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TEVETA
Technical Education, Vocational and Entrepreneurship Training Authority

DIPLOMA IN PRODUCTION AND OPERATIONS MANAGEMENT

LEVEL 6 YEAR II EXAMINATIONS

FINAL INTEGRATED SUMMATIVE EXAMINATION

SITTING: JULY/AUGUST 2025

SUBJECT: MANUFACTURING TECHNOLOGY II

TIME: THREE (3) HOURS **TOTAL MARKS: 100**

PASS MARK: 50

INSTRUCTIONS TO CANDIDATES

1. Write your examination number and national registration card number on the answer booklet provided. Ensure to append your signature in the space provided on the answer booklet.
2. Write your answer SCRIPT SERIAL NUMBER on the examination register provided and the entry slip.
3. There are two (2) sections in this paper, Sections A and B.
4. Section A consists of ten (10) multiple choice questions carrying two (2) marks each. Answer all questions.
5. Section B has six (6) questions. Answer question Two (2) which is compulsory and any other three (3) questions of your choice from the remaining five (5).
6. Use pencils and graph papers (provided) for drawings and graphs.
7. Cell phones are not allowed in the examination room.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A MULTIPLE CHOICE QUESTIONS

QUESTION 1

Write the letter of the correct answer in the answer booklet provided.

1.1 Which of the following device is mostly associated with Automation?

a) NC machine

b) Flexible manufacturing

c) Computer graphics workstation

d) Robots (2 marks)

1.2 Which of the following are cleaning fluids?

a) Emulsions

b) Solvents

c) Alkaline solutions

d) All of the mentioned (2 marks)

1.3 Washing machine is a Robot. True or false?

a) True

b) False (2 marks)

1.4 How many Degrees of Freedom (DOF) does a prismatic and revolute joint have respectively?

a) 1, 1

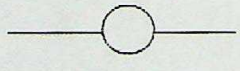
b) 2, 1

c) 1, 2

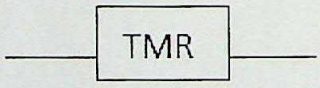
d) 2, 2 (2 marks)

1.5 Which of the following symbol denotes Timer?

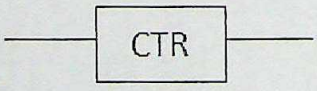
a)



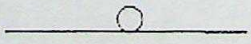
b)



c)



d)

 (2 marks)

1.6 What are the types of FMS Layouts?

a) Crossed, Circular, Asymmetric, Parabolic

b) In Line, Loop, Open Field and Robot Centered

c) Square, Pyramidal, Circular and Hyperbolic

d) Triangular, Trapezoidal and Angular (2 marks)

1.7 Which of the following is the process of converting raw materials into finished products?

a) Trading

b) Manufacturing

c) Testing

d) Inspecting (2 marks)

1.8 How are production operations classified in Process and Discrete Product manufacturing industries?

a) Heavy and Light

b) Loop and Open Field

c) Inline and Outline

d) Continuous and Batch (2 marks)

1.9 Which type of error occurs as result of change in raw material or drift in equipment setting?

a) Aberration Errors

b) Absolute Errors

c) Random Errors

d) Systematic Errors (2 marks)

1.10 Which is concerned with applying the necessary corrective action to overcome the error?

a) Error Recovery

b) Part Recovery

c) Tool Recovery

d) Operator Recovery (2 marks)

Total (20 marks)

SECTION B

ATTEMPT QUESTION TWO (2) AND ANY OTHE THREE (3) QUESTIONS

QUESTION 2 (COMPULSORY)

A Programmable Logic Controller (PLC) is a ruggedized computer used for industrial automation. These controllers can automate a specific process, machine function, or even an entire production line. The PLC receives information from connected sensors or input devices, processes the data, and triggers outputs based on pre-programmed parameters. Depending on the inputs and outputs, a PLC can monitor and record run-time data such as machine productivity or operating temperature, automatically start and stop processes, generate alarms if a machine malfunctions, and more.

