Faculté de génie
Génie mécanique

uOttawa
L'Université canadienne
Canada's university

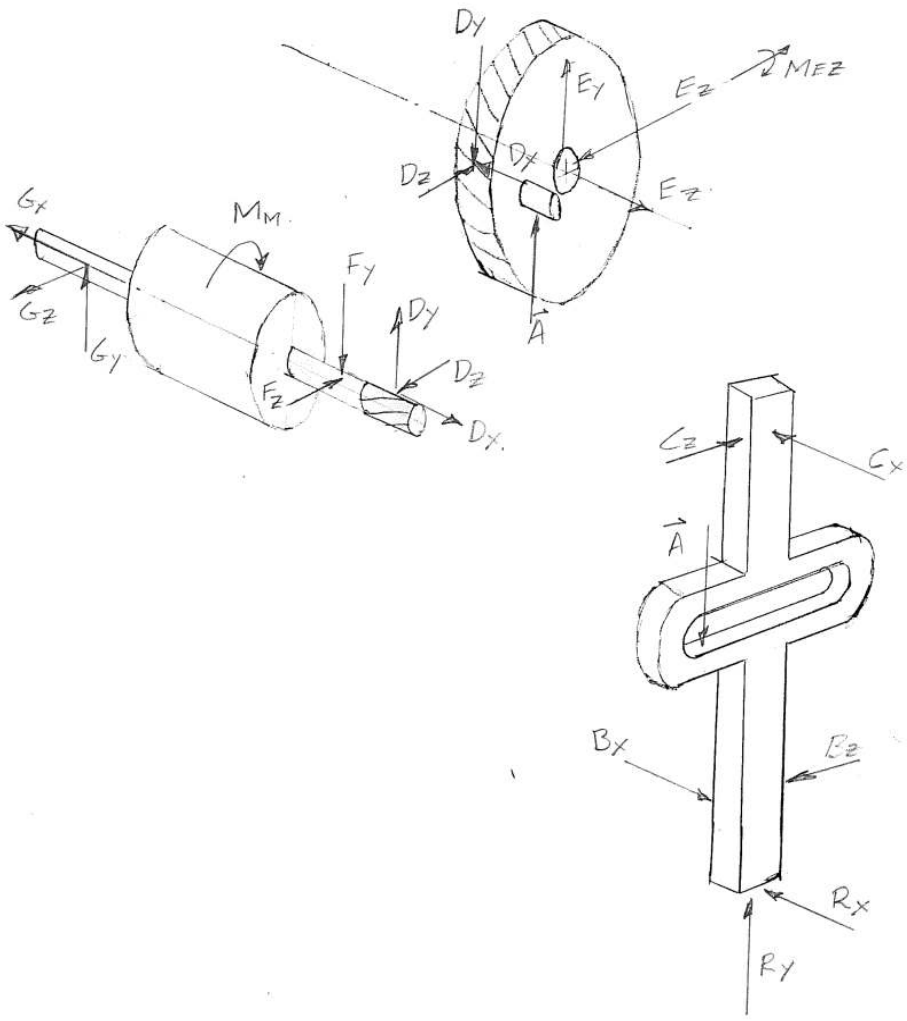
Faculty of Engineering
Mechanical Engineering

Name:_____ ID_____ Section_____

MCG 1100 - Dissection Lab 10 - Work Sheet

Solutions - Sabre Saw

1. In the space below, sketch free-body diagrams of two of the moving parts of the mechanism. Start with the output component, and draw a FBD of it and of the component that connects to it (motor shaft or intermediate shaft). Show the forces in three dimensions.
Note: M_M is the motor torque. M_{EZ} is necessary to balance the z-moment produced by A. C_Z and B_Z are needed to balance the x-moment produced by A on the Scotch yoke. R_X, R_Y are cutting forces.



2. Identify the different types of bearings used in the motor and in the drive components.

Motor: *ball bearings (sealed units)*

Other components (name): *needle bearing (shaft of large gear)*
plain (journal) bearing (pin on large gear which engages Scotch yoke)

3. Measure the diameter of a shaft in the drive mechanism, giving the size in inches precise to 0.001". Which measuring instrument did you use, and why?

0.236" (shaft of large gear). Used micrometer because most precise.

4. Identify the materials and manufacturing processes used for the following parts. In each case, suggest a reason why this particular material was chosen.

(a) the housing or case of the machine
plastic, injection moulded (only process for plastic)

(b) any metal parts inside the machine (list different parts separately if different metals or processes are used)
- gears - steel (cheap and strong)
- cut by gear-teeth machining process, probably hobbing
- Scotch yoke - stamped of heavy sheet metal (one can see rounding from the stamping process on one side, also marks on the edges), one side ground flat to remove burrs from stamping
- piece to hold blade - milled from solid steel, welded to Scotch yoke
- bearing housing - zinc alloy die casting (soft, dull grey)

(c) any plastic parts inside the machine
- brush holders, switch - injection moulded

5. Based on the gears in the drive, estimate the speed of the motor driving the machine. (Note: the output speed should be given on the nameplate; if yours isn't, make a reasonable estimate.)

gear ratio 46:5

output speed 3000 rpm, input speed = 3000 x 46 / 5 = 27 600 rpm

6. Examine the electric motor and identify the brushes, the commutator, the stator and the rotor.

(a) What material is the commutator surface made of and why?

- copper - high electrical conductivity

(b) What is the material of the stator core? Describe its construction and the method used to manufacture it.

- steel - must be a magnetic material for an electromagnet. Made of laminations stamped of thin sheet steel which are stacked together to produce the core. The purpose of this is to reduce eddy currents in the core.

(c) The rotor has had small amounts of material removed from it by grinding. Why was this done?

