ROLL NO. _____

Code: DE120 **Subject: CONTROL ENGINEERING**

DipIETE – ET (New Scheme)

Time: 3 Hours **June 2019** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct answer or the best alternative in the following: (2×10)

a. Marginally stable systems
(A) are also called as unstable system
(B) have one of the pole lying in R.H.S. of s-plane
(C) equal numbers of zeros and poles
(D) none of the above

b. The transfer function of a system is $\frac{1000}{(1+0.1s)(1+0.01s)}$, the corner frequencies are
(A) 0.1and 0.01 **(B)** 10 and 100
(C) 0.01 and 1000 **(D)** None of these

c. The maximum phase shift that can be provided by a lead compensator with the transfer function
(A) 15º **(B)** 30º
(C) 45º **(D)** 60º

d. For a second order system with the closed loop transfer function $T(s) = \frac{9}{s^2+4s+9}$, the settling time for 2% band in seconds is
(A) 1.5 **(B)** 2.0
(C) 3.0 **(D)** 4.0

e. Which of the following will not decrease as a result of negative feedback?
(A) Instability **(B)** Bandwidth
(C) Overall gain **(D)** Distortion

f. Differentiators are not used in a system due to
(A) large noise and saturation in the amplifier
(B) large resistance and inductance
(C) huge size and cost
(D) None of these

g. If some poles of a system lies on the imaginary axis, the system is
(A) absolutely stable **(B)** conditionally stable
(C) marginally stable **(D)** unstable

h. The bode plot of the transfer function G(s) = s, is
(A) zero magnitude and zero phase shift
(B) Constant magnitude and constant phase shift
(C) 6 db/octave and phase shift $\pi/2$
(D) -6 db/octave and phase shift $\pi/2$

i. Synchros are generally used as transmitters of
(A) Data logger **(B)** digital data
(C) angular data **(D)** All of these

j. A system with G(s)H(s) = $5/s^2$ is of type
(A) 0 **(B)** 1
(C) 2 **(D)** 3

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks

Q.2 a. Distinguish between: **(6)**
(i) open loop control system and closed loop control system.
(ii) Transfer function model and state space model

b. Obtain the transfer function $\theta_2(s)/T(s)$ for the given mechanical system in fig.1: **(10)**

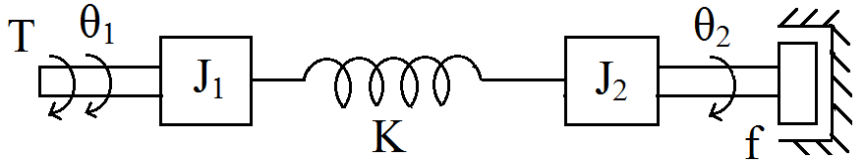

Fig.1

Q.3 a. Obtain the transfer function C(s)/R(s) for the multi loop control system shown in Fig.2 below. **(8)**

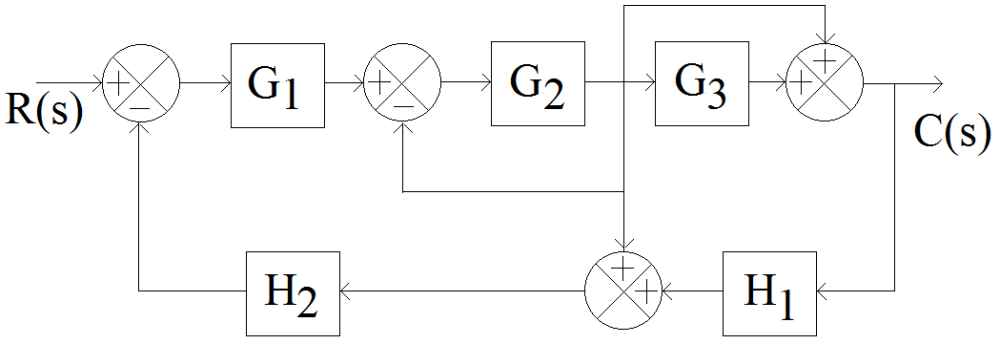

Fig. 2

b. Draw a signal flow graph for the following set of equations: **(8)**
$y_2 = ay_1 - gy_3$; $y_3 = ey_2 + cy_4$; $y_4 = by_2 - dy_4$
Hence find the gains $\frac{y_2}{y_1}$ and $\frac{y_3}{y_1}$

Q.4 a. Find the Laplace transform of y in the equation $\frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 2y = 8$, assuming initial condition to be zero. **(4)**

b. Discuss the standard test signals with neat sketches. **(6)**

c. Determine the range of values of K so that the system having the following characteristic equation will be stable: $s(s^2 + 2s + 3)(s+2) + K = 0$ **(6)**

Q.5 a. Sketch the root locus of the system having $G(s)H(s) = K(s+3)(s+4)/s(s+2)$ for $0 \leq K \leq \infty$ **(12)**

b. Define stability. Differentiate between absolute and relative stability. **(4)**

Q.6 a. Define the sensitivity of a control system. Find the sensitivity of the overall transfer function. **(8)**

b. Explain different controller components used in control systems. **(8)**

Q.7 Construct Bode plots for the frequency response function,
$GH(j\omega) = \frac{2}{j\omega\left(1+\frac{j\omega}{2}\right)\left(1+\frac{j\omega}{s}\right)}$ **(16)**

Q.8 a. List five advantages of Nyquist plot. **(5)**

b. For $G(s)H(s) = \frac{1}{s(s+2)}$, draw the Nyquist plot and decide the stability. **(11)**

Q.9 a. Explain use of passive electric network for implementation of lag, lead and lag-lead compensators. **(8)**

b. Explain the term compensation. Draw and explain different methods of compensation. **(8)**