PP I

TECHNICAL UNIVERSITY OF MOMBASA

School of Engineering & Technology

Department of Electrical & Electronic Engineering

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE (ELECTRICAL & ELECTRONIC ENGINEERING)

EEE 4303: CONTROL ENGINEERING I.

END OF SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

DATE: APRIL 2025

I0nstructions to Candidates

You should have the following for this examination
-Answer Booklet, examination pass and student ID
This paper consists of **five** Questions; Question ONE is compulsory. In addition attempt any Other TWO Questions.
Do not write on the question paper.

Question ONE (**Compulsory 30 marks**)

a) (i) Define the term control systems
(ii) Explain the features of closed loop and open loop control systems.
(iii) Outline any FOUR advantages and limitations of open loop control systems.

[13 marks]

b) For a unity feedback system having a forward transfer function $G(s)=\frac{K}{s(1+0.6s)(1+0.4s)}$ determine;
(i) Range of values of **K** for stability
(ii) Marginal value of **K**
(iii) Frequency of sustained oscillations

[8 marks]

c) For the closed-loop control system with negative feedback
(i) Write down an expression for the open loop transfer function.
(ii) Sketch the Nyquist diagram
(iii) Comment upon the stability of the system.

[9 marks]

$$G(s)=\frac{2}{s(1+s)}$$

$$H(s)=\frac{1}{1+0\cdot5s}$$

Question TWO

a) For the **Figure Q2a** determine the transfer function $\frac{X_1(s)}{F(s)}$

[12 marks]

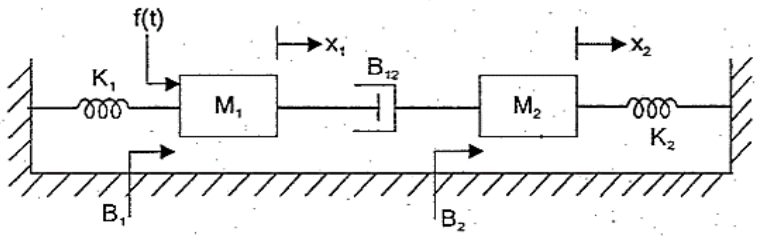


Figure Q2a

b) Using Routh criterion, determine the stability of a unity feedback system having a loop transfer function

[8 marks]

$$G(S)=\frac{e^{-sT}}{s(s+1)}$$

Question THREE

a) Using block diagram reduction technique, determine closed loop transfer function C(s)/R(s)of figure Q3a

[11 marks]

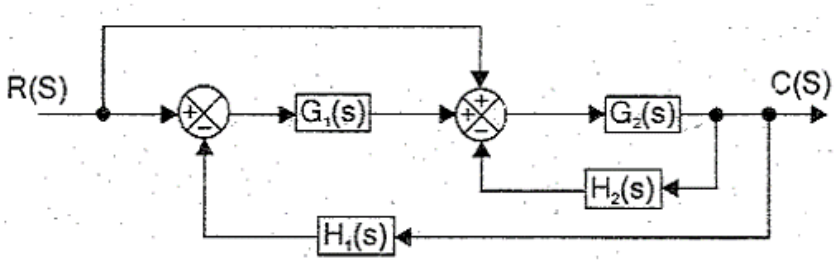


Figure Q3a

b) Draw a signal flow diagram of the system whose block diagram is Figure 3Qb. Apply Masons gain formula to determine the overall transmittance of the system

[9 marks]

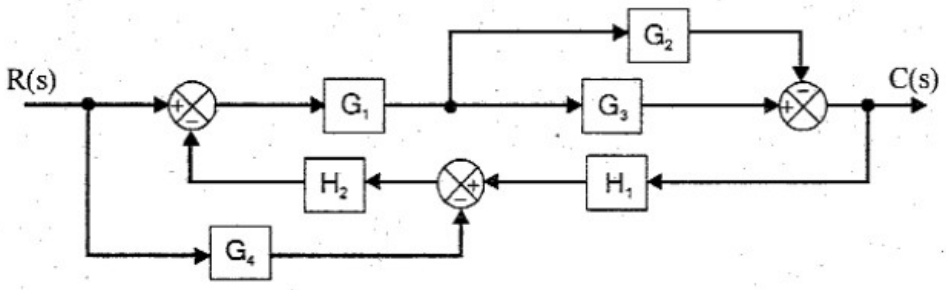


Figure Q3b

Question FOUR

a) With the aid of diagram explain the following as applied to control systems.

