Roll No.----------------------

Paper Code		
5	0	7

(To be filled in the OMR Sheet)

प्रश्नपुस्तिका क्रमांक
Question Booklet No.

O.M.R. Serial No.

प्रश्नपुस्तिका सीरीज
Question Booklet Series
A

M.Sc (Electronics) Third Semester, Examination, February/March-2022
ELC-301(N)
Control System

Time : 1:30 Hours **Maximum Marks-100**

जब तक कहा न जाय, इस प्रश्नपुस्तिका को न खोलें

निर्देश : –

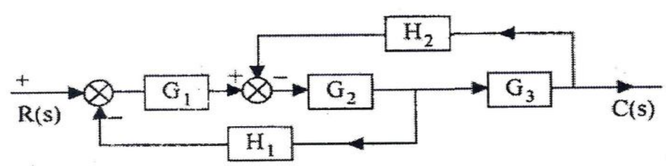
1. परीक्षार्थी अपने अनुक्रमांक, विषय एवं प्रश्नपुस्तिका की सीरीज का विवरण यथास्थान सही– सही भरें, अन्यथा मूल्यांकन में किसी भी प्रकार की विसंगति की दशा में उसकी जिम्मेदारी स्वयं परीक्षार्थी की होगी।
2. **इस प्रश्नपुस्तिका में 100 प्रश्न हैं, जिनमे से केवल 75 प्रश्नों के उत्तर परीक्षार्थियों द्वारा दिये जाने है। प्रत्येक प्रश्न के चार वैकल्पिक उत्तर प्रश्न के नीचे दिये गये हैं। इन चारों में से केवल एक ही उत्तर सही है। जिस उत्तर को आप सही या सबसे उचित समझते हैं, अपने उत्तर पत्रक (O.M.R. ANSWER SHEET)में उसके अक्षर वाले वृत्त को काले या नीले बाल प्वांइट पेन से पूरा भर दें। यदि किसी परीक्षार्थी द्वारा निर्धारित प्रश्नों से अधिक प्रश्नों के उत्तर दिये जाते हैं तो उसके द्वारा हल किये गये प्रथमतः यथा निर्दिष्ट प्रश्नोत्तरों का ही मूल्यांकन किया जायेगा।**
3. प्रत्येक प्रश्न के अंक समान हैं। आप के जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।
4. सभी उत्तर केवल ओ०एम०आर० उत्तर पत्रक **(O.M.R. ANSWER SHEET)** पर ही दिये जाने हैं। उत्तर पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।
5. ओ०एम०आर० उत्तर पत्रक **(O.M.R. ANSWER SHEET)** पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाय।
6. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी प्रश्नपुस्तिका बुकलेट एवं ओ०एम०आर० शीट पृथक–पृथक उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें।
7. निगेटिव मार्किंग नहीं है।

507

महत्वपूर्ण : – **प्रश्नपुस्तिका खोलने पर प्रथमतः जॉच कर देख लें कि प्रश्नपुस्तिका के सभी पृष्ठ भलीभॉति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्ष निरीक्षक को दिखाकर उसी सीरीज की दूसरी प्रश्नपुस्तिका प्राप्त कर लें।**

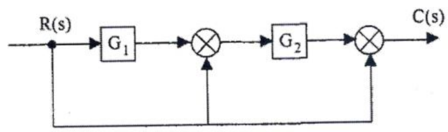
Rough Work / रफ कार्य

1. Which one of the following is open loop ?
   (A) The respiratory system of man
   (B) A system for controlling the movement of the slide of a copying milling machine.
   (C) A thermostatic control
   (D) Traffic light control
2. When a human being tries to approach an object, his brain acts as :
   (A) An error measuring device
   (B) A controller
   (C) An actuator
   (D) An amplifier
3. As compared to a closed –loop system, an open – loop system is :
   (A) More stable as well as more accurate
   (B) Less stable as well as less accurate
   (C) More stable but less accurate
   (D) Less stable but more accurate
4. The principles of homogeneity and superposition are applied to :
   (A) Linear time variant systems
   (B) Non – linear time variant systems
   (C) Linear time invariant systems
   (D) Non – linear time invariant systems
5. For block diagram shown in fig. $C(s)/R(s)$ is given by :

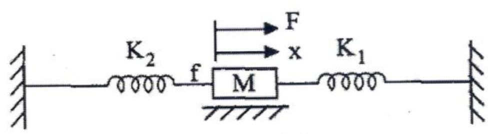


   (A) $\frac{G_1G_2G_3}{1+H_2G_2G_3+H_1G_1G_2}$
   (B) $\frac{G_1G_2G_3}{1+G_1G_2G_3H_1H_2}$
   (C) $\frac{G_1G_2G_3}{1+G_1G_2G_3H_1+G_1G_2G_3H_2}$
   (D) $\frac{G_1G_2G_3}{1+G_1G_2G_3H_1}$

6. Feedback control systems are :
   (A) Insensitive to both forward – and feedback – path parameter changes.
   (B) Less sensitive to feedback –path parameter changes then to forward – path parameter changes.
   (C) Less sensitive to forward – path parameter changes than to feedback – path parameter changes.
   (D) Equally sensitive to forward and feedback – path parameter changes.
7. A system is represented by the block diagram given in the figure.



