Lab 04 Group Tue_3_2

Q1

See code

Q2

Stall torque = 31.1 Ncm -> r = 2cm -> 15.55N tangential force
K = 500 N/m -> 15.55 N => 3.11 cm

The spring should stretch 3.11 cm before the servo stalls.

Q3

Measurement:
Relaxed: 6mm
Tensionned: 17mm

Displacement: 11mm

The actual displacement is much shorter than calculated, the main cause for this deviation is friction in the system (gears and friction of wire)

Q4

Ratios:
60 -> 48 -> 18 -> 48 : Resulting ratio of 2.13
Measurement:
Relaxed: 6mm
Tensionned: 31mm
Displacement: 25mm

Now we achieve a much higher displacement.

Q5

The motor can move 180 degrees. We need a range of 0°-900° (2.5 windings) for the seconds indicator and 0°-360° for the minute indicator. So we need the following ratios:
Seconds: 900°/180° = 5. This can be achieved with the pairing 60 -> 12
Minute: 360°/180° = 2. This can be achieved with the pairing 60 -> 30

Q6

Stall Torque (5.0V) = 31.1Ncm
Second_wheel:

teeth ratio: servo_wheel to second_wheel = 60/12 = 5
-> Diameter will have same ratio
-> Torque at second_wheel = 31.1Ncm /5 = **6.22Ncm**

Minute_wheel:

Teeth ratio: servo_wheel to minute_wheel = 60/30 = 2
-> Diameter will have same ratio
-> Torque at minute_wheel = 31.1Ncm /2 = **15.55Ncm**

Q7

Middle gear: 60 teeth
Seconds: 12 teeth
Minutes: 30 teeth

Q8

The delay() function stores the timestamp of when the function is called. It then loops until the difference between the current and the start time has exceeded the desired number of seconds. Therefore, it delays the program that calls the function by the desired amount of seconds.

Q9

See code

Q10

See code

As our servo motor achieved larger angles than 0°-180° we manually adjusted the range (mapping) of the pulse width to the desired angles. This can be seen in Servo_Timer.ino and Servo_Poti.ino.

Q11

See video