(i) Delay time

(ii) Rise time

(iii) Peak time

[6 marks]

b) Figure Q4b is a positional control system with velocity feedback. Given that $\xi = 0.5$. for a unit step input, determine;

(i) The response $c(t)$

(ii) Rise time

(iii) Peak time

(iv) Maximum overshoot

(v) Settling time

[14 marks]

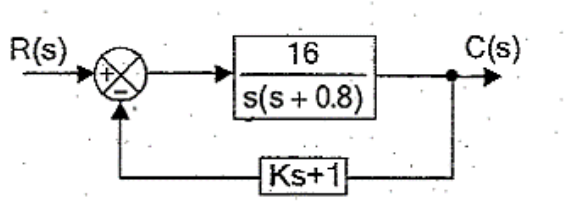


Figure Q4b

Question FIVE

a) A closed-loop control system is used to regulate the speed of an electric motor that drives a conveyor belt on which castings are transported from one location to another. The Control system has an error actuated amplifier that cooperates a high power relay and subsequently this relay drives the electric motor. The motor speed is monitored by a tachogenerator which feeds a voltage signal negatively to the error detector. The gains of the current amplifier, the relay and the electric dc motor are respectively stated as 50 mA/V, 1 60_ V/A, 80 rev/min/V and the tachogenerator has it sensitivity of 2 mV/rev/min.

(i) Draw a block diagram of the arrangement.

(ii) Determine for the command (input) voltage that is necessary to maintain a motor Speed of 1,500 rev/min with a particular load on the conveyor belt.

(iii) Determine the instantaneous change in the error voltage if the load on the belt suddenly increases so that speed falls to 1 250 rev/min,

[11 marks]

