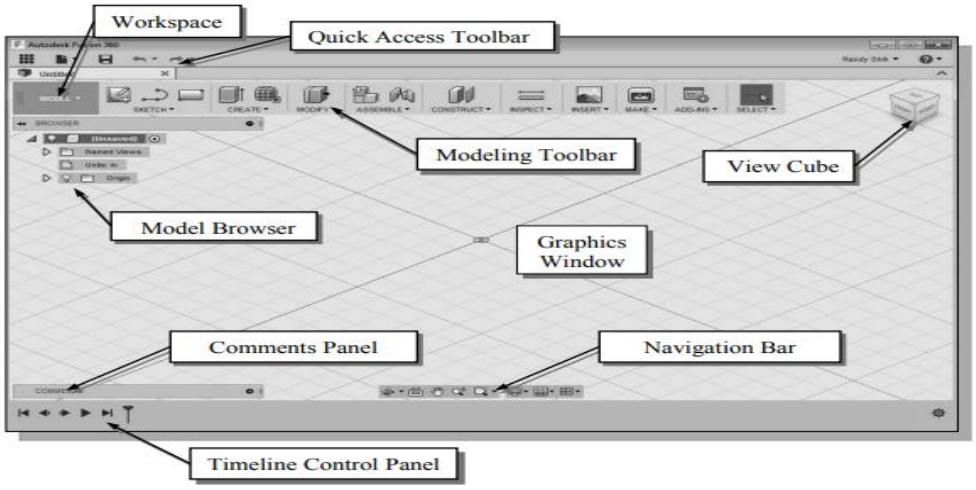
UNIT III - **Fusion 360**

1. What is meant by parametric modeling?

   The feature-based parametric modeling technique enables the designer to incorporate the original design intent into the construction of the model. The word parametric means the geometric definitions of the design, such as dimensions, can be varied at any time in the design process. Parametric modeling is accomplished by identifying and creating the key features of the design with the aid of computer software. The design variables, described in the sketches as parametric relations, can then be used to quickly modify/update the design.

2. What are the steps involved in the parametric part modeling process in Fusion 360?
   1. Create a rough two-dimensional sketch of the basic shape of the base feature of the design.
   2. Apply/modify constraints and dimensions to the two-dimensional sketch.
   3. Extrude, revolve, or sweep the parametric two-dimensional sketch to create the base solid feature of the design.
   4. Add additional parametric features by identifying feature relations and complete the design.
   5. Perform analyses on the computer model and refine the design as needed. 6. Create the desired drawing views to document the design.

3. Draw the layout of Fusion 360?



4. What is meant by sketching plane?

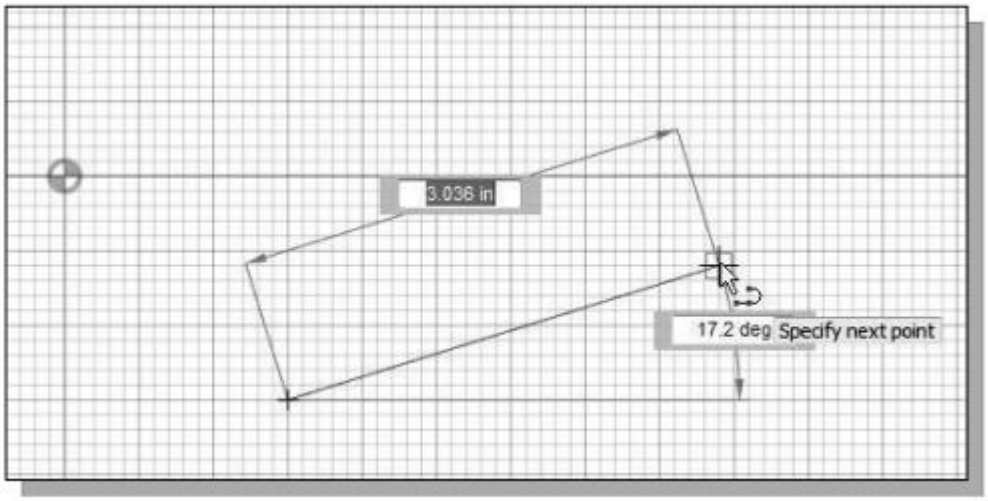
The Autodesk Fusion 360 sketching plane is a special construction approach that enables the planar nature of the 2D input devices to be directly mapped into the 3D coordinate system. The sketching plane is a local coordinate system that can be aligned to an existing face of a part, or a reference plane.