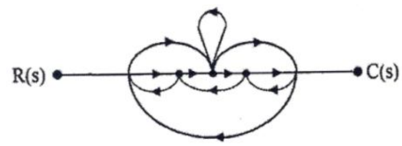
Which one of the following represents the input – output relationship of the above diagram :
   (A) $R(s) \rightarrow (G_1 G_2) \rightarrow C(s)$
   (B) $R(s) \rightarrow (G_1 + G_2) \rightarrow C(s)$
   (C) $R(s) \rightarrow (1 + G_1 + G_1 G_2) \rightarrow C(s)$
   (D) $R(s) \rightarrow (1 + G_2 + G_1 G_2) \rightarrow C(s)$
8. Consider a simple mass –spring – friction system as given in the figure.



K_1, K_2– Spring Constants, f – Friction, M – Mass, F – Force, x – Displacement

The transfer function $\frac{X(s)}{F(s)}$ of the given system will be :
   (A) $Ms^2 + fs + K_1.K_2$
   (B) $\frac{1}{Ms^2+fs+K_1+K_2}$
   (C) $\frac{1}{Ms^2+fs+\frac{K_1.K_2}{K_1+K_2}}$
   (D) $\frac{K_2}{Ms^2+fs+K_1}$

9. The signal flow of a system is shown in the given figure. In this graph, the number of three non – touching loops is :



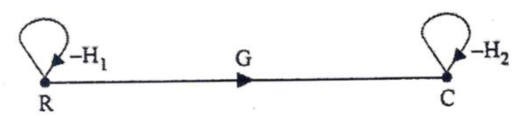
(A) Zero

(B) 1

(C) 2

(D) 3

10. When the signal flow graph is as shown in the figure, the overall transfer function of the systems, will be :



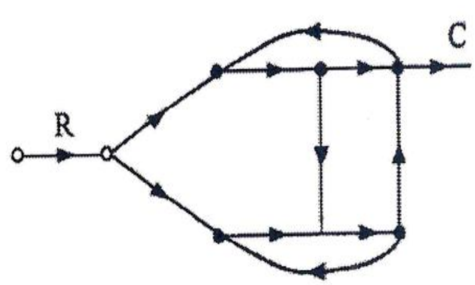
(A) $\frac{C}{R} = G$

(B) $\frac{C}{R} = \frac{G}{1+H_2}$

(C) $\frac{C}{R} = \frac{G}{(1+H_1)(1+H_2)}$

(D) $\frac{C}{R} = \frac{G}{1+H_1+H_2}$

11. The signal flow graph shown in the given figure has :



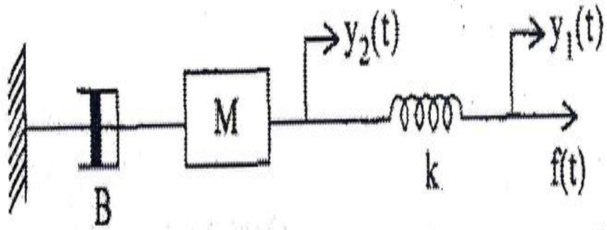
(A) Three forward paths and two non – touching loops.

(B) Three forward paths and two loops.

(C) Two forward paths and two non – touching loops.

(D) Two forward paths and three loops.

12. The mechanical system is shown in the given figure :



The system is described as :

(A) $M\frac{d^2y_1(t)}{dt^2} + B\frac{dy_1(t)}{dt} = k[y_2(t) - y_1(t)]$

(B) $M\frac{d^2y_2(t)}{dt^2} + B\frac{dy_2(t)}{dt} = k[y_2(t) - y_1(t)]$

(C) $M\frac{d^2y_1(t)}{dt^2} + B = k[y_1(t) - y_2(t)]$

(D) $M\frac{d^2y_2(f)}{dt^2} + B\frac{dy_2(t)}{dt} = k[y_1(t) - y_2(t)]$

13. Which of the following are the characteristics of closed – loop systems ?

1. It does not compensate for disturbances.
2. It reduces the sensitivity of plant – parameter variations.
3. If does not involve output measurements.
4. It has the ability to control the system transient response.

Select the correct answer using the codes given below :

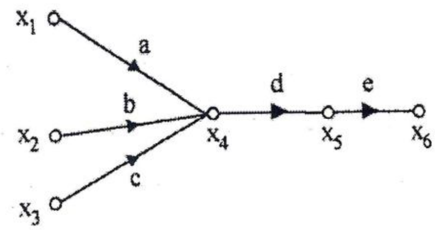
(A) 1 and 4

(B) 2 and 4

(C) 1 and 3

(D) 2 and 3

14. Form the signal flow graph shown in the figure, the value of x_6 is :



(A) $de(ax_1 + bx_2 + cx_3)$

(B) $(a + b + c)(x_1 + x_2 + x_3)(d + e)$

(C) $(ax_1 + bx_2 + cx_3)(d + e)$

(D) $abcde\ (x_1 + x_2 + x_3)$

15. The open – loop transfer function of a unity feedback control system is $G(s) = \frac{1}{(s+2)^2}$. The closed –loop transfer function will have poles at :