b) Define the following terms with the aid of diagrams

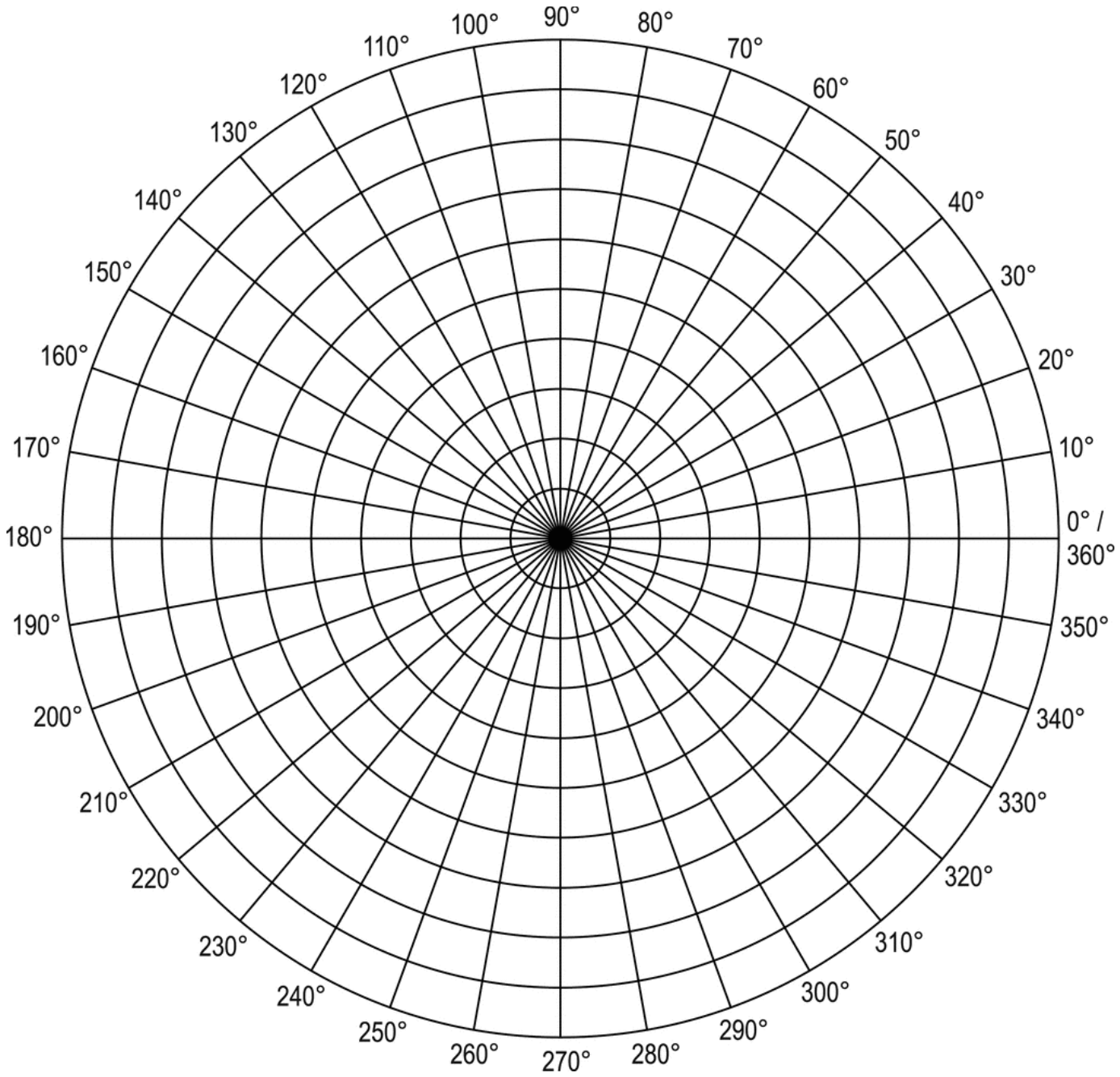
(i) Resonant peak

(ii) Resonant frequency

(iii) Band width

(iv) Cutoff rate

[9 marks]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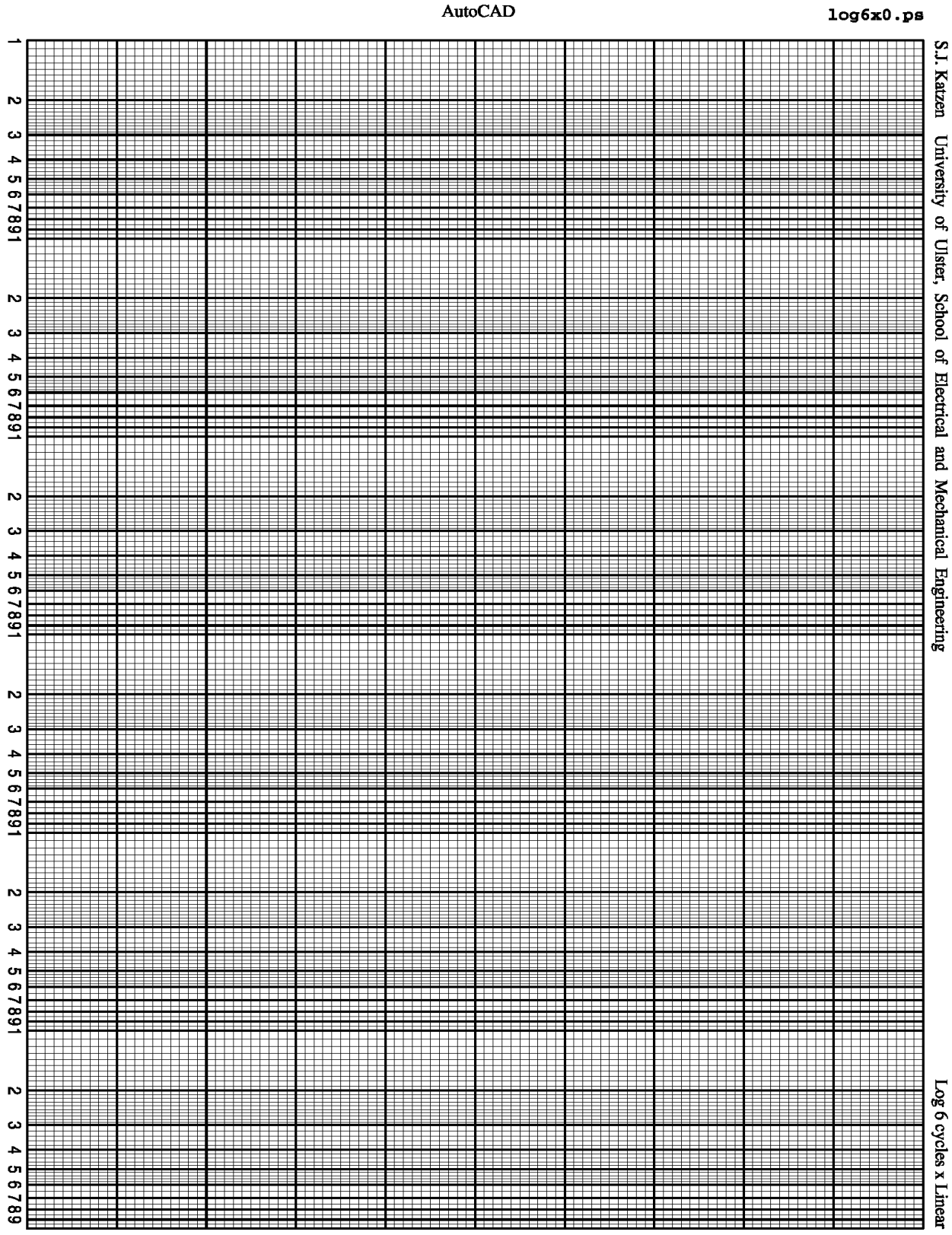