TASK:

a) Define the following terms:

   i. Continuous Analog Data. (2 marks)

   ii. Programmable Logic Controllers. (2 marks)

b) Explain **two (2)** automation strategies and their effects on Efficiency, To, U, MLT and WIP. (6 marks)

c) The lamp Y is turned ON when K_1 and K_2 or K_3 or KS_4 are closed.

   i) Draw the Mitsubishi F2 - 40 Controller ladder diagram. (5 marks)

   ii) Describe the Mitsubishi F2 – 40 Controller ladder (5 marks)

Total (20 Marks)

QUESTION 3

a) State **four (4)** principles of Value Analysis and Value Engineering. (4 marks)

b) Outline the main steps followed during Value Analysis investigation. (4 marks)

c) The diameter of a disc is 140 mm, thickness is 3.5 mm and average shear force is 750N/mm^2. Calculate the blanking force. (4 marks)

d) The deep-drawing blank diameter is 350 mm, the first draw punch diameter is 210 mm and on first re-draw it reduces to 150. Determine

   i. The percentage reduction of the re-draw. (2 marks)

   ii. The drawing ratio. (2 marks)

e) Let the strip be 54 mm wide and the layout to have the blanks in line with space of say 1mm between the edges of successive holes.

   iii. Determine the scrap percentage. (2 marks)

   iv. Strip the layout for blanking 52 mm washer. (2 marks)

8

Total (20 marks)

QUESTION 4

A joint of an industrial robot is similar to a joint in the human body; it provides relative motion between two parts of the body. Each joint provides the robot with the degree of freedom (D.O.F) of motion. One DOF is associated with one joint. Future robots might have more than one degree of freedom. Nearly all industrial robots have mechanical joints that can be classified into five types. Two types provide linear motion, and three types provide rotary motion.

a) Describe the operation of the following types of Robot configuration:
   i. Cylindrical. (3 marks)
   ii. Polar configuration. (3 marks)

b) State **two (2)** main commands used in Robotic technology giving an example in each case. (3 marks)

c) Describe **two (2)** sensors incorporated in Robotic technology, giving a suitable example in each case. (3 marks)

d) With the help of sketches, describe **two (2)** types of joints used in Robotic Technology. (8 marks)

Total (20 Marks)

QUESTION 5

a) State **four (2)** ways by which the problem of selecting the suitable machine may arise. (4 marks)

b) Contrast the Special-Purpose and General-Purpose machines. (3 marks)

c) Explain **three (4)** principles which govern the choice of manipulation methods in selecting the manufacturing processes. (4 marks)

d) An engineering wishes to design and manufacture metal slabs to be used to construct a bridge which was washed away by the recent rains in Kacholola. There are four (4) machines Q, R, Y and C in the workshop, through which the metal slabs must pass before they are ready for dispatch as shown in the table, together with the Set-up and Operation times for each machine:

Machine	Set-up Times (hrs)	Operation Times (minutes)
Q	7	28
R	2	8
Y	3	21
C	10	17

The batch size is 35 components and the average non-operation time per machine is 6.5 hours.

Calculate:

i. The Manufacturing Lead Time (MLT). (3 marks)

ii. The Component of Production Time. (3 marks)

iii. The production rate for operation at machine Y. (3 marks)

Total (20 Marks)

QUESTION 6

a) Define the following terms:

i. Motion Statement. (2 mark)

ii. Asynchronous transfer. (2 mark)

iii. Absolute positioning. (2 mark)

b) State **four (4)** advantages of using industrial codes. (4 marks)

c) Distinguish between the Polycodes and the Monocodes. (4 marks)

d) With an example in each case, explain **three (3)** types of data used in process monitoring and control. (6 marks)

Total: (20 Marks)

QUESTION 7

Pneumatic valves are used in many different applications and are therefore required to be operated by a variety of different methods. For example, a circuit which requires a high degree of safety might be operated by a key, whereas a pneumatic circuit-breaking valve, which could be activated as soon as danger developed, would be best fitted with a large push button.

a) Draw the symbols of the following manufacturing components:

i. Two-pressure valve. (3 marks)

ii. Valve coil. (3 marks)

iii. Coupling socket. (3 marks)

iv. A lever-operated, diaphragm-return valve. (3 marks)

b) A double-acting cushioned cylinder has a force of 119 X 10^6 N acting on the piston surface area of 6290 mm^2. The piston rod had 68mm diameter while the piston made 350 strokes. Find the gauge pressure in bars, and if it is operated for 4 cycles/min, how much air will be delivered? (8 marks)

Total (20 Marks)

10