5. Explain the step by step procedure to set up graphic cursor?

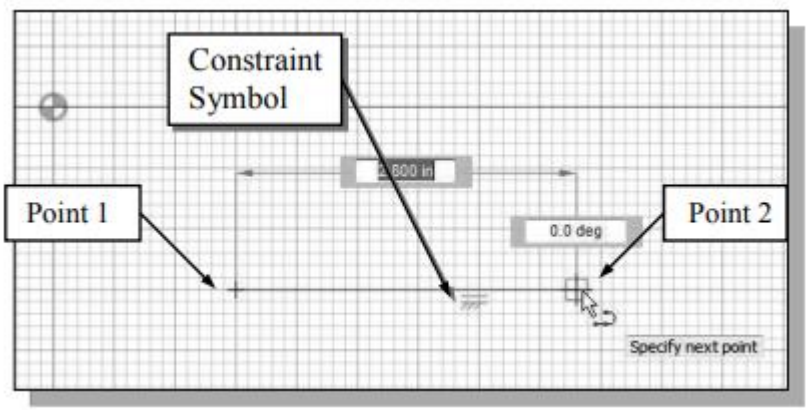
Graphics Cursors ¬ Notice a crosshair cursor is shown when graphical input is expected.

1. Left-click a starting point for the shape, roughly just below the center of the graphics window.

2. As you move the graphics cursor, you will see a digital readout next to the cursor and also in the Status Bar area at the bottom of the window. The readout gives you the cursor location, the line length, and the angle of the line measured from horizontal. Move the cursor around and you will notice different symbols appear at different locations.



3. Move the graphics cursor toward the right side of the graphics window and create a horizontal line as shown below (Point 2). Notice the geometric constraint symbol, a short horizontal line indicating the geometric property, is displayed.



6. What are the advantages of Fusion 360?

- Fusion 360 is ideal for technical design jobs. Because it could work on the cloud with multiple users, you can work on the same file with your team-mate or your customer.
- Fusion 360's other great functionality is its assembly features. You could easily and effectively create assembly parts via Fusion 360.
- And its greatest feature: Parametric design. This gives a huge capability to a designer. You could change some design parameters after finishing your whole job. Thus, making last-minute changes is very easy on Fusion 360 after negotiating the final design with your customer.
- Fusion 360 comes free with full features. It's a great software solution for a budget restricted start-up company.

7. What are the disadvantages of Fusion 360?

- Even though it has a very good cloud software, Fusion 360 gets very laggy when using slow internet connections.
- Fusion 360 uses a vast amount of your device's memory. It is recommended to select the RAM value as high as possible on your device.
- Fusion 360's sculpting and retopology features are behind the competing software on the market.

8. What are the applications of Fusion 360?

   Fusion 360 is an excellent tool for the precise modeling of 2D and 3D objects, but you can do much more with it, such as animate your designs, render objects, simulate loads, and even prepare models for CNC machining. Many small and large businesses use the platform for designing and prototyping their products, as Fusion 360 offers CAD, CAM, and CAE possibilities.

9. Can Fusion 360 create a better model for 3D printing?

Fusion 360 is an excellent choice for creating models for 3D printing.

- It allows you to create not only “prismatic” models such as gears or brackets, but it also allows you create more “organic” models using T-Splines, including characters, plants, and vehicles.

