SPRING SEMESTER EXAMINATION – 2000

Saturday, 25 November 2000

2.00 PM to 5.10 PM

48621 - MANUFACTURING ENGINEERING

Time allowed:  3 hours + 10 minutes reading time

All questions are to be attempted

All questions are not of equal value.

Marks for each question (out of a total of 120) are indicated.

This is a closed book examination

Marks will be given for correct diagrams where they are appropriate

Please keep answers brief. Write answers in the space provided. Use the back of the page if required.

There are 20 pages to this examination as well as this cover sheet.
PART A. Machining Processes: (50 marks out of 120)

1. Describe the function of a Job Shop.
   (1 mk)
   __________________________________________________________________________
   __________________________________________________________________________

2. What is a Cutting Tool?
   (1 mk)
   __________________________________________________________________________
   __________________________________________________________________________

3. Name three cutting tool materials and list them in order of cutting speed performance.
   (2 mks)
   i) _________________________________________________________________________
   ii) _________________________________________________________________________
   iii) _______________________________________________________________________

4. In continuous chip formation how is a Built Up Edge formed? Sketch a BUE.
   (2 mks)
   __________________________________________________________________________
   __________________________________________________________________________
5. Name three basic chip formation processes and sketch a schematic diagram of each.

(3 mks)

(i) _____________________  (ii) ______________________  (iii) _____________________

6. Name two different types of work-holding devices commonly used on centre lathes.

(1 mk)  
(i) ______________________________  (ii) _______________________________

7. What are the three basic methods for machining tapers on a lathe?

(3 mks)  
(i) ____________________________________________

(ii) ____________________________________________

(iii) ____________________________________________

8. Name two devices used for supporting slender work on a centre lathe.

(1 mk)  
(i) ______________________________ (ii) ______________________________
9. Sketch a boring process in a centre lathe on the following page and develop a formula for the Metal Removal Rate.
Indicate the following on the diagram and use these symbols in your formula:

\[ D_1 = \text{Final dia.} \quad D_2 = \text{Initial dia.} \quad L = \text{Length of cut} \quad fr = \text{Feedrate} \]

\[ N = \text{spindle speed} \quad \text{Hint: MRR = Volume removed / time} \]

(5 mks)
10. Identify the machine tool below and name the five major parts shown on the diagram.

(3 mks)

Machine Tool:

(i) ______________________

(ii) ______________________

(iii) ______________________

(iv) ______________________

(v) ______________________

11. What two problems resulting from the incorrect sharpening of a twist drill would cause it to cut oversize?

_____________________________________________________________________

(2 mks) __________________________________________________________________________

____________________________________________________________________________
12.a) Dividing Heads have an input to output ratio. What is that ratio?

(1 mk) ____________________

12.b) Given a selection of hole plates with 49, 43, 39, and 29 holes, calculate the input increment to produce a 60 toothed gear.

(3 mks) ____________________

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

13. Draw the schematic of a peripheral climb milling process, using a plain cutter and indicate:

(i) Cutting tool  (ii) Feed / tooth (and typical units)  (iii) Depth of cut (and typical units)

(4 mks)
14. Name two processes that are commonly used to produce an accurate hole?

(1 mk)

i) ____________________________________ ii) ______________________________________

15. What is the benefit of web thinning when drilling holes?

(1mk)

___________________________________________________________

16. Name four grinding processes and state the principal features of each.

(2mks)

(i) _____________________________________________

(ii) ____________________________________________

(iii) ____________________________________________

(iv) ____________________________________________

17. Interpret the grinding wheel code: 37C 120 KV.

(1 mk)

___________________________________________________________

___________________________________________________________

18. Why do some grinding wheels need balancing?

(1 mk)

___________________________________________________________

How is this achieved?

___________________________________________________________

___________________________________________________________

19. Name a material that would normally be ground dry and nominate a reason for your choice.

(1 mk)

___________________________________________________________
20. Identify two common types of abrasives used in grinding wheels and the code symbol for each.