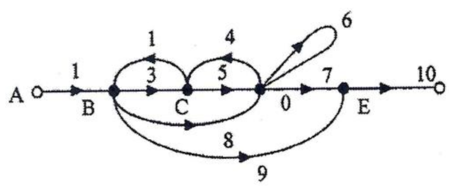
(A) $-2, -2$

(B) $-2, -1$

(C) $-2 \pm j1$

(D) $-2, 2$

16. The signal flow diagram of a system is shown in the given figure. The number of forward paths and the number of pairs of non – touching loops are respectively :



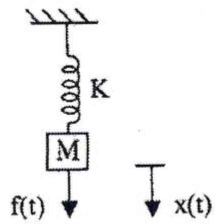
(A) 3, 1

(B) 3, 2

(C) 4, 2

(D) 2, 4

17. For the system shown in the given figure the given figure the transfer function $\frac{X(s)}{F(s)}$ is :



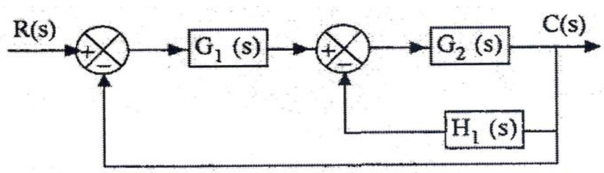
(A) $\frac{1}{Ms^2+K}$

(B) $\frac{Ms^2+1}{K}$

(C) $\frac{K}{Ms^2+1}$

(D) $\frac{1}{Ms^2+M}$

18. The $\frac{C(s)}{R(s)}$for the system shown in the following block diagram is :



(A) $\frac{G_1(s)G_2(s)}{1+G_1(s)[G_2(s)+H_1(s)]}$

(B) $\frac{G_1(s)G_2(s)}{1+G_2(s)[G_1(s)+H_1(s)]}$

(C) $\frac{G_1(s)+G_2(s)}{1+G_2(s)[G_2(s)+H_1(s)]}$

(D) None of the above

19. The sensitivity s_{c^M} of a system with the transfer function $M = \frac{G}{1+GH}$ is given by :

(A) $\frac{1}{1+GH}$

(B) $\frac{1+GH}{H}$

(C) $\frac{1+G}{H}$

(D) H

20. The unit step response of a particular control system is given by $c(t) = 1 - 10e^{-t}$.

Then its transfer function is :

(A) $\frac{10}{s+1}$

(B) $\frac{s-9}{s+1}$

(C) $\frac{1-9s}{s+1}$

(D) $\frac{1-9s}{s(s+1)}$

21. 1. Transfer function can be obtained from the signal flow graph of the system.

2. Transfer function typically characterizes linear time variant system.

3. Block diagram of the system can be obtained from its transfer function given the ratio of output to input in frequency domain of the system.

4. Transfer function gives the ratio of output to input in frequency domain of the system.

Which of the following is the correct combination about the four statements stated above.

(A) Only (1) and (2) are correct

(B) Only (2), (3) and (4) are correct

(C) Only (3) and (4) are correct

(D) Only (1), (2) and (4) are correct

22. Which of the following is not valid in case of signal flow graph ?

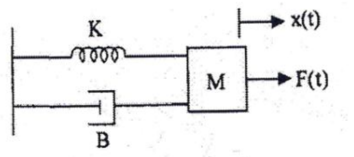
(A) In signal flow graph signals travel along branches only in the marked direction.

(B) Nodes are arranged from right to left in a sequence.

(C) Signal flow graph is applicable to linear systems only.

(D) For signal flow graph, the algebraic equations must be in the form of cause and effect relationship.

23. In the figure alongside, spring constant is K, viscous friction coefficient is B, mass is M and the system output motion is x(t) corresponding to input force F(t) . Which of the following parameters r



1. Time constant= $\frac{1}{M}$
2. Damping coefficient= $\frac{B}{2\sqrt{KM}}$
3. Natural frequency of oscillation= $\sqrt{\frac{K}{M}}$

Select the correct answer using the codes given below :

Codes :

(A) 1, 2 and 3

(B) 1 and 2

(C) 2 and 3

(D) 1 and 2

24. Consider the following statements regarding the advantages of closed –loop negative feedback control – systems over open – loop systems :

1. The overall reliability of the closed – loop systems is more than that of open – loop system.
2. The transient response in the closed – loop system decays more quickly than in open – loop system.
3. In an open – loop system, closing of the loop increases the overall gain of the system.
4. In the closed – loop system, the effect of variation of component parameters on its performance is reduced.

