UNIVERSITY OF SASKATCHEWAN
COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING
MECHANICAL ENGINEERING LABORATORY III
ME 418.3 LAB TEST

TIME: 3 Hours
Log books, lab manuals and M Lab reports permitted **December 4, 2006**

Name: _____

Student Number: _____

Signature: _____

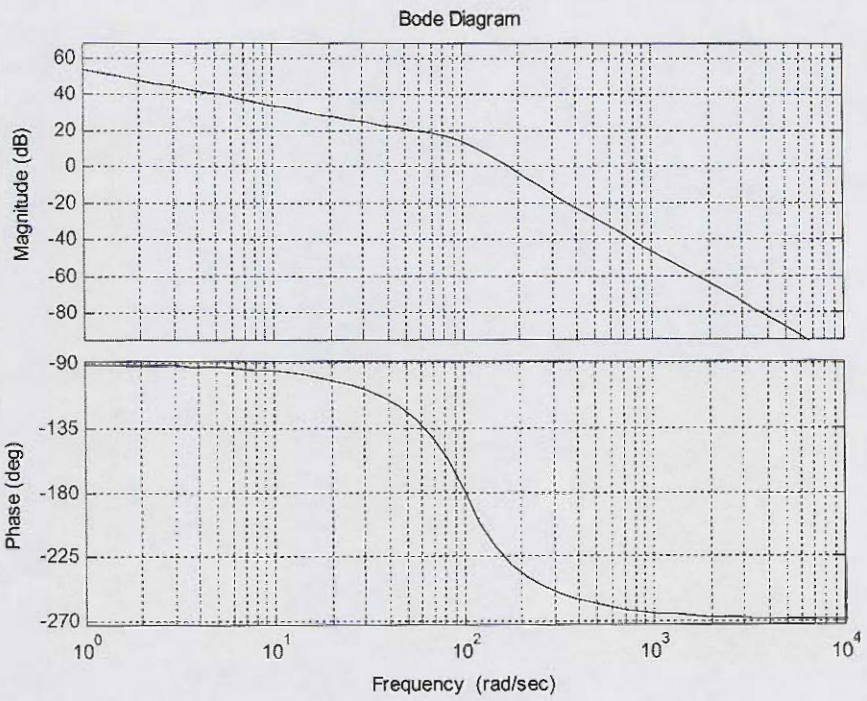
Please answer each question in the space provided. You may use the back of each sheet if required.

Question	Marks	Score
1	7	
2	7	
3	7	
4	18	
5	7	
6	6	
7	7	
8	2	
9	5	
10	7	
11	7	
12	8	
13	2	
14	10	
Total	100	

Marks

(7) 1. The following Bode diagram was obtained from the sinusoidal frequency response of a hydraulic control system in C2 Lab by using a spectrum analyzer.

a) Determine the order of the system and explain why.
b) Estimate the transfer function for the system.
c) If ONLY given the Magnitude Bode diagram (without the Phase Bode diagram), can we uniquely determine the transfer function? Explain why or why not.



(3) 2. a) Which D1 fatigue testing machines would be best suited to testing flat plate specimens of spring steel?

(4) b) Draw and label typical shear and bending-moment diagram(s) for the fatigue specimen(s), produced by the above machine(s).

3. A wear scar measuring 3.00 mm x 5.00 mm has been developed on the ROCLE lubricity machine with the three laboratory test weights applied to a hydraulic fluid, as was done in Laboratory D2.

(3) (a) Calculate the size of the wear scar area developed.

(4) (b) Determine the contact stress sustained by this hydraulic oil film in MPa.

4. Manufacturing Labs:

(2) (a) What does a G50 command indicate to a CNC controller?

(2) (b) Why are the two Servo motors on our CNC lathe in the laboratory different from each other?

(3) (c) How do you determine whether cutter compensation is to the left or right of a shape to be machined? Make a sketch.

(2) (d) Why is the spindle on a CNC machine belt and not gear driven?

(2) (e) Which parts on our CNC lathe in the laboratory are pneumatically operated?

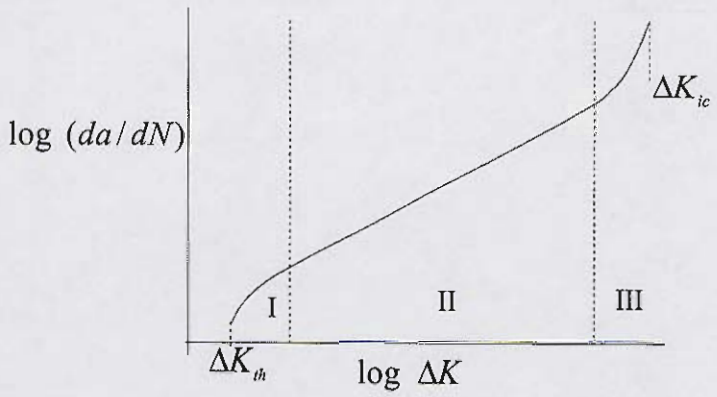
(2) (f) The creation of an accurate CNC program requires a number of steps and revisions. One of the revisions that may be necessary after a first run is to evaluate and calculate new offset values.
How do you find these offset values?