(1 mk)
   i) ________________________________________________________________
   ii) _____________________________________________________________

21. What is Point Relief grinding? _______________________________________

(1 mk)
   ________________________________________________________________

22. Name and briefly describe three methods of machining gears.

(3 mks)
   i) ______________________________________________________________

   ________________________________________________________________
   ii) _____________________________________________________________

   ________________________________________________________________
   iii) ___________________________________________________________

23. State the main reason why generated gear teeth are superior to teeth that have been milled using an involute cutter.

(1 mk)
   ________________________________________________________________

24. What are jigs and fixtures? Describe their function.

(1 mk)
   Jigs: __________________________________________________________

   ________________________________________________________________
   Fixtures: _______________________________________________________

25. Name a work holding device that is used in grinding but not in milling or turning. What excludes its use in these operations?

(1 mk)
   ________________________________________________________________
26. Workholders are designed on the 3-2-1 principle. Describe the principle referred to and sketch an application.

(2 mks)
PART B. Metal Forming and Casting Processes (40 marks out of 120)

1. What are the four basic classes of processes used to change the shape of engineering materials?
   (2 mks)
   i) ______________________________________ ii) ______________________________________
   iii) ______________________________________ iv) ______________________________________

2. What are the advantages of casting a complex shaped part over machining the part?
   (2 mks)
   ______________________________________
   ______________________________________

3. On the diagram of a typical Sand Mould, indicate the following features. State the purpose of each in the space provided.
   (5 mks)

   Cope: ______________________________________
   Gating system: ______________________________________
   Riser: ______________________________________
   Core: ______________________________________
   Parting line: ______________________________________
4. What is the difference between *Shrinkage Allowance* and *Machining Allowance* in casting?

(1 mk)

___________________________________________________________________________
___________________________________________________________________________

5. A complex shaped aluminium cover plate is required for a gear pump. The plate will be prototyped by initially making two only for testing. Later batches of 200 cover plates and eventually 20,000 per year may be required. Give appropriate manufacturing processes for each of the three stages:

Stage 1: _________________________________________________________________

Stage 2: _________________________________________________________________

Stage 3: _________________________________________________________________

(2 mks)

6. In Permanent Mould Casting what is *mould life* dependent on?__________________________

(1 mk)

___________________________________________________________________________

7. List the advantages and limitations of:

(2 mks)

i) Expendable mould casting:_______________________________________________

___________________________________________________________________________

ii) Multiple use mould casting:______________________________________________

___________________________________________________________________________

8. List four engineering products that would traditionally be *cast* (in preference to other processes)

(2 mks)

i)____________________________________ ii)__________________________

iii)____________________________________ iv)__________________________

9. How does *Die Casting* differ from ordinary permanent mould casting techniques?

(2 mks)

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

10 __________________________________________________________________________
10. In the bench vice illustrated below, detail the materials and materials processes that are usual for the items listed. Is there any heat treatment necessary?

(3 mks)

a) Jaw pieces, movable and fixed.____________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

b) Replaceable Jaws_______________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

c) Slide_________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
11. In the *Steel Making* process, how is the Carbon Content of the product controlled and what influence does it have on the properties of the steel. _________________________________

(2 mks)

______________________________________________________________

12. List three materials from which casting patterns are made and give one advantage of each.

(2 mks)

i) ___________________ ____________________________________________

ii)____________________ __________________________________________

iii)____________________ __________________________________________

13. Briefly describe the differences between deforming a metal or alloy by *hot* and *cold working*.

(2 mks)

Hot Working: _____________________________________________________

Cold working: _____________________________________________________

14. Forging is often called *Plastic Working*. What does this mean?

(1 mk)

_______________________________________________________________

15. List three possible advantages of hot forging a metal item over casting the item.

(2 mks)

i)______________________________________________________________

ii)____________________________________________________________________

iii)____________________________________________________________________

16. Sketch and briefly outline the *roll forming* process for seam welded tube.

(3 mks)
For each of the following items fill in the probable manufacturing processes:

(6 mks) The BTR ring gear is given as an example to guide you. Place N/A where a process is not applicable.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>BTR ring gear (EXAMPLE ONLY)</th>
<th>Low pressure bronze globe valve body</th>
<th>Aluminium belt pulley</th>
<th>Universal beam</th>
<th>Differential casing</th>
<th>Ball bearing race</th>
<th>Engine exhaust valve and stem</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PRECISION GRINDING</th>
<th>tooth</th>
<th>flanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEAT TREATMENT</td>
<td></td>
<td>gas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>carburize</td>
</tr>
<tr>
<td>MACHINING PROCESS</td>
<td></td>
<td>drill</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hub</td>
</tr>
<tr>
<td>ROLL FORGED SECTION OR PLATE</td>
<td></td>
<td>turn</td>
</tr>
<tr>
<td>FORGED BLANK</td>
<td>yes</td>
<td>N/A</td>
</tr>
<tr>
<td>CAST BLANK</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>
18. Identify the process by which the sectioned and etched gear blank (below) was probably produced.

(1 mk) __________________________________________________________
PART C  Welding, Cutting and Heat Treatment  (30 marks out of 120 marks)

1. Explain how the Oxy-fuel gas cutting process works giving relevant chemical equations.

(1 mk)

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

2. List three safety features present in Oxy-fuel welding equipment.

(1 mk)

i) __________________________________________

ii) __________________________________________

iii) __________________________________________

3. Why might Plasma arc cutting be more attractive than Oxy-fuel cutting?

(1 mk)

___________________________________________________________________________

___________________________________________________________________________

4. Name the numbered parts of the Oxy-acetylene welding torch illustrated below:

(2 mk)

1. ______________________ 2. ______________________

3. ______________________ 4. ______________________

5. ______________________ 6. ______________________
5. How does brazing differ from welding?

(2 mks)

___________________________________________________________________________

Why is brazing an appropriate method of joining dissimilar metals with widely different melting points?

___________________________________________________________________________

6. Sketch a cross section of each of the following welds. In each case show the filler metal: (assume arc welding, steel sections)

(3 mks)

i) Fillet weld

ii) V Butt weld

iii) Double-U Butt weld

iv) Plug weld

v) Spot weld
7. List *four* types of *weld defect* causing weakness in welded joints.

**2 mks**

i) __________________________________________

ii) _________________________________________

iii) _________________________________________

iv) _________________________________________

8. With the aid of a sketch discuss what is meant by “*Heat Affected Zone*”. What problems might this cause?

**2 mks**

_________________________________

_________________________________

_________________________________

_________________________________

_________________________________

9. i) Using a sketch give an example and describe what causes *distortion* in welding.

**2 mks**

_________________________________

_________________________________

_________________________________

_________________________________

_________________________________
Briefly discuss two methods of minimising distortion in welding.

(2 mks)

a)___________________________________________________________________________
_____________________________________________________________________________

b)___________________________________________________________________________
_____________________________________________________________________________

11. Name the numbered components in the diagram below which illustrates an electrical resistance welding circuit. Explain the function of each.

SEE DeG Fig 38.1, p962

(2 mks)

i)___________________________________________________________________________
_____________________________________________________________________________

ii)_________________________________________________________________________
_____________________________________________________________________________

iii)_________________________________________________________________________
_____________________________________________________________________________

iv)_________________________________________________________________________

v)_________________________________________________________________________
12. Describe the three welding methods below. Point out their specific differences.

(3 mks)

i) Shielded Metal Arc Welding. __________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

ii) Gas Tungsten Arc Welding (TIG) _______________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

iii) Gas Metal Arc Welding (MIG) ________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

13. List three reasons for using welding fixtures. What purposes do they serve?

(2 mks)

i)_________________________________________________________________________

ii)_________________________________________________________________________

iii)________________________________________________________________________

14. Why design machines in parts which have to later be assembled and joined together? Give four possible reasons.

(2 mks)

i)_________________________________ ii)____________________________________

iii)________________________________ iii)___________________________________
List advantages of the following joining methods:

(3 mks)

Welded joints
i) _____________________________
ii) _____________________________
iii) _____________________________
iv) _____________________________

Bolted joints
i) _____________________________
ii) _____________________________
iii) _____________________________
iv) _____________________________

Adhesively bonded joints
i) _____________________________
ii) _____________________________
iii) _____________________________
iv) _____________________________

END OF PAPER