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SGDM 5008 - AUTOMATED TECHNOLOGY

MAW EXAM

15/5/2020

Question 1

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1a CAD Solid model is needed which can be created through CAD/CAM package or scanned from an existing component.

The model then needs to be converted to an .STL file. This file consists of x , y and z coordinates of ^{the} three vertices of each surface triangle, with an index to describe the orientation of the surface normal. Support pillars are generated at this stage.

The file then needs to be sliced. A series of closely spaced horizontal planes are mathematically placed passed through the .STL file. Generating a series of closely spaced 2D cross-sections of the 3D object.

The model is then built. The additive manufacturing technology parameters are set. The file is then sent to the 'AM' machine. The layers are built up as the elevator incrementally lowers the removable base by the slice thickness of each layer.

Finally, the part is cleaned and finished. The part is removed from the base. If support material is used, it can now be removed. The part can now be finished by curing, sanding or polishing. Finally, the part is cleaned.

Question 1

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1b

Liquid Based. Using a process called curing, the liquid build material is converted into a solid state. An example of this is multijet printing.

Solid Based. This encompasses all forms of material in solid state for example wires, rolls, laminates or pellets. An example of this is 3D Printing.

Powder Based. The material used in this type of AM is in the form of grain like powder. An example of this is selective laser melting.

1c

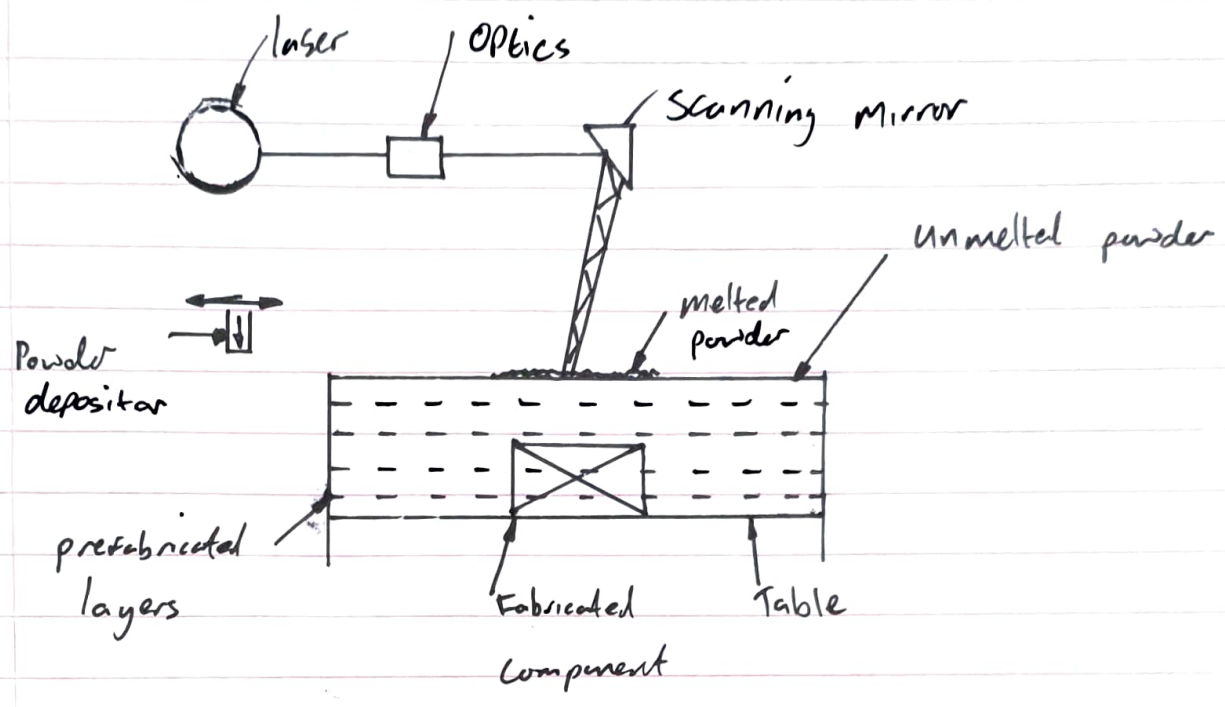
Support material is used in order to prevent adverse structural effects from arising and not limited to gravity. This material is also used to separate the part from the base and/or floating geometries. Selective laser melting and selective laser sintering do not require support material as the powder provides a solid base under the part.

