

Module Title: AUTOMATED TECHNOLOGY

Module Code: SGDM5008

Level: 5

Module Leader: Rob Rees

Award: BSc Mechanical Engineering

Lecturer: Rob Rees

RESIT

**Examination Solutions
2019-20**

RESIT EXAMINATION SOLUTIONS

(To accompany the examination paper sent to the external examiner
but NOT to be seen by students)

Programme:	BSc Mechanical Engineering	Level:	5
Module:	Automated Technology SGDM5008 - RESIT SOLUTIONS		
Author:	Rob Rees	Date:	03/10/2019

Q No	Question	Marks
1a).	RAPID PROTOTYPING IS A CLASS OF TECHNOLOGIES THAT CAN AUTOMATICALLY CONSTRUCT PHYSICAL MODELS FROM COMPUTER AIDED DESIGN (CAD) DATA.	2
1b).	DISCUSSION BASED ON THE THREE CATEGORIES OF R.P. • LIQUID BASED • SOLID BASED • POWDER BASED. EXAMPLES OF LIQUID BASED (ONE FROM). • SLA. • SGC. EXAMPLES OF SOLID BASED (ONE FROM). • 3D PRINTING • FDM • LOM. EXAMPLES OF POWDER BASED (ONE FROM) • SLS • SLM.	6



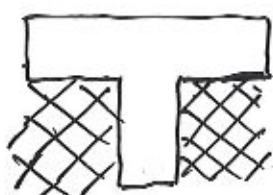
Question

Marks

1c)

SUPPORT STRUCTURE IS A DISPOSABLE MATERIAL THAT PROVIDES SUPPORT TO OVERHANGING GEOMETRIES DURING THE BUILD PROCESS. SUPPORT STRUCTURE IS TYPICALLY PLA BASED AND WATER SOLUBLE.

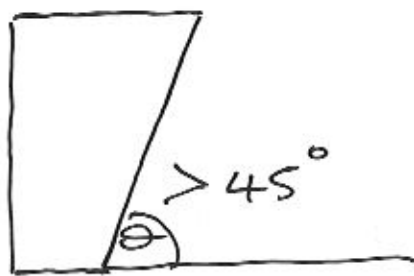
PART ORIENTATION DURING THE BUILD PROCESS CAN DRAMATICALLY REDUCE THE AMOUNT OF SUPPORT MATERIAL REQUIRED.



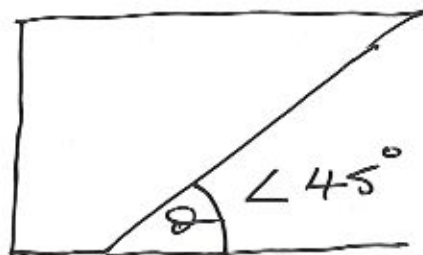
POORLY ORIENTED PART REQUIRING SUPPORT STRUCTURE.



PART ORIENTED CORRECTLY & THEREFORE DOES NOT REQUIRE SUPPORT STRUCTURE.



SUPPORT CAN BE OMITTED.



SUPPORT REQUIRED.

6

1d)

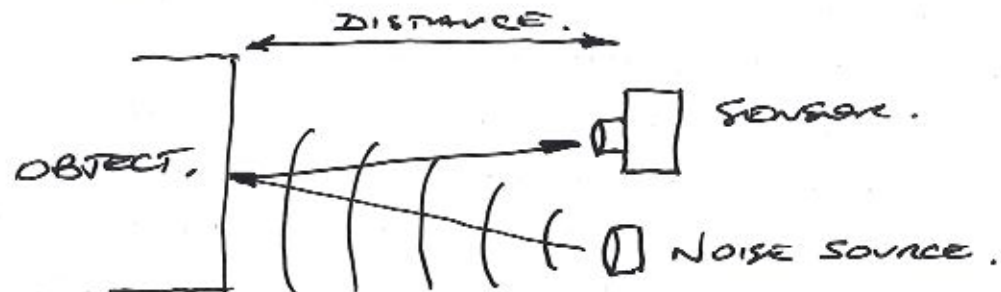
SELECTIVE LASER SINTERING (SLS)

