1. \[ e(t) \xrightarrow{Z\cdot O\cdot H} p(t) \quad T = \frac{\pi}{15} \text{ sec} \]

A signal \( e(t) = 5 \cos t \) is applied to a sampler and \( Z\cdot O\cdot H \) circuit with \( T = \frac{\pi}{15} \) sec.

(a) List all the frequencies in the output \( p(t) \) which are less than 30 rad/s.

(b) The output of the circuit has a frequency component of 1 rad/s. Find the magnitude and phase of this component.

2. Given \( G(s) = \frac{e^{-2st}}{s(s+10)} \), \( T = 0.1 \) sec

Using the residue method, find \( G(z) \).

3. \[ x(t) \xrightarrow{T=0.1} G(s) \xrightarrow{G(p)} C(t) \]

4. (a) Write \( \frac{C(z)}{R(z)} \) in terms of \( G(z) \).

(b) Find \( G(z) \) in the simplified form.

(c) Using the results of (a) and (b), find \( \frac{C(z)}{R(z)} \) in the simplified form.

(d) If \( x(t) = u(t) \), find \( C(z) \).

(e) Now find \( C(0), C(T), C(2T) \) and \( \lim_{n \to \infty} C(nT) \).
4. Convert the analog controller $G_c(s)$ given below to a digital controller using:
   (a) Matched Z-transform
   (b) Bilinear transformation with prewarping

   $$G_c(s) = 10 \frac{s+1}{s+10}$$

   Assume $T = 0.1$ sec