- You can use Fusion 360 to create and then edit your objects for 3D printing. You can also bring in models from other software and make modifications, such as de-featuring them by removing small features or blends.

- Fusion 360 can export as an OBJ or STL file format that is read by most 3D printing software. It also has the ability to print directly to your 3D printer.

- Fusion 360 even allows you to edit mesh or STL data that is brought in from a laser-scan or other source. Before printing, you can reduce or increase the surface count, edit out features, fill holes, etc.

10. What is the difference between tinkercad and fusion 360?

Tinkercad is catered towards younger users and those with no modeling experience. It's designed to allow anyone to start making 3D models, featuring an intuitive browser-based interface that can be controlled entirely by a mouse. Its focus is on education and encouraging thinking in terms of three dimensional objects and their relative sizes, positions, and orientations. Tinkercad employs a drag-and-drop method of combining basic 3D shapes to build more complex objects, making it one of the simplest 3D modeling options available. Several tutorials are available to guide new users through their first models.

Fusion360 is a desktop 3D modeling program that uses cloud computing to assist with heavy computational loads like simulations. Beyond 3D modeling, it also includes workspaces for 3D sculpting (labeled Create Form in the software), sheet metal fabrication, rendering, animation of assemblies and operations, manufacturing with CNC machines and lathes, and simulations of static and nonlinear stress, thermal stress, structural buckling, and shape optimization. There's a lot going on under the hood of Fusion360, so it's intended for more experienced users, or at least those aspiring to become more experienced users.

UNIT IV – 3D SCANNER

1. What is meant by 3D scanning?

3D scanning is the process of analyzing a real-world object or environment to collect data on its shape and possibly its appearance (e.g. colour). The collected data can then be used to construct digital 3D models.

2.What are the applications of 3d scanning technology?

augmented reality,motion capture, gesture recognition, robotic mapping, industrial design, orthotics and prosthetics, reverse engineering and prototyping, quality control/inspection and the digitization of cultural artifacts.

3.Write a short note on time of flight 3D scanner.

The time-of-flight 3D laser scanner is an active scanner that uses laser light to probe the subject. At the heart of this type of scanner is a time-of-flight laser range finder. The laser range finder finds the distance of a surface by timing the round-trip time of a pulse of light.

4.What are the advantage and disadvantages of time of flight.

Time-of-flight and triangulation range finders each have strengths and weaknesses that make them suitable for different situations. The advantage of time-of-flight range finders is that

they are capable of operating over very long distances, on the order of kilometres. These scanners are thus suitable for scanning large structures like buildings or geographic features. The disadvantage of time-of-flight range finders is their accuracy. Due to the high speed of light, timing the round-trip time is difficult and the accuracy of the distance measurement is relatively low, on the order of millimetres.

5.What are the advantage and disadvantages of triangulation.

Triangulation range finders are exactly the opposite. They have a limited range of some meters, but their accuracy is relatively high. The accuracy of triangulation range finders is on the order of tens of micrometers.

6.What are the advantages of structured light 3D scanner?

The advantage of structured-light 3D scanners is speed and precision. Instead of scanning one point at a time, structured light scanners scan multiple points or the entire field of view at once. Scanning an entire field of view in a fraction of a second reduces or eliminates the problem of distortion from motion. Some existing systems are capable of scanning moving objects in real-time. VisionMaster creates a 3D scanning system with a 5-megapixel camera – 5 million data points are acquired in every frame.

7.What is the difference between long range 3d scanner and short range 3D scanners?

Long-range 3D laser scanners capture the geometry of large spaces or objects, such as a building, in one scan, which is then combined with multiple scans as a point cloud to create a digital twin of the environment, object, or structure. Generally, a long-range 3D scanner is necessary when the subject is more than one meter away from the scanner. Industries including aerospace, power generation, architectural, civil engineering, and construction use this 3D scan data for various purposes.