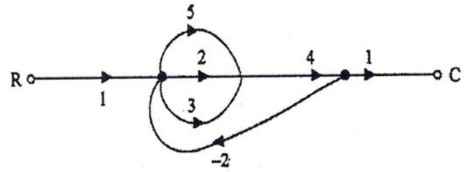
(A) 1 and 3 are correct

(B) 1 and 2 are correct

(C) 2 and 4 are correct

(D) 3 and 4 are correct

25. In the signal flow graph shown in the figure, the value of the C/Rratio is :



(A) $\frac{28}{57}$

(B) $\frac{40}{57}$

(C) $\frac{40}{81}$

(D) $\frac{28}{81}$

26. Consider the following statements :

1. The effect of feedback is to reduce the system error.
2. Feedback increases the gain of the system in one frequency range but decreases in another.
3. Feedback can cause a system that is originally stable to become unstable .

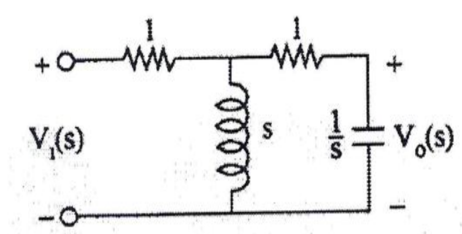
(A) 1, 2 and 3

(B) 1 and 2

(C) 2 and 3

(D) 1 and 3

27. Select the correct transfer function $\frac{V_0(s)}{V_1(s)}$ from the following, for the given system :



(A) $\frac{1}{2(s^2+s+1)}$

(B) $\frac{s}{2(s+1)^2}$

(C) $\frac{s}{2s^2+2s+1}$

(D) $\frac{1}{2s^2+2s+1}$

28. The unit impulse response of a unity feedback system is given by :

$c(t) = -te^{-t} + 2e^{-t}, (t \geq 0)$The open – loop transfer function is equal to :

(A) $\frac{s+1}{(s+2)^2}$

(B) $\frac{2s+1}{s^2}$

(C) $\frac{s+2}{(s+1)^2}$

(D) $\frac{s+1}{s^2}$

29. Consider the unit step response of a unity –feedback control system whose open – loop transfer function is $(s) = \frac{1}{s(s+1)}$.The maximum overshoot is equal to :

(A) 1.143

(B) 0.153

(C) 0.163

(D) 0.173

30. For a feedback control system of type 2, the steady state error for a ramp input is :

(A) infinite

(B) Constant

(C) Zero

(D) Indeterminate

31. The closed –loop transfer function of a control system is given by $\frac{C(s)}{R(s)} = \frac{1}{1+s}$. For the input $r(t) = \sin t$, the steady state value of $c(t)$ is equal to :

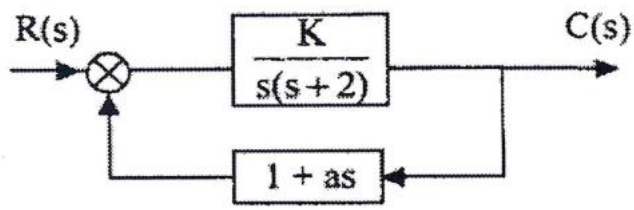
(A) $\frac{1}{\sqrt{2}}\cos t$

(B) 1

(C) $\frac{1}{\sqrt{2}}\sin t$

(D) $\frac{1}{\sqrt{2}}\sin\left(t - \frac{\pi}{4}\right)$

32. For the system shown in figure with a damping ratio ξ of 0.7 and an undamped natural frequency ω_n of 4 rad/sec, the value of K and a are :



(A) $K = 4, a = 0.35$

(B) $K = 8, a = 0.455$

(C) $K = 16, a = 0.225$

(D) $K = 64, a = 0.9$

33. A unity feedback system has open – loop transfer function $G(s)$. The steady – state error is zero for :

(A) Step input and type 1 $G(s)$

(B) Ramp input and type 1 $G(s)$

(C) Step input and type 0 $G(s)$

(D) Ramp input and type 0 $G(s)$

34. A linear time –invariant system initially at rest, when subjected to a unit – step input, gives a response $(t) = te^{-t}, t > 0$. The transfer function of the system is :

(A) $\frac{1}{(s+1)^2}$

(B) $\frac{1}{s(s+1)^2}$

(C) $\frac{s}{(s+1)^2}$

(D) $\frac{1}{s(s+1)}$

35. A unity feedback system has open – loop transfer function $(s) = \{25/[s(s+6)]\}$. The peak overshoot in the step – input response of the system is approximately equal to :

(A) 5%

(B) 10%

(C) 15%

(D) 20%

36. Introduction of integral action in the forward path of a unity feedback system results in a :

(A) Marginally stable system

(B) System with no steady state error

(C) System with increased stability margin

(D) System with better speed of response

37. For a unit step input, a system with forward path transfer function $G(s) = \frac{20}{s^2}$ and feedback path transfer function $H(s) = (s+5)$, has a steady state output of :

(A) 20

(B) 5

(C) 0.2

(D) Zero

38. The transfer function of a control system is given as $T(s) = \frac{K}{s^2+4s+K}$. Where K is the gain of the system in radians/Amp. For this system to be critically damped, the value of K should be :

(A) 1

(B) 2

(C) 3

(D) 4

39. A linear system, initially at rest, is subject to an input signal $r(t) = 1 - e^{-t}(t \geq 0)$. The response of the system for $t > 0$ is given by $c(t) = 1 - e^{-2t}$. The transfer function of the system is :