- to balance the rotor

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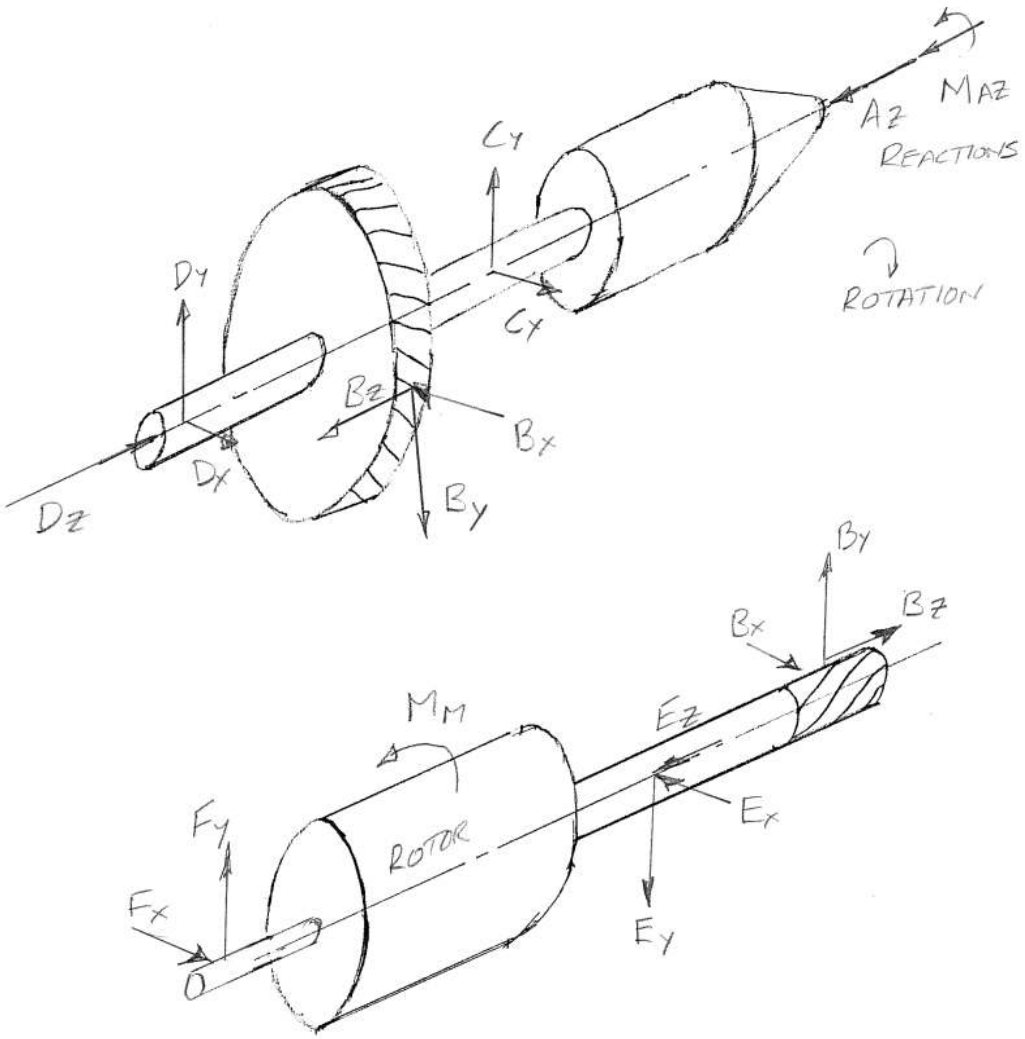
MCG 1100 - Dissection Lab 10 - Work Sheet

Solutions - Electric Drill

1. In the space below, sketch free-body diagrams of two of the moving parts of the mechanism. Start with the output component, and draw a FBD of it and of the component that connects to it (motor shaft or intermediate shaft). Show the forces in three dimensions.
Note: M_M is the motor torque. M_{AZ} is the reaction torque from the drill bit. A_Z is the reaction to the drill being pushed into the work, and must be balanced by a thrust force D_Z..



2. Identify the different types of bearings used in the motor and in the drive components.

Motor: *ball bearings (sealed units)*

Other components (name): *ball bearing behind chuck*
plain (journal) bearing on end of chuck shaft, with a single ball to act as a thrust bearing

3. Measure the diameter of a shaft in the drive mechanism, giving the size in inches precise to 0.001". Which measuring instrument did you use, and why?

0.313" (shaft of large gear). Used micrometer because most precise.

4. Identify the materials and manufacturing processes used for the following parts. In each case, suggest a reason why this particular material was chosen.

(a) the housing or case of the machine
plastic, injection moulded (only process for plastic)

(b) any metal parts inside the machine (list different parts separately if different metals or processes are used)
- gears - steel (cheap and strong), turned and faced, teeth cut by gear-teeth machining process, either milling or hobbing
- shafts - steel - machined by turning
- bearing housing - zinc alloy die casting (soft, dull grey)

(c) any plastic parts inside the machine
- brush holders, switch - injection moulded

5. Based on the gears in the drive, estimate the speed of the motor driving the machine. (Note: the output speed should be given on the nameplate; if yours isn't, make a reasonable estimate.)

gear ratio 46:4

output speed 2700 rpm, input speed = 2700 x 46 / 4 = 31 050 rpm

6. Examine the electric motor and identify the brushes, the commutator, the stator and the rotor.

(a) What material is the commutator surface made of and why?

- copper - high electrical conductivity

(b) What is the material of the stator core? Describe its construction and the method used to manufacture it.

- steel - made of laminations stamped of thin sheet steel which are stacked together to produce the core

(c) The rotor has had small amounts of material removed from it by grinding. Why was this done?

- to balance the rotor