1d Selective Laser Melting is capable of making metal components. A CO_2 laser is used to melt a pre-heated layer of heat fusible metal powder to form a metal slice. The metal powder is melted to give the parts higher density. The loose powder is brushed off. No support material is used and the parts have a much higher strength and dimensional accuracy to SLS parts.

Question 1

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1d



Question 3

3a

The first phase of the industrial revolution was steam. Thomas Newcomen designed an atmospheric engine to pump water out of a local tin mine. James Watt introduced a condensing system in order to allow some of the steam energy to be reused and increased efficiency, power and cost effectiveness of steam engines. The second phase of the industrial revolution was electricity. In 1821 Michael Faraday invented the electric motor. This gave machines independent power. The third phase of the industrial revolution was computers. Numerical control was developed in the 1940's using punched tape. These advances in early computing were made during WWII. In the 1960's mainframe computers are widely used in industry. This phase of the revolution opened gateways to some of the most powerful inventions used in industry like CNC, CAD/CAM and robots. The fourth and most recent phase in the revolution is intelligence. This is the trend towards advanced automation and data exchange in manufacturing. This is based on cyber physical systems which combine physical infrastructure with Artificial intelligence.

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Question 3

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3b Volume. The capacity to handle enormous amounts of data per second is required.

Variety. Differing Forms of data that are incorporated or interact with ~~our~~ our bodies and devices in order to perform specific tasks.

Velocity. The ability to carry out real time analysis.

Veracity. To produce accurate, reliable information to inform and facilitate decision making.

3c The IoT is a concept that is based on the interconnection of any product with any other around it. To manufacture devices that transfer data without human interaction. IIOT devices are more resistant to more extreme conditions that are found in industry. 5G Technology is essential to Industry 4.0 as it is 100x faster than 4G. It will increase the amount of devices connected to the internet from 7000 million to 1 Billion. It will reduce the response time to 1 millisecond from 10 milliseconds on 4G. And finally, it reduces energy consumption by 90% allowing batteries to last longer.

3d The Smart Key of a car employs an RFID ~~card~~ circuit that allows the car to recognise the presence of the key from 1m. Therefore, allowing the driver to open the car and start the car with the key still in their pocket.

Question 3

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3e As ~~was~~ a result of industry 4.0

There are many advantages of industry 4.0.

These are the increased efficiency of manufacturing as well as the reduction in the amount

of physical work needed to be done. However,

there are also some limitations. Those ~~are~~ are

there is a lack of security of information /

data as well as if one system fails

it could in turn halt the entire process.

Question 2

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2a A robot is a reprogrammable device designed to manipulate and transport parts, tools or specialised manufacturing implements through programmed motions in order to perform specific manufacturing ~~tasks~~ tasks. A Cobot is ~~an~~ a robot that is designed to work with humans. Robots improve product quality as well as improve the working conditions for employees. However, because it is a power mechanism, it can be prone to slippage and/or backlash. Cobots can be easily moved and easily programmed. However, they rely on the efficiency of the human and simply can not compete with traditional robots in terms of production rate.

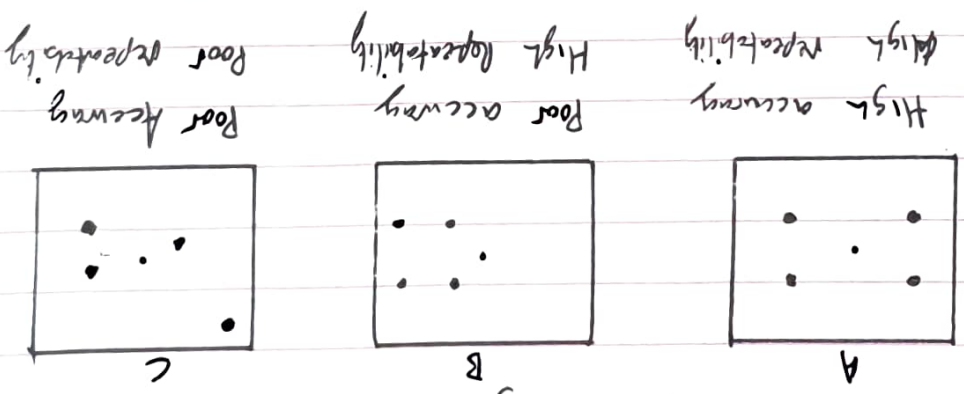
2b There are a load of positive impacts that robots are having on manufacturing and there are a number of reasons why companies should invest in Robotics. Robots reduce operation costs by reducing overheads and direct costs. Robots improve product quality by producing high quality finishes every time. They reduce material waste and increase yield. They improve Health & Safety at the workplace by doing the more health threatening, unpleasant jobs and they can also increase production ~~and~~ outputs as they can run 24/7. Commonly known as lights out production.

