NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

MASTER OF ENGINEERING IN MANUFACTURING ENGINEERING AND OPERATIONS MANAGEMENT

MANUFACTURING TECHNOLOGY

TIE 6122

First Semester Supplementary Examination Paper

August 2015

This examination paper consists of 4 printed pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: None

Examiners' Names: Dr Zwelibanzi B Dlodlo and Mr Nicholas Tayisepi

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer four (4) questions altogether. Choose two (2) questions from each Section A and B
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**25**
3.	**25**
4.	**25**
5.	**25**
6.	**25**
TOTAL MARKS ATTAINABLE BY CANDIDATE	**100**

SECTION A

Answer two (2) questions from this Section

Question 1

a) Although high speed steel (HSS) cutting tools have been superseded by tools made from relatively new cutting tool materials such as cemented carbides and ceramics which machine faster, there are applications where they still remain attractive. Explain. [7]

b) Describe, with the aid of neat illustrative sketches where appropriate, the different ways in which cutting tools fail. [10]

c) Which are the four basic types of chip formation mechanism produced during machining processes? [8]

Question 2

a) Explain the following milling operations with the aid of illustrations, where appropriate:

(i) straddle milling, [2]

(ii) upcut milling, [2]

(iii) climb milling, [2]

(iv) face milling. [2]

b) A face milling operation is used to machine 5 mm from the top surface of a rectangular piece of aluminum 400 mm long by 100 mm wide. The cutter has four teeth (cemented carbide inserts) and is 150 mm in diameter. Cutting conditions are: v = 3 m/s, f = 0.27 mm/tooth and d = 5.0 mm. Determine the time to make one pass across the surface. [5]

c) Explain the distinction between the cutting actions of grinding and milling. [4]

d) What constitutes the composition of grinding wheels? [4]

e) The following data relates to the magnitude of forces and power which occur when precision grinding. Cutting speed is 525 m/min, work speed is 10.98 m/min, width of cut 12.7 mm, Depth of cut 0.0076 mm. The tangential force on the wheel is 62.3 N.

Calculate the material removal rate. [4]

Question 3

a) During a machining manufacturing operation the process parameters were measured respectively thus and the values were as follows: cutting speed v_c = 165 m/min, cutting force F_c = 1080 N, thrust force F_a = 1000 N, tool rake angle (γ) = 10^0 and the shear plane angle was found to be 19^0. Determine the:

(i) velocity of shearing along the shear plane, [3]

(ii) velocity of sliding along the chip tool interface, [3]

(iii) work done per minute in shearing the metal against friction. [3]

b) Explain the role played by rapid prototyping in enhancing product turn-around time of product design and manufacturing process. [4]

c) With the aid of well annotated sketches briefly explain the following rapid prototyping techniques:

(i) 3D printing, [4]

(ii) Stereolithography, [4]

(iii) Fused deposition modeling. [4]

SECTION B

Answer two (2) questions from this Section

Question 4

a) Compare Electrochemical Machining (ECM) and Electron Discharge Machining (EDM) in the basic operation of producing (sinking) a cavity such as one for an injection moulding or casting a die as regards tool material, tool wear, material removal rate, power source, current level and cutting fluid. [15]

b) Name and illustrate four specialized applications of ECM. [10]

Question 5

a) Briefly discuss the various processes based on the application of the laser and indicate how they differ in intensity. [10]

b) Name the typical tasks and identify the type of lasers used in these operations. 5]

c) Which material properties affect the performance of laser cutting and how is the necessary power determined? [10]

Question 6.

a) What are the two main considerations for the choice of a processing method for polymers? [2]

(b) With the aid of diagrams describe the following processing methods for polymers:
(i) Compression moulding [8]
(ii) Transfer moulding [8]

c) Giving examples, explain for which conditions the processing methods in (b) are most suitable. [7]