(A) $\frac{(s+2)}{(S+1)}$

(B) $\frac{(s+1)}{(S+2)}$

(C) $\frac{2(s+1)}{(S+2)}$

(D) $\frac{1(s+1)}{2(S+2)}$

40. If the time response of a system is given by the following equation :

$y(t) = 5 + 3\sin\big((\omega t + \delta_1) + e^{-3t}\sin(\omega t + \delta_2) + e^{-5t}\big)$ then the steady – state part of the above response is given by :

(A) $5 + 3\sin(\omega t + \delta_1)$

(B) $5 + 3\sin\big((\omega t + \delta_1) + e^{-3t}\sin(\omega t + \delta_2)\big)$

(C) $5 + e^{-5t}$

(D) 5

41. The impulse response of a system is $5\,e^{-10t}$. Its step response is equal to :

(A) $0.5\,e^{-10t}$

(B) $5(1 - e^{-10t})$

(C) $0.5(1 - e^{-10t})$

(D) $(1 - e^{-10t})$

42. The transfer function of a system is $\frac{10}{1+s}$. When operated as a unity feedback system, the steady – state error to a unit step input will be :

(A) Zero

(B) $\frac{1}{11}$

(C) 10

(D) Infinity

43. A linear second –order system with the transfer function $G(s) = \frac{49}{s^2+16s+49}$ is initially at rest and is subject to a step input signal. The response of the system will exhibit a peak overshoot of :

(A) 16%

(B) 9%

(C) 2%

(D) Zero

44. A system has the following transfer function :$G(s) = \frac{100(s+5)(s+50)}{s^4(s+10)(s^2+3s+10)}$. The type and order of the systems are respectively :

(A) 4 and 9

(B) 4 and 7

(C) 5 and 7

(D) 7 and 5

45. The unit impulse response of a linear time –invariant second order system is :$g(t) = 10e^{-8t} \sin 6t \,(t \geq 0)$. The natural frequency and the damping factor of the system are respectively :

(A) 10 rad/s and 0.6

(B) 10 rad/s and 0.8

(C) 5 rad/s and 0.6

(D) 6 rad/s and 0.8

46. $[-a \pm jb]$ are the complex conjugate roots of the characteristic equation of a second order system. Its damping coefficient and natural frequency will be respectively :

(A) $\frac{b}{\sqrt{a^2+b^2}}$ and $\sqrt{a^2 + b^2}$

(B) $\frac{b}{\sqrt{a^2+b^2}}$ and $a^2 + b^2$

(C) $\frac{a}{\sqrt{a^2+b^2}}$ and $\sqrt{a^2 + b^2}$

(D) $\frac{a}{\sqrt{a^2+b^2}}$ and $a^2 + b^2$

47. A unity feedback control system has a forward path transfer function $G(s) = \frac{10(1+4s)}{s^2(1+s)}$. If the system is subjected to an input $r(t) = 1 + t + \frac{t^2}{2} (t \geq 0)$, the steady –state error of the system will be :

(A) Zero

(B) 0.1

(C) 10

(D) Infinity

48. The steady state error due to a ramp input for a type two system is equal to :

(A) Zero

(B) Infinite

(C) Non – Zero number

(D) Constant

49. A second order control system is defined by the following differential equation : $4\frac{d^2c(t)}{dt^2} + 8\frac{dc(t)}{dt} + 16c(t) = 16u(t)$. The damping ratio and natural frequency for this system are respectively :

(A) 0.25 and 2 rad/s

(B) 0.50 and 2 rad/s

(C) 0.25 and 4 rad/s

(D) 0.50 and 4 rad/s

50. The open loop transfer function of a unity feedback system is given by $G(s) = \frac{K}{s(s+1)}$. If the value of gain K is such that the system is critically damped, the closed loop poles of the system will lie at :

(A) -0.5 and -0.5

(B) $\pm j0.5$

(C) 0 and -1

(D) $0.5 \pm j0.5$

51. In the derivative error compensation :

(A) Damping decreases and settling time decreases

(B) Damping increases and settling time increases

(C) Damping decreases and settling time increases

(D) Damping increases and settling time decreases

52. A second order system exhibits 100% overshoot. Its damping coefficient is :

(A) Equal to 0

(B) Equal to 1

(C) Less than 1

(D) Greater than 1

53. In the type 1 system, the velocity error is :

(A) Inversely proportional to bandwidth

(B) Directly proportional to error constant

(C) Inversely proportional to error constant

(D) Independent of error constant

54. A unity feedback control system has a forward path transfer function equal to $\frac{42.25}{s(s+6.5)}$. The unit step response of this system starting from rest, will have its maximum value at a time equal to :

(A) 0 sec

(B) 0.56 sec

(C) 5.6 sec

(D) Infinity

55. A plant has the following transfer function $G(s) = \frac{1}{s^2+0.2s+1}$. For a step input it is required that the response settles to within 2% of its final value. The plant settling time is :

(A) 20 sec

(B) 40 sec

(C) 35 sec

(D) 45 sec

56. Assuming the transient response of a second – order system to be given by : $C(t) = 1 - \frac{e^{-4t}}{\sqrt{1-\delta^2}} \sin(\omega_n\sqrt{1-6^2} + \Theta)$ the settling time for the 5% criterion will be :

(A) $\frac{1}{4}$ sec

(B) $\frac{3}{4}$ sec

(C) $\frac{5}{4}$ sec

(D) 4 sec

57. Consider the following overall transfer function for a unity feedback system : $\frac{4}{s^2+4s+4}$. Which of the following statements regarding this system are correct ?