(2) (g) How do we determine the direction of the spindle rotation on a lathe?

(3) (h) During machining, chattering (vibration) of the tool occurs. What measures can be taken to solve this problem?

(7) 5. An engineer is designing a 4-stroke diesel engine to power a generator that requires a minimum of 350 kW to run. The engine is to run at a maximum speed of 1500 revolutions per minute and the dimensions of each cylinder of the engine have been fixed at a bore of 100 cm and a stroke of 200 mm. A simulated dynamometer test on a cylinder gave a P-V diagram of area 2.53 volts^2 and a diagram length of 1.23 volts with a dynamometer constant of 1800 kPa/volt. Given that the total friction power is 80 kW, determine the minimum number of cylinders required on the engine to power the generator.

6. The following figure gives the relationship between the growth rate of fatigue cracks and the stress-intensity range, ΔK_1.



(2) (a) Name the three stages of fatigue failure. Which stage follows the Paris law?

(1) (b) Explain the significance of ΔK_{th} and ΔK_{ic}.

(3) (c) How can we get "A" and "m" in the Paris law from this plot?

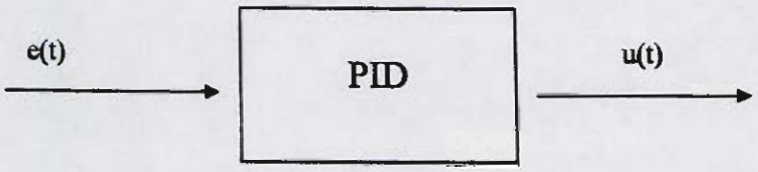
(3) 7. (a) Corrosion is the degradation of a metal by environmental factors. What are the three basic requirements for corrosion attack on a metal? Briefly explain the contribution of each requirement to the feasibility of corrosion.

(4) (b) What is cathodic protection? What is anodic protection? There are some Aluminum alloys and low alloy carbon steels that require protection from corrosion. Briefly explain why each of these materials may or may not undergo anodic protection.

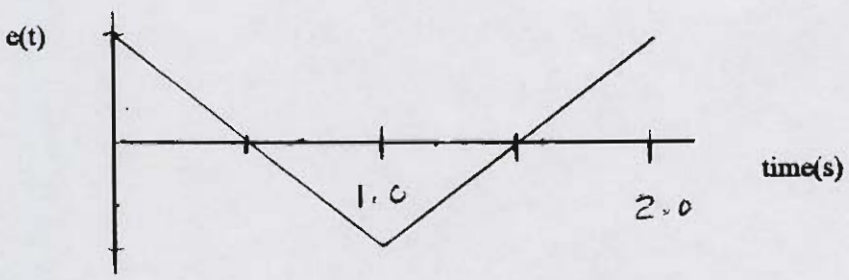
(2) 8. What is meant by "settling time"?

(5) 9. In Controls Lab #C1, you studied the effect of 0%, 10%, 45% and 100% velocity feedback. Which one would you judge gave the best response and why?

10.



The above PID controller is subjected to an input signal *e(t)*, shown below. Sketch the general shape of the output component of u(t) associated with each of the P, I and D components up to a time of 2.0s in the space provided on the graph below.



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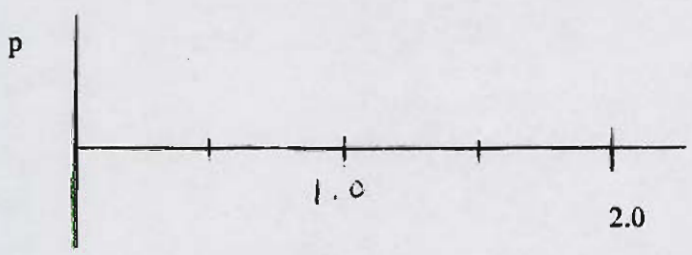

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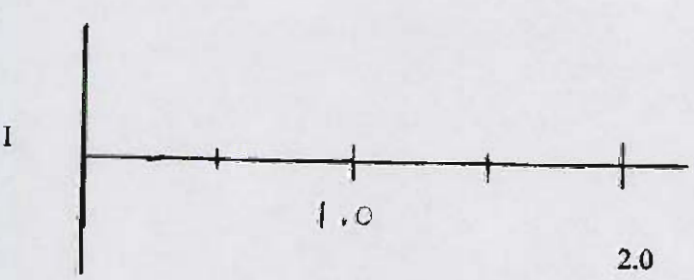