AutoCAD
log6x0.ps
S.J. Katzen University of Ulster, School of Electrical and Mechanical Engineering
Log 6 cycles x Linear
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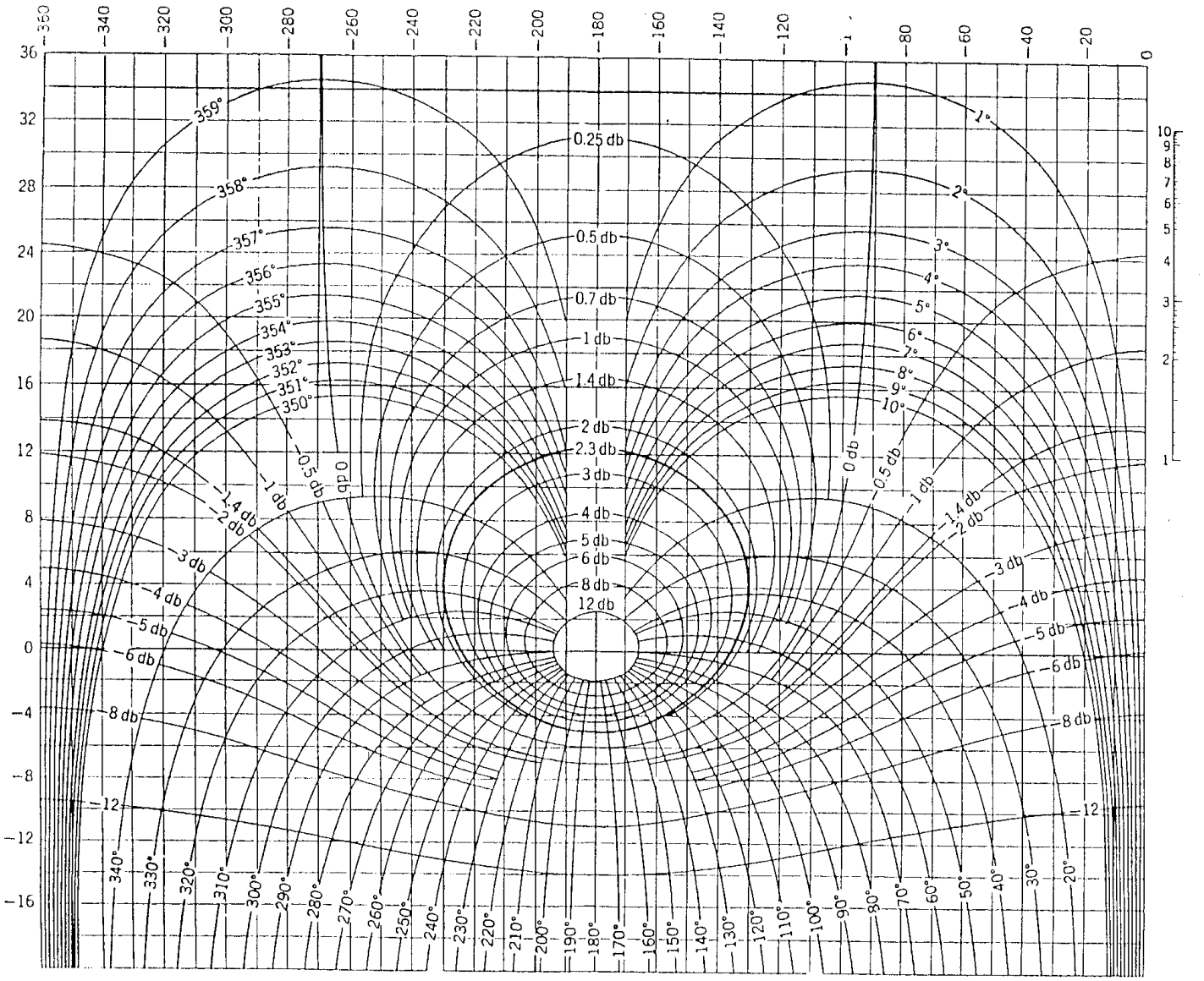
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