Total No. of printed pages = 8

CAI-501/CS/5th Sem/2018/M

CONTROL SYSTEMS

Full Marks – 70

Pass Marks – 28

Time – Three hours

The figures in the margin indicate full marks for the questions.

PART – A

1. Fill in the blanks : 1×10=10

   (a) The element for viscous friction is often represented by a _____.

   (b) The transfer function is defined only when the _____ are neglected.

   (c) A synchro is commonly known as _____.

   (d) _____ loops are loops which do not possess any common node.

   (e) The distance between the time response peak and the steady output is called the _____.

   (f) The _____ error is a measure of system accuracy.

[Turn over

(g) The velocity error constant K_v is indicative of the error in output for a _____ input.

(h) Stability is a very important characteristic of the _____ response of the system.

(i) The root locus is _____ about the real axis.

(j) The bode plot is also called as the _____ plot.

2. Choose the correct answer : 1×15=15

(i) The output of the controller in a control system is given to _____.

(a) Amplifier

(b) Comparator

(c) Final control element

(d) Plant

(ii) The synchro-transmitter acts like a/an _____.

(a) Transformer (b) Alternator

(c) Tacho-generator (d) Induction motor

(iii) The position and velocity errors of a Type-2 system are _____.

(a) Constant , Constant

(b) Zero, Constant

(c) Constant, Infinity

(d) Zero, Zero

(iv) In a critically damped system, the damping factor is of the order of _____

(a) zero (b) less than unity

(c) unity (d) greater than unity

(v) The type zero system has _____ at the origin.

(a) no pole (b) net pole

(c) simple pole (d) two pole

(vi) If the characteristic equation of a system is s^2+2s+1 are _____.

(a) undamped (b) overdamped

(c) critically damped (d) underdamped

(vii) Three blocks with gains of 5, 6 and 8 are connected in series. The total gain of the arrangement is _____

(a) 17 (b) 160

(c) 19 (d) 240

(viii) The overshoot due to increase of damping factor _____.

(a) increases

(b) decreases

(c) remains constant

(d) None of the above

(ix) The Laplace transform of impulse function is _____

(a) 0 (b) 1

(c) s (d) 1/s

(x) The motion of mechanical element can be described as _____.

(a) purely rotational

(b) purely translational

(c) rotational or translational or combination of both

(d) None of these

(xi) If the system has $G(s) = 1/s(1+4s)$, the system is _____.

(a) stable
(c) marginally stable
(b) unstable
(d) conditionally stable

(xii) For a second order system as ξ is increased from zero, the response becomes _____.

(a) more oscillatory
(c) zero
(b) less oscillatory
(d) infinity

(xiii) A feedback system has the transfer function given by

$C(s)/R(s) = 4(s+2)(s+4)/s^4(s+1)\ (s^3+ 3s^2+ 6s+8)$. It is a _____.

(a) Type-6 system
(c) Type-8 system
(b) Type-4 system
(d) Type-10 system

(xiv) If all the roots of the characteristic equation have negative real parts, then the system is _____.

(a) stable

(b) unstable

(c) conditionally stable

(d) marginally stable

(xv) The frequency where M has a peak value is known as the _____.

(a) Peak frequency

(c) Normalized frequency

(b) Resonant frequency

(d) None of these

PART – B

3. Answer any *five* questions : 9×5=45

(a) Determine the transfer function of the system shown in the below figure 1.

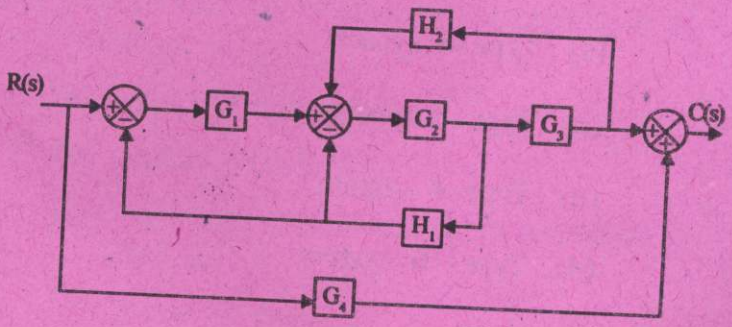

Figure 1

(b) Derive the transfer function $Y_2(s)/F(s)$ for the given mechanical system shown in below figure 2.

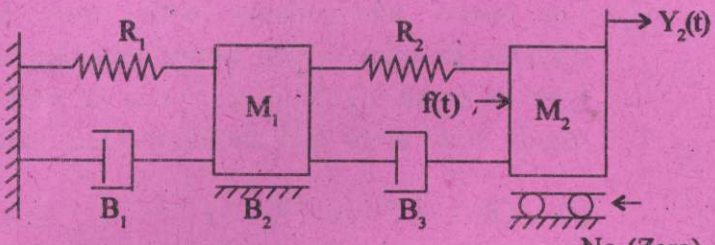

Figure 2

(c) Obtain the response of a unity feedback system whose open-loop transfer function is $G(s) = 2/s(s+3)$ for a unit-step input and sketch the response.

(d) Using routh criterion, determine the location of the roots of the following characteristic equations and comment on the stability of the systems.

(a) $S^4+4s^3+s^2+8s+1=0$

(b) $s^4+8s^3+18s^2+16s+5=0$

(e) A unity feedback control system has an open loop transfer function, $G(s) = 5/s(s+1)$. Find the natural frequency, damping ratio, peal time, percentage overshoot and settling time for a step input of 10 units.

(f) Explain the construction and working of a synchro with suitable example.

(g) For servo mechanisms with open loop transfer function given below explain what type of input signal give rise to a constant steady state error and calculate their values.

(i) $G(s) = 20/(s+1)(s+4)$

(ii) $G(s) = 10(s+4)/s(s+1)(s+2)$

(iii) $G(s) = 20/s^2(s+1)(s+4)$