No. of Printed Pages : 3

BAS-020

00741

B.TECH. (AEROSPACE ENGINEERING) (BTAE)

Term-End Examination

December, 2013

BAS-020 : BASIC CONTROL THEORY

Time : 3 hours *Maximum Marks : 70*

Note : (i) *Attempt **any five** questions. **All** questions carry **equal** marks.*

(ii) *Scientific calculator is **permitted**.*

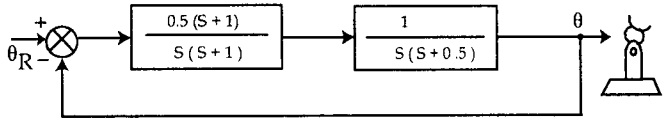
(iii) *Use of Graph paper & semi-log paper is **permitted**.*

1. (a) A linear time-invariant system initially at rest, when subjected to a unit-step input, gives a response $y(t)=te^{-t}$; $t>0$. Find the transfer function of system. **4**

(b) Write an expression for the final value theorem of the Laplace transform. What is the condition under which the theorem is valid ? **6**

(c) Explain open and close loop system with suitable examples. **4**

2. A ground-based tracking radar is used to track aircraft targets. Assume that azimuth axis position control loop of the tracking radar can be represented by the block diagram as shown in fig below : 14



Determine the steady-state errors of the tracker for the following inputs caused by the aircraft motion.

(a) $\theta_R = 10t$

(b) $\theta_R = 10t + 0.1t^2$

3. (a) Using principle of argument, derive the Nyquist stability criterion. 7

(b) Give an account of meaning of the terms 'gain margin' and 'phase margin' with reference to Nyquist plots. 7

4. Use Bode plots to determine the range of 'K' within which a unity feedback system with open loop transfer fuction G(s) is stable. Given :

(a) $G(s) = \dfrac{K}{(s+2)(s+4)(s+5)}$ 5

(b) $G(s) = \dfrac{K}{s(1+0.2s)(1+0.02s)}$ 5

Why do we use logarithmic scale for frequency in Bode plots ? 4

5. Consider a unity feedback system with open loop transfer function **14**

$$G(s) = \frac{K(s^2+1)}{s(s+1)} \; ; K \geq 0$$

Sketch the root locus plot. Show that the complex root branches lie on a circle.

6. The open loop transfer function of a unity feedback system is given by **14**

$$G(s) = \frac{K}{s(\tau s+1)} ; K > 0, \; \tau > 0$$

By what factors should the gain K be reduced so that the peak overshoot of unit step response of the system is reduced from 75% to 25% ?

7. Write short notes on **any two** of the following : **2x7=14**

(a) PID controller

(b) Signal conversion and processing

(c) Stability of the system