**M. Tech.-II (Mechanical CAD/CAM) (CBCS – 2015 Course) :**
**WINTER - 2018**
**SUBJECT : CONTROL SYSTEMS**

Day : Tuesday
Date : 20/11/2018

Time : 11.00 AM TO 02.00 PM
Max. Marks : 60

**W-2018-3149**

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**N.B.**

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Answers to both the sections should be written in **SEPARATE** answer books.
4) Draw neat and labelled diagram **WHEREVER** necessary.
5) Use of non-programmable calculator is **ALLOWED.**
6) Assume suitable data, in necessary.

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## SECTION – I

**Q. 1** Draw and explain in brief functional block diagram of application of control sytems. **(10)**

**a)** Hydraulic power steering control of an automobile

**b)** Liquid level control system using float

**OR**

State and explain the aspects that must be taken into account while designing a control systems. **(10)**

**Q. 2** A unity feedback system has $G(s) = \frac{16}{s(s+5)}$. **(10)**

If a step input is given calculate:

**i)** Damping Ratio

**ii)** Overshoot

**iii)** Settling Time

**OR**

$G(s) = \frac{6}{s(s+4)}$, $H(s) = 1$. Calculate the transient response parameters for the given system with input $r(t) = 2a(t)$. **(10)**

**Q. 3** Comment on stability of following control systems: **(10)**

$$s^5 + s^4 + 4s^3 + 24s^2 + 3s + 63 = 0.$$

**OR**

An open loop transfer function has poles at s = 0 and – 1 and a zero at s = - 2. If H =1, check for range of k for stability. **(10)**

**P. T. O.**

## SECTION - II

**Q. 4** What is Bode plot of a control system? Explain its advantages over other methods of analysis of control systems in the frequency domain. **(10)**

**OR**

Write short notes on frequency domain specifications. **(10)**

**Q. 5** Obtain the state transition matrix for the system: **(10)**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & 3 \\ 0 & -3 \end{bmatrix} x\ (t).$$

**OR**

Consider the system with state equation **(10)**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & 6 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

Estimate the state controllability by Gilbert's test.

**Q. 6** Draw the constructional details of servomotor and explain function of each subsystem. **(10)**

**OR**

What is the need of compensation in non-linear control systems? Comment on use of lead compensator and lag-lead compensation. **(10)**

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