Question 2

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Accuracy. The difference between the true path and the actual path.

Repeatability. The measure of a robot's ability to go to a point along a path a time and time again.



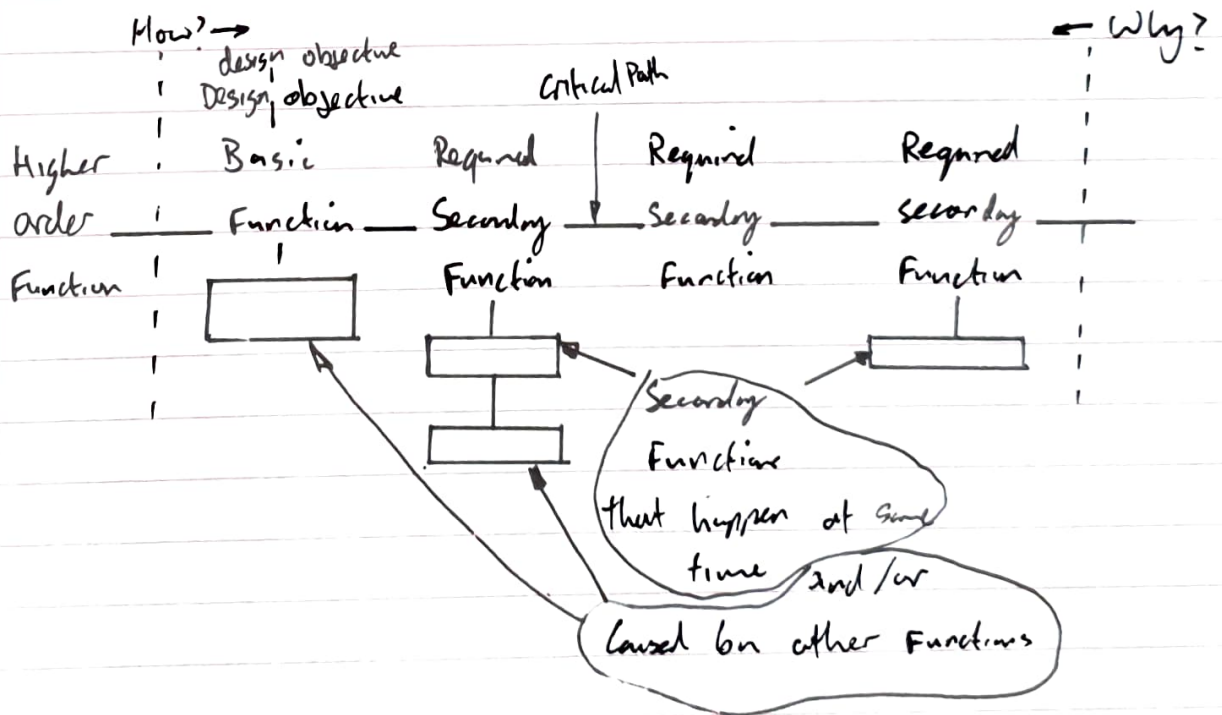
Industrial robots are being used in conjunction with AM. Large scale parts can be produced due to the working envelope of the robot. The working envelopes can be enlarged using alternative robots or controllable rigid trackways. AM is developing a robotic AM technology in order to build the first green base. Also this type of AM is currently used in order to produce large scale prototypes.

Question 5

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5a Value engineering is a systematic method to improve the value of a product by an examination of its ~~best~~ function. Value is the ratio of Function to cost. The big data and advanced analytics of industry 4.0 can provide accurate real time product/manufacturing data. This data can be used to reduce costs as well as add product value.

5b FAST Stands For Function Analysis System Technique. FAST Diagrams are used to test the validity of all functions of a product. Deepen the understanding of the problem to be solved. Multi disciplinary teams can understand the system thoroughly and quickly and reducing cost whilst maintaining function.



Question 5

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5c

The Boston Matrix is a means of analysing

the product portfolio to make informed market strategy ~~decisions~~ decision. Developed by the Boston Consulting Group. This matrix links growth rate

market share and cash flow. Products are

categorised as question marks, stars, cash

cows and dogs. Question marks have low

market share in a high growth market.

Stars produce high revenue and have potential

for growth. Dogs are associated with negative

cash flow. Cash cows have positive cash

flow and sell themselves.

5d Industry 4.0 and IIOT has the potential to provide useful time product performance data which can be used for product life cycle analysis.