1. Position error constant K_p for the system is 4.

2. The system type one.

3. The velocity error constantK_1 for the system is fimte.

Select the correct answer using the codes given below :

(A) 1, 2 and 3

(B) 1 and 2

(C) 2 and 3

(D) 1 and 3

58. The response c(t) of a system is descended by the differential equation : $\frac{d^2c(t)}{dt^2} + 4\frac{dc(t)}{dt} + 5c(t) = 0$. The system response is :

(A) Undamped

(B) Underdamped

(C) Critically damped

(D) Oscillatory

59. The transfer function $G(s)$of a PID controller is :

(A) $K\left(1 + \frac{1}{T_1 s} + T_d s\right)$

(B) $K(1 + T_i s + T_d s)$

(C) $K\left(1 + \frac{1}{T_1 s} + \frac{1}{T_d s}\right)$

(D) $K\left(1 + T_1 s + \frac{1}{T_d s}\right)$

60. Consider the following statements :

A proportional plus derivative controller

1. Has high sensitivity

2. Increases the stability of the system

3. Improves the steady – state accuracy

Which of these statements are correct ?

(A) 1, 2 and 3

(B) 1 and 2

(C) 2 and 3

(D) 1 and 3

61. The open loop transfer function of a system is given by $(s) = \frac{k}{s(s+2)(s+4)}$. The maximum value of k for which the unity feedback system will be stable, is :

(A) 16

(B) 32

(C) 48

(D) 64

62. The characteristic equation $1 + G(s)H(s) = 0$ of a system is given by :
$s^4 + 6s^3 + 11s^2 + 6s + K = 0$. For the system to remain stable, the value of gain K should be :

(A) Zero

(B) Greater than zero but less than 10

(C) Greater than 10 but less than 20

(D) Greater than 20 but less than 30

63. The open – loop transfer function of a unity feedback control system is : $G(s)H(s) = \frac{30}{s(s+1)(s+T)}$. Where T is a variable parameter. The closed loop system will be stable for all values of :

(A) $T > 0$

(B) $0 < T < 3$

(C) $T > 5$

(D) $3 < T < 5$

64. The characteristic equation of a feedback control system is $s^3 + Ks^2 + 5s + 10 = 0$.For the system to be critically stable, the value of K should be :

(A) 1

(B) 2

(C) 3

(D) 4

65. Which of the following statement about the equation below, for Routh Hurwitz criterion is true $2s^4 + s^3 + 3s^2 + 5s + 10 = 0$:

(A) It has only one root on the imaginary axis.

(B) It has one root in the right half of the s-plane.

(C) The system is unstable.

(D) The system is stable.

66. When all the roots of the characteristic equation are found in the left half of s-plane, the system response due to initial condition will :

(A) Increase to infinity as time approaches infinity

(B) Decreases to zero as time approaches infinity

(C) Remain constant for all time

(D) Be oscillating

67. How many roots of the characteristic equation $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 15 = 0$ line in the left half of the s-plane ?

(A) 1

(B) 2

(C) 3

(D) 5

68. Consider a negative feedback system where, $G(s) = \frac{1}{(s+1)}, H(s) = \frac{K}{s(s+2)}$. The closed –loop system is stable for :

(A) $K > 20$

(B) $15 < K < 10$

(C) $8 \leq K \leq 14$

(D) $K < 6$

69. The value of K for which the unity feedback system $G(s) = \frac{1}{s(s+2)(s+4)}$ crosses the imaginary axis is :

(A) 2

(B) 4

(C) 6

(D) 48

70. If the characteristic equation of a closed – loop system is $1 + \frac{K}{s(s+1)(s+2)} = 0$ the centroid of the asymptotes in root – locus will be :

(A) Zero

(B) 2

(C) -1

(D) -2

71. The open –loop transfer function of a feedback control system is $(s) = \frac{K}{s(s^2+3s+6)}$.
The break –away point(s) of its root –locus plot :

(A) Exist at $(-1 \pm j1)$

(B) Exist at $\left(-\frac{3}{2} \pm \sqrt{\frac{15}{16}}\right)$

(C) Exists at origin

(D) Do not exist

72. Which of the following are the characteristics of the root locus of : $G(s)H(s) = \frac{K(s+5)}{(S+1)(s+3)}$

1. It has one asymptote
2. It has intersection with$j\omega -$ axis
3. It has two real axis intersections
4. it has two zeros at infinity

Select the correct answer using the codes given below :

(A) 1 and 2

(B) 2 and 3

(C) 3 and 4

(D) 1 and 3

73. A unity feedback system has $G(s) = \frac{K}{s(s+1)(s+2)}$. In the root – locus, the break – away point occurs between :