Short-range 3D scanners are useful when an object is within one meter of the scanner. These scanners include contact and non-contact. Typically, a short-range 3D scanner is good to digitize objects ranging in various sizes from a tiny gear to a full-size aircraft. Therefore, it's popular with manufacturing and engineering applications such as dimensional inspection, reverse engineering, rapid prototyping, CFD/FEA analysis, and beyond.

8. How does a scanner works?

3D scanners generally work by employing lasers, light, or sensors to detect the surface of a physical object and assign data points to the location of that surface. Those data points blanket the surface(s) of the part three-dimensionally and are collected and compiled to digitally recreate the object with high accuracy and detail. One very popular short-range 3D scanning solution is structured light technology using two high-end cameras and a projector. This non-contact method displays a fringe pattern across the object's surface, and as the pattern shifts, the cameras collect data from the object's surface. This technology originally started with white halogen light but now has advanced to blue LED. The bright light source helps with capturing data on shiny and dark-colored surfaces. These 3D scanners are highly accurate and use the principles of triangulation. The modernized version is Triple Scan technology, which combines high-resolution images from the right, left, and both cameras to create each scan.

9.What is the role of 3D scanning in quality control?

For quality control processes, 3D scanning is the new gold standard for improving products, reducing waste, cutting costs, and gaining a competitive edge. By utilizing the latest 3D scanning technology, manufacturers have access to more accurate data than ever before, and this information streamlines production processes in multiple ways. By identifying problematic parts earlier, manufacturers can save both time and money by reducing development iterations. 3D scan data allows the digital assembly of various components to assess fit and finish before any physical parts get shipped— a significant advantage in modern quality control processes.

10. How to Choose the Best 3D Scanning Technology

Choosing the best 3D scanning technology for your specific application requires evaluating certain aspects of the scanner and your project. Certain 3D scanners will work best with some applications, but they might not work well for other projects. To learn how to choose the best 3D scanning technology, consider the following:

- Budget:

While some 3D scanners may cost more, they offer higher accuracy and collect higher data quality. If you are scanning an intricate part or are working with tight tolerances, higher accuracy will be worth the additional cost. Accurate 3D scanners that cost more also have more robust hardware, high-quality optics, stronger software capabilities, and may also include a PC. If you're a hobbyist, these metrology-grade 3D scanners may be more than what you need; however, at the professional level, it's important to remember, "You get what you pay for."

- Tolerance Requirements:

If you're working with applications with tight tolerance requirements, having the ability to verify whether your part is in or out of tolerance is essential, so make sure you're selecting a 3D scanner that can satisfy your tolerance requirements.

- Time:

Low-quality 3D scanners require more time to collect the same amount of data that a high-quality 3D scanner can, which can cause a bottleneck in manufacturing production. If you need high throughput, make sure to consider the time it takes the scanner to execute a scanning session.

- Environment:

When choosing the best 3D scanner, it's essential to consider where the 3D scanning will need to occur and what will be needed in the environment. For example, if you need an automated solution, you will need more space than when scanning something small with a handheld 3D scanner. Also, consider if you need to travel with the scanner, which would require you to have a portable scanner. If you need to take the scanner outdoors, or in indoor, industrial environments, or anywhere else where lighting could vary, you'll need to consider those aspects as well.

UNIT V – APPLICATIONS IN 3D SCANNING

1.List out any four applications of 3D printing in automobile industry.

2. List out four best softwares for 3D printing.

3. How is 3D printing is used in biomedical?

4. How is 3D printing is used for education?

5. List out any for infrastructure built using 3D printing technology.

6.What is the first 3D building constructed in India? Where it is located?

7. How is 3D printing is used in architecture?

8.3D printing can be used in food technology industry. Justify?

9. How is 3D printing is used in healthcare?

10.Differentiate traditional manufacturing technology and 3D printing manufacturing technology.