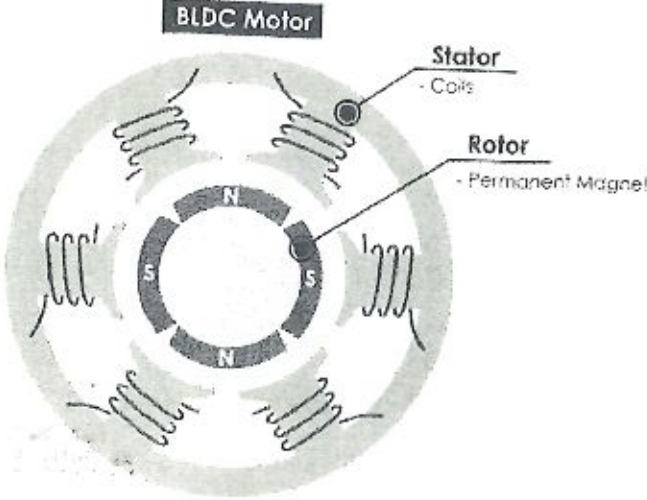
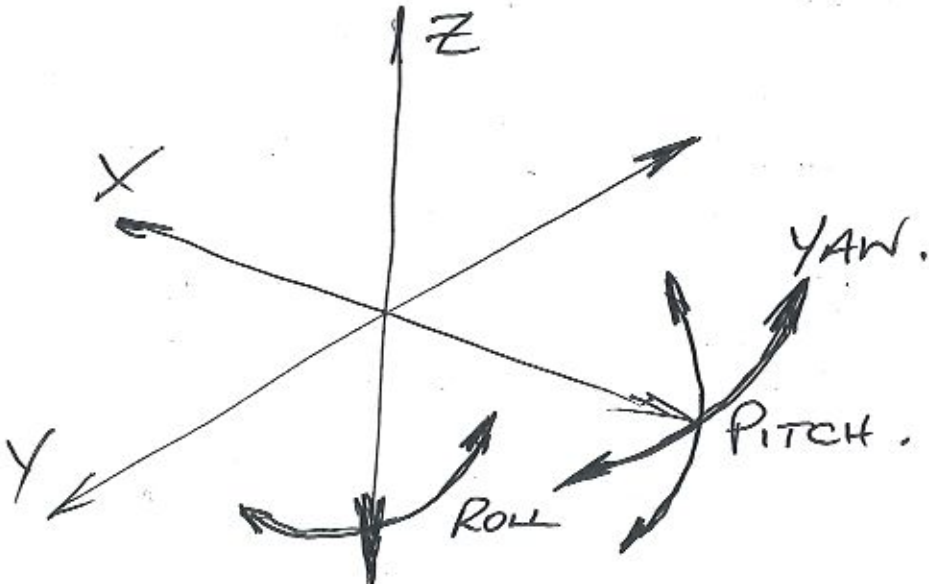
SCHEMATIC DIAGRAM OF THE PROCESS REQD.

A FUTURE DEVELOPMENT THAT IS BEING TESTED ON EARTH IS THE USE OF INDUSTRIAL ROBOTICS CARRYING SLS TECHNOLOGY TO BUILD LIVING QUARTERS ON THE SURFACE OF THE MOON.

	Question	Marks
1d) CONT.	THE ADDITIVE MANUFACTURING PROCESS SLS IS THE ONLY PROCESS WITH THE ABILITY TO MAKE USE OF THE MOONS SILICATE MINERALS AS THE BUILD MATERIAL. THESE POWDERED MINERALS ARE IDEAL FOR THE SINTERING PROCESS AND CAN READILY BE CONVERTED INTO CERAMIC TYPE STRUCTURES THAT CAN SUPPORT LIFE.	6
2a)	COBOT - COLLABORATIVE ROBOT THAT IS DESIGNED TO WORK IN HARMONY WITH HUMANS. COBOTS NOT SUITABLE FOR HEAVY INDUSTRIAL APPLICATIONS, AS THEY HAVE LOWER ACCELERATION (TYPICALLY 250 mm/sec) WHICH IS FOUR TIMES LESS THAN THEIR INDUSTRIAL COUNTERPARTS. ALSO - GRIPPER & FIXTURE EXCHANGE NOT POSSIBLE WITH COBOT. ALSO - COBOTS HAVE A MUCH SHORTER LIFESPAN & CAN LIFT A SIGNIFICANTLY LOWER PAYLOAD. COBOTS ARE TYPICALLY DESIGNED TO WORK IN 'CLEAN' ASSEMBLY CELLS, (DOING THE TASKS MORE EFFICIENTLY THAN HUMANS), BUT UNABLE TO COMPLETE EVERY TASK HENCE THE HUMAN PRESENCE.	6.