(A) $s = 0$ and -1

(B) $s = -1$ and $-\infty$

(C) $s = -1$ and -2

(D) $s = -2$ and $-\infty$

74. The loop transfer function of a feedback control system is given by : $G(s)H(s) = \frac{k}{s(s+2)(s^2+2s+2)}$. Number of asymptotes of its root loci is :

(A) 1

(B) 2

(C) 3

(D) 4

75. The breakaway point of the root locus for the system $G(s)H(s) = \frac{k}{s(s+1)(s+4)}$ is :

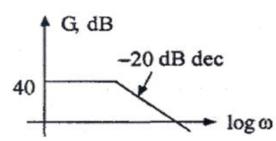
(A) -0.465

(B) -2.87

(C) -1.0

(D) -2.0

76. The magnitude plot for a transfer function is shown in figure :



What is the steady –state error corresponding to a unit step input ?

(A) $\frac{1}{101}$

(B) $\frac{1}{100}$

(C) $\frac{1}{41}$

(D) $\frac{1}{40}$

77. A system has fourteen poles and two zeros. The slope of its highest frequency asymptote in its magnitude plot is :

(A) -40 dB/decade

(B) -240 dB/decade

(C) -280 dB/decade

(D) -320 dB/decade

78. The phase angle of the system $G(s) = \frac{s+5}{s^2+4s+9}$ varies between :

(A) $0°$ and $90°$

(B) $0°$ and $-90°$

(C) $0°$ and $-180°$

(D) $-90°$ and $-180°$

79. For the second – order transfer function $T(s) = \frac{4}{s^2+2s+4}$. The maximum resonance peak will be :

(A) 4

(B) $\frac{4}{3}$

(C) 2

(D) $\frac{2}{\sqrt{3}}$

80. A second –order overall transfer function is given by $\frac{4}{s^2+2s+4}$. Its resonant frequency is :

(A) 2

(B) $\sqrt{2}$

(C) $\sqrt{3}$

(D) 3

81. The phase angle for the transfer function $G(s) = \frac{1}{(1+sT)^3}$ at corner frequency is :

(A) $-45°$

(B) $-90°$

(C) $-135°$

(D) $-270°$

82. An open loop transfer function of a unity feedback control system has two finite zeros, two poles at origin and two pairs of complex conjugate poles. The slope of high frequency asymptote in Bode magnitude plot will be :

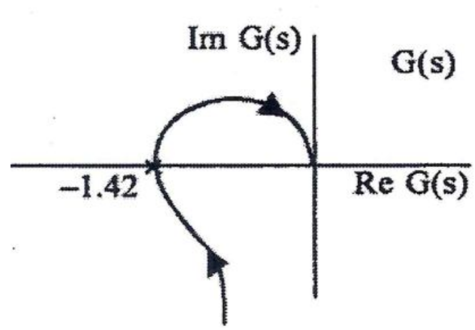
(A) +40 dB/decade

(B) 0 dB/decade

(C) -40 dB/decade

(D) -80 dB/decade

83. The polar plot of a type -1, 3-pole, open-loop system is shown in Fig. The closed-loop system is :



(A) Always stable

(B) Marginally stable

(C) Unstable with one pole on the right half of s-plane

(D) Unstable with two poles on the right half of s-plane

84. The open – loop transfer function of a unity feedback control system is $G(s) = \frac{10}{(s+5)^3}$. The gain margin of the system will be :

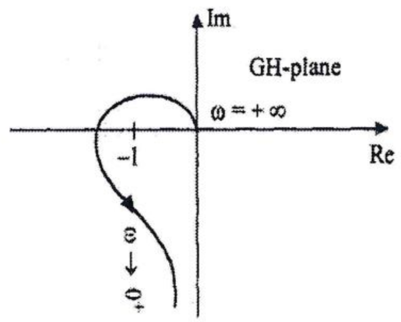
(A) 20 dB

(B) 40 dB

(C) 60 dB

(D) 80 dB

85. The Nyquist plot of the open –loop transfer function of a feedback control system is shown in the given figure. If the open – loop poles and zeros are all located in the left half of s – poles, then the number of closed – loop poles in the right half s – plane will be :



(A) Zero

(B) 1

(C) 2

(D) 3

86. The polar plot of $G(s) = \frac{10}{s(s+1)^2}$ intersects real axis at $\omega = \omega_0$, Then , the real part and ω_0 are respectively given by :

(A) -5, 1

(B) -2.5, 1

(C) -5, 0.5

(D) -5, 2

87. For the transfer function $G(s)H(s) = \frac{1}{s(s+1)(s+0.5)}$ the phase cross –over frequency is :

(A) 0.5 rad/sec

(B) 0.707 rad/sec

(C) 1.732 rad/sec

(D) 2 rad/sec

88. The open loop transfer function of a unity feedback control system is given as $G(s) = \frac{1}{s(1+sT_1)(1+sT_2)}$

(A) $\frac{1}{\sqrt{T_1T_2}}$ and $\frac{T_1+T_2}{T_1T_2}$

(B) $\sqrt{T_1T_2}$ and $\frac{T_1+T_2}{T_1T_2}$

(C) $\frac{1}{\sqrt{T_1T_2}}$ and $\frac{T_1T_2}{T_1+T_2}$

(D) $\sqrt{T_1T_2}$ and $\frac{T_1T_2}{T_1+T_2}$

89. The advantages of Nyquist stability test are :

(A) It guides in stabilizing an unstable system.