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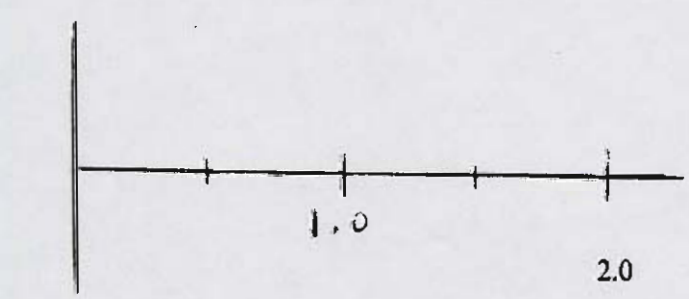


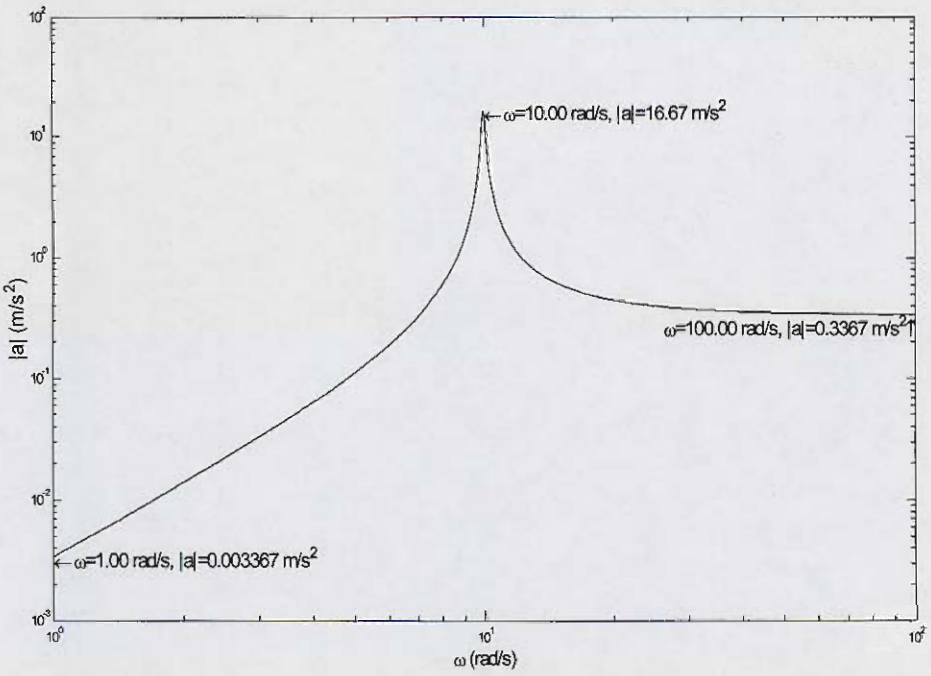
(7) 11. The reservoir in the lab contains pressurized air at a stagnation pressure of 700 kPa. The air enters the converging-diverging nozzle used in the lab. The flow through the nozzle can be assumed steady, one-dimensional and isentropic. The back pressure is adjusted so that the flow at the throat is choked and no shocks occur in the nozzle. At an unknown location in the nozzle, the static pressure probe measures 288.4 kPa. Determine the location, x, with respect to the nozzle entrance, where this measurement was made.

(7) 12. The loudest noise ever heard by humans is believed to be the volcanic eruption of Krakatoa in 1883. The sound pressure level of the explosion was estimated to be 180 dB at a point 160 km away. The explosion was reportedly heard on the island of Rodrigues near Mauritius, 4,800 km away.
(a) Assuming free field conditions and an isotropic source, estimate the sound pressure level on Rodrigues.

(1) (b) Discuss two reasons why this may not be an accurate method of estimating the sound pressure level.

(2) 13. Give one "real life" example of vibration reduction through each of
(a) balancing,
(b) springs, and
(c) inertial blocks

14. A spring-supported mass with $m_1 = 3$ kg has the following acceleration magnitude vs frequency response:



(4) (a) Sketch the displacement magnitude vs frequency plot, showing calculated values corresponding to the marked values above.

(5) (b) Given a spring with a stiffness of 1000 N/m, determine the proper mass for an absorber designed to minimize the resonant peak. Using the same assumptions as the analysis in the lab manual, estimate the magnitude of the acceleration of m_1 at 6 rad/s and 10 rad/s with the absorber installed. Also estimate the frequencies and acceleration amplitudes of the two new resonant peaks.

(1) (c) Give two reasons why the measured magnitudes of the resonant peaks will not match the calculated magnitude.