	Question	Marks
26)	DISCUSSION BASED ON TWO DIFFERENT DISTANCE / RANGE SENSORS MAGNETIC PROXIMITY SENSORS • WORKS ON THE BASIS OF A CHANGE IN FLUX DENSITY CAUSED BY THE MOVEMENT OF A NEARBY OBJECT. ACOUSTIC PROXIMITY SENSORS. • ACOUSTIC EMITTER SENDS OUT SOUND WAVES WHICH ARE DISTORTED WHEN AN OBJECT MOVES NEARBY. CHANGE IN AMPLITUDE IS DETECTED WHICH TRIGGERS A SIGNAL.  EE - SUBMARINE ISSUING ACOUSTIC 'PINGS' TO DETECT AN OBJECT PHOTO ELECTRIC PROXIMITY SENSORS. • DETECTS PRESENCE (NOT INTENSITY) OF REFLECTED VISIBLE OR INVISIBLE LIGHT. NOT SUITABLE FOR RANGE SENSING ONLY PRESENCE / NON PRESENCE. LASER RANGE SENSORS • USES A LASER BEAM TO DETERMINE THE DISTANCE OF AN OBJECT BASED ON THE 'TIME OF FLIGHT' PRINCIPLE.	6

	Question	Marks
2c)	BRUSHLESS MOTOR CONSISTS OF TWO MAIN PARTS — STATOR & ROTOR.  PERMANENT MAGNETS ARE ON THE ROTOR AND ELECTROMAGNETS ON THE STATOR. A COMPUTER CHANGES THE ELECTROMAGNETS POLARITY IN ORDER TO ATTRACT TO THE PERMANENT MAGNETS ENABLING 360° MOVEMENT AND ACCURATE ELECTRONIC CONTROL OF THE ROTATION SPEED (RPM).	4.
2d)		



	Question	Marks
2d) CONT.	Roll is rotation about the Z axis Pitch is rotation about the X axis Yaw is rotation about the Y axis. Roll, Pitch & Yaw are also used in aviation and defined as above.	4.
3a)	Discussion based on industry 4.0 NEW TECHNOLOGIES (AUTOMATED) & DIGITALLY CONNECTED MAKING INTELLIGENT DECISIONS BASED ON REAL TIME DATA. FLEXIBLE / SUSTAINABLE MANUFACTURE WITH MINIMAL INTERVENTION BY HUMANS. ESSENTIAL REQUIREMENTS • IIOT. • 5G • THE FOUR V'S OF BIG DATA. • INTELLIGENT SENSORS. • IPV6 PROTOCOL (128 bits) • SMART PHONE TECHNOLOGY REMOXY UNAVAILABLE.	5.