(B) It enables to predict closed loop stability form open loop results.

(C) It is applicable to experimental results of frequency response of open loop system

(D) All of the above

90. The phase lead compensation is used to :

(A) Increase rise time and decrease overshoot

(B) Decrease both rise time and overshoot.

(C) Increase both rise time and overshoot.

(D) Decrease rise time and Increase overshoot

91. Indicate which one of the following transfer functions represents phase lead compensator ?

(A) $\frac{s+1}{s+2}$

(B) $\frac{6s+3}{6s+2}$

(C) $\frac{s+5}{3s+2}$

(D) $\frac{s+8}{s^2+5s+6}$

92. The transfer function of a compensating network is of the form $\frac{1+\alpha Ts}{1+Ts}$ .If this is a phase – lag network the value of α should be :

(A) Exactly equal to 0

(B) Between 0 and 1

(C) Exactly equal to 1

(D) Greater than 1

93. Which one of the following compensations is adopted for improving transient response of a negative unity feedback system ?

(A) Phase lead compensation

(B) Phase lag compensation

(C) Gain compensation

(D) Both phase lag compensation and gain compensation

94. The state transition matrix for the system $\dot{X} = AX$ with initial state X(0) is :

(A) $(sI - A)^{-1}$

(B) $e^{At}X(0)$

(C) Laplace inverse of $[(sI - A)^{-1}]$

(D) Laplace inverse of $[(sI - A)^{-1}X(0)]$

95. The Eigen values of the system represented by $\dot{X} = \begin{Bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{Bmatrix} X$ are :

(A) 0, 0, 0, 0

(B) 1, 1, 1, 1

(C) 0, 0, 0, -1

(D) 1, 0, 0, 0

96. The transfer function of a multi – input multi – output system, with the state – space representation of

$\dot{X} + AX + BU$

$Y = CX + DU$

Where X represents the state, Y the output and U the input vector, will be given by:

(A) $C(sI - A)^{-1}B$

(B) $C(sI - A)^{-1}B + D$

(C) $(sI - A)^{-1}B + D$

(D) $(sI - A)^{-1}B + D$

97. Consider the following properties attributed to state model of a system :

1. State model is unique.
2. State model can be derived from the system transfer function.
3. State model can be derived for time variant systems.

(A) 1, 2 and 3 are correct

(B) 1 and 2 are correct

(C) 2 and 3 are correct

(D) 1 and 3 are correct

98. A linear time invariant system is described by the following dynamic equation :

$\dot{X} = AX + Bu \qquad y = CX$

$A = \begin{Bmatrix} 0 & 1 \\ -2 & -3 \end{Bmatrix}, \qquad B = \begin{Bmatrix} 0 \\ 1 \end{Bmatrix}, \qquad C = [1 \quad 1]$

The system is :

(A) Both controllable and observable

(B) Controllable but unobservable

(C) Observable but not controllable

(D) Both uncontrollable and unobservable

99. The effect of adding poles and zeros can be determined quickly by :

(A) Nicholas chart

(B) Nyquist Plot

(C) Bode Plot

(D) Root locus

100. 1. Nyquist criterion is in frequency domain

2. Bode Plot is in frequency domain

3. Root locus plot is in time domain

4. Routh Hurwitz criterion is in time domain.

Which of the following is the correct combination about the four statements stated above.

(A) 1, 2 and 3 are correct

(B) 2, 3 and 4 are correct

(C) 1 and 2 are correct

(D) All four are correct

******

DO NOT OPEN THE QUESTION BOOKLET UNTIL ASKED TO DO SO

1. Examinee should enter his / her roll number, subject and Question Booklet Series correctly in the O.M.R. sheet, the examinee will be responsible for the error he / she has made.
2. **This Question Booklet contains 100 questions, out of which only 75 Question are to be Answered by the examinee. Every question has 4 options and only one of them is correct. The answer which seems correct to you, darken that option number in your Answer Booklet (O.M.R ANSWER SHEET) completely with black or blue ball point pen. If any examinee will mark more than one answer of a particular question, then the first most option will be considered valid.**
3. Every question has same marks. Every question you attempt correctly, marks will be given according to that.
4. Every answer should be marked only on Answer Booklet **(O.M.R ANSWER SHEET).**Answer marked anywhere else other than the determined place will not be considered valid.
5. Please read all the instructions carefully before attempting anything on Answer Booklet**(O.M.R ANSWER SHEET).**
6. After completion of examination please hand over the Answer Booklet **(O.M.R ANSWER SHEET)** to the Examiner before leaving the examination room.
7. There is no negative marking.

Note: On opening the question booklet, first check that all the pages of the question booklet are printed properly in case there is an issue please ask the examiner to change the booklet of same series and get another one.