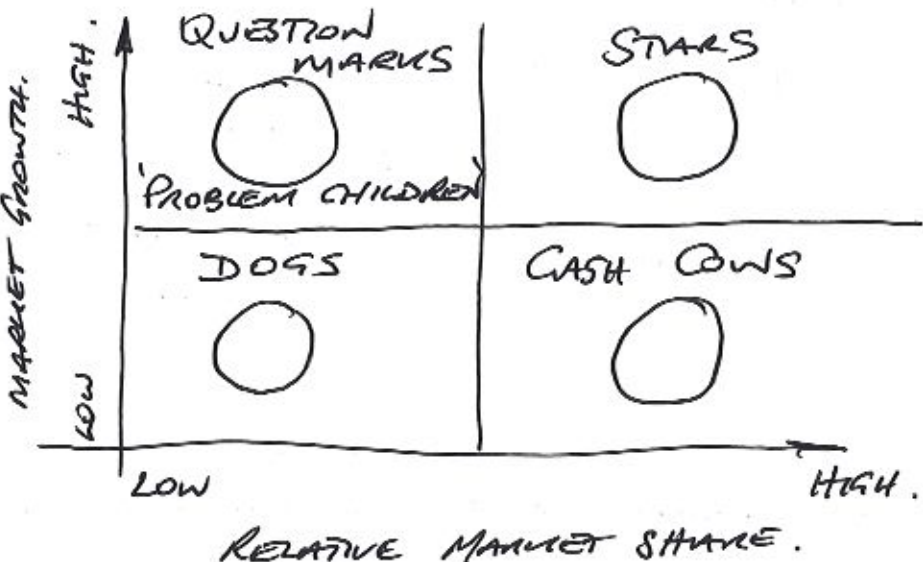
	Question	Marks
3b)	INTERNET OF THINGS (IOT) IS A CONCEPT BASED ON THE INTERCONNECTION OF ANY PRODUCT WITH ANY OTHER AROUND THE WORLD. THE GOAL IS TO MAKE DEVICES TRANSFER DATA WITHOUT HUMAN INTERVENTION. THIS REQUIRES THE USE OF IPV6 PROTOCOL (128 bits). THIS HUGE INCREASE OF IPV6 IN THE ADDRESS SPACE IS AN IMPORTANT FACTOR AS IT WILL ENABLE THE ASSIGNMENT OF AN IP ADDRESS TO EVERYTHING ON THE PLANET.	4.
3c)	DISCUSS A CASE STUDY DELIVERED IN THE MODULE ON HOW PRODUCT DESIGN IS EFFECTED BY INDUSTRY 4.0. Eg - BESPOKE PRODUCTS MANUFACTURED TO EXACT CUSTOMER SPECIFICATIONS BASED ON REAL TIME DATA BUZZROW IE - CAR SEATS MANUFACTURED TO EXACT CUSTOMER REQUIREMENTS. * CLOTHES MADE TO BESPOKE SPECIFICATIONS, ONLY ACHIEVABLE AT HIGH 'TAILORS' RATES.	5.
3d)	NEXT GENERATION SENSORS DISCUSSION. • SIMPLE WIRING (CONNECTION BETWEEN MASTER & 10-LINK DEVICE TO MAXIMUM DISTANCE WITH UNSHIELDED 3 WIRE CABLE). • EASY OPERATION AND AUTOMATIC PARAMETER ADJUSTMENT. • UNLIMITED EXPANSION • 100% COMPATIBLE	6

DETAILED DISCUSSION ON ABOVE



	Question	Marks
4a)	VALUE ENGINEERING PRODUCT COST IS MADE UP OF • DIRECT COST • INDIRECT COST. <u>DIRECT COST</u> COST OF BOUGHT IN ITEMS (MATERIAL, COMPONENTS ETC) COMBINING WITH DIRECT LABOUR. ALSO (ASSEMBLY, TESTING & PACKAGING). <u>INDIRECT COST</u> COST OF MANUFACTURING PROCESS ASSIGNED TO THE PRODUCT EG FACILITY, MANAGEMENT, OTHER OVERHEADS. DETAILED DISCUSSION BASED ON ABOVE USING EXAMPLES DISCUSSED DURING THE MODULE.	6.
4b)	INDUSTRY 4.0 IS IMPACTING ON VALUE ENGINEERING AS IT IS PROVIDING MANUFACTURERS WITH REAL TIME DATA. EG HOW A PRODUCT IS USED HOW OFTEN A PRODUCT IS USED. DATA FROM THE PRODUCT (FEEDBACK) BIG DATA COLLECTION IN ORDER TO IMPLEMENT INCREMENTAL DESIGN CHANGES TO INCREASE THE PRODUCTS LIFE CYCLE.	4.



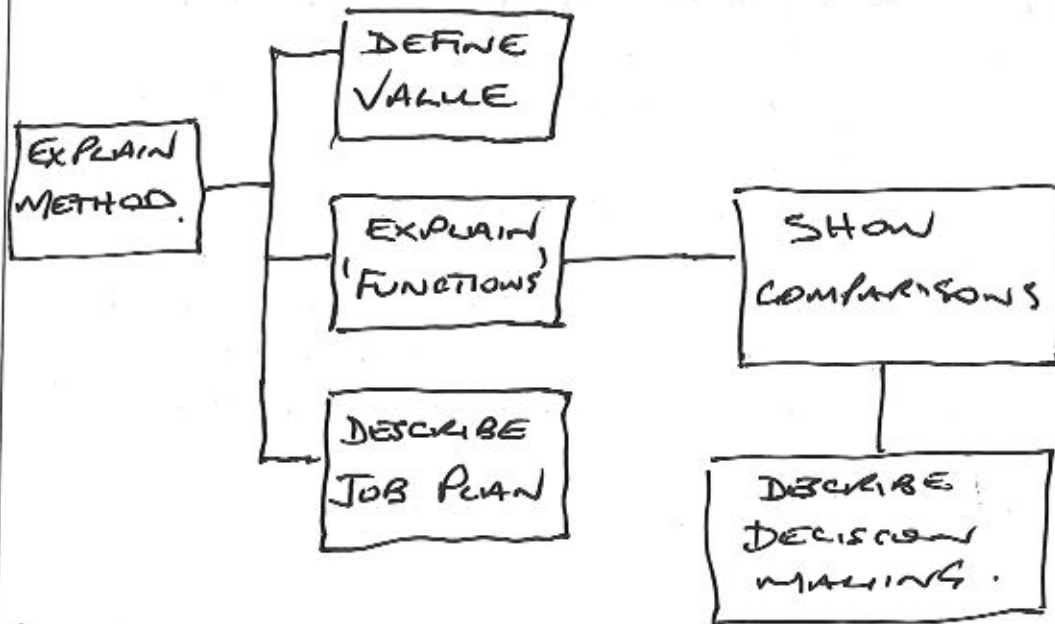
	Question	Marks
4c)	The Boston Matrix is a common method of Portfolio Analysis developed by the Boston Consulting Group (BCG). Product Life Cycle Analysis shows sales of one product over time. The Boston Matrix is able to analyse more than one of a company's products and categorises them into...  DISCUSSION BASED ON THE IMPORTANCE OF ABOVE WHEN APPLIED TO THE PRODUCT LIFE CYCLE ANALYSIS.	5
4d)	FAST DIAGRAMS F - FUNCTION A - ANALYSIS S - SYSTEM T - TECHNIQUE. FAST DIAGRAMS REPRESENT THE FUNCTIONS OF A PROJECT, PRODUCT OR PROCESS BASED ON THE QUESTIONS HOW OR WHY?	

4d)
CONT.

Question

Marks

BASICS OF FAST DIAGRAM.



HIGHER ORDER FUNCTION (HOF).

BASIC FUNCTION

SUPPORTING FUNCTIONS.

DISCUSSION OF A WELL KNOWN PRODUCT THAT HAS BENEFITED FROM VALUE ANALYSIS

EG - FLAT SCREEN TV'S OR ANY OTHERS COVERED DURING THE MODULE.

5

5a)

WORD ADDRESS PROGRAMMING IS THE MOST COMMON SYSTEM IN USE AND RELIES ON A 'WORD' WHICH IS SIMPLY A LETTER, FOLLOWED BY A NUMBER OR SERIES OF NUMBERS. BETWEEN THE LETTER AND NUMBERS THERE MAY BE



	Question	Marks
5a) CONT.	AN ALGEBRAIC SIGN (+ OR -) BUT IN MOST CASES THE POSITIVE SIGN IS OMITTED. THE WORD (LETTER) CAN BE EITHER A PREPARATORY FUNCTION (G CODE), MISCELLANEOUS FUNCTION (M CODE), DIMENSIONAL INFORMATION OR RELATIVES TO THE OPERATIONAL MACHINING REQUIREMENTS EG T. (TOOL) F (FEED) S (SPINDLE SPEED) ETC. CONVERSATIONAL PROGRAMMING IS A FAR MORE USER FRIENDLY LANGUAGE SYSTEM THAT OFFERS MACHINE CONTROL 'PROMPTS' TO OPERATOR/PROGRAMMERS WHICH INPUTS A PROGRAM. CONVERSATIONAL PROGRAMMING IS NORMALLY CARRIED OUT AT THE MACHINE CONTROL WHEREAS WORD ADDRESS IS MORE SUITED TO OFF-LINE PROGRAMMING.	4
5b)	G76 - THREAD CUTTING CYCLE (FIRST LINE OF CANNED CYCLE) P02 - SPINDLE PASSES 10 - TOOL PULL OUT 60 - THREAD ANGLE	



	Question	Marks
5b) CONT.	(SECOND LINE OF CANNED CYCLE) G76 X 9.852 — THREAD CORE ϕ Z-16 — THREAD LENGTH. R0 — PARALLEL THREAD P 1074 — THREAD DEPTH (MICRONS) Q 400 — DEPTH OF CUT OF 1ST PASS (MICRONS). F 1.75. — LEAD (PITCH) OF THREAD. DISCUSSION ON RELATIONSHIP OF ABOVE PARAMETERS ESPECIALLY $2 \times \text{THREAD DEPTH}$ MUST EQUAL OD — THREAD CORE ϕ.	6
5c)	OPERATIONAL PLAN BREAKS THE MACHINING OPERATION INTO MANAGEABLE 'CHUNKS' AND IS THE MAIN BASIS OF A LOGICAL MACHINING STRATEGY. TOOLING DECISIONS, WORKHOLDINGS OPTIONS AND BEFORE MACHINING NOTES CAN BE ADDED DURING PROGRAMMING AND MOST IMPORTANTLY AS A RESULT OF AN OPERATORS EXPERIENCE WHILST USING A PROGRAM TO MACHINE A COMPONENT.	

5c)
 CONT.

Question					Marks
OP NO	OP DESCRIPTION	TOOL NO	TOOL DESCRIPTION	MACHINING NOTES	
1	ROUGHING.	1.	35° DIAMOND	TOOL OFFSET 1. HYDRAULIC 3 JAW CHUCK.	
2	FINISHING	1.	35° DIAMOND		
3	THREADING.	2.	60° EXTERNAL THREADING	M03 R/H THREAD (TOOL UPSIDE DOWN).	
4.	PARTING OFF.	3	3MM PARTING OFF TOOL	CLS ON. FLOOD COOLANT.	

DISCUSSION ON ABOVE AND THE IMPORTANCE OF THE NOTE COLUMN TO OPERATIONS — ANY SPECIAL REQUIREMENTS OR DIFFICULTIES EXPERIENCED DURING THE CMT PRODUCTION RUN SHOULD BE DOCUMENTED HERE. 4

5d)

CEMENTED CARBIDE

DESIGNED TO FORM A 'C' CHIP TO TAKE HEAT AWAY FROM THE COMPONENT
 • UP TO HRC 90 COMPONENT HARDNESS.

CERAMICS

HIGH SPEED APPLICATIONS
 UNPREDICTABLE IN UNFAVOURABLE CONDITIONS ESPECIALLY INTERMITTENT CUTTING.

• UP TO HRC 93 COMPONENT HARDNESS.

CUBIC BORON NITRIDE (CBN).

VERY HIGH RPM REQUIRED TO MELT MATERIAL PRIOR TO THE MACHINING ACTION.

	Question	Marks
5d) CONT.	USED FOR 'HARD MACHINING' & VERY EXPENSIVE. • UP TO HRC 95 COMPOUND HARNERS <u>DIAMOND</u> UNSUITABLE FOR MACHINING STEELS DUE TO DIAMOND'S CHEMICAL AFFINITY TO IRON. BRITTLE — USED AS A LAST OPTION WHERE ALL OTHER TOOLING HAS FAILED. • NATURALLY OCCURRING DIAMOND BEING HRC 100 WHICH THEORETICALLY SHOULD BE THE HARDEST SUBSTANCE KNOWN TO MAN.	6