Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

FOURTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER EXAMINATIONS, JUNE 2017

SUBJECT: LINEAR CONTROL THEORY [ICE 2203]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Semi log graph paper is supplied

1A. Differentiate the terms (i) Open loop systems (ii) Closed loop systems **2**

1B. Derive the transfer function of a Armature controlled D.C servomotor **3**

1C. Obtain the transfer function of the Electrical network shown in Fig Q1C. **5**

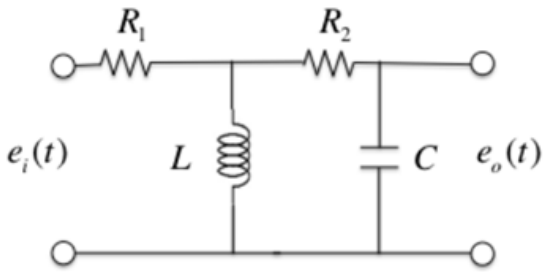

Fig Q1C

2A. Explain the block diagram reduction rules for (i) moving a pick off point ahead of the block (ii) Moving a Pick off point beyond the block. **2**

2B. Write the differential equations governing the Mechanical system shown in Fig Q2B. Also write down its electrical equivalent circuit using force voltage analogy. **3**

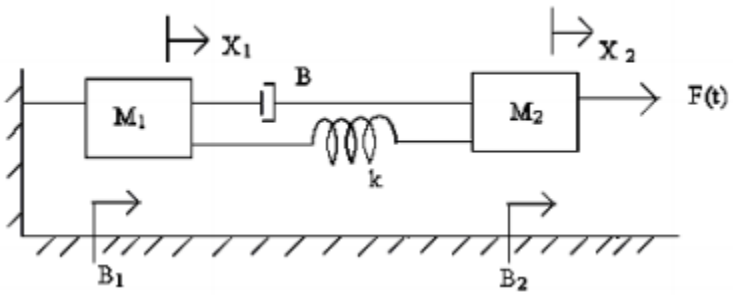

Fig Q2B

2C. Using block diagram reduction technique reduce the block diagram shown in Fig Q2C into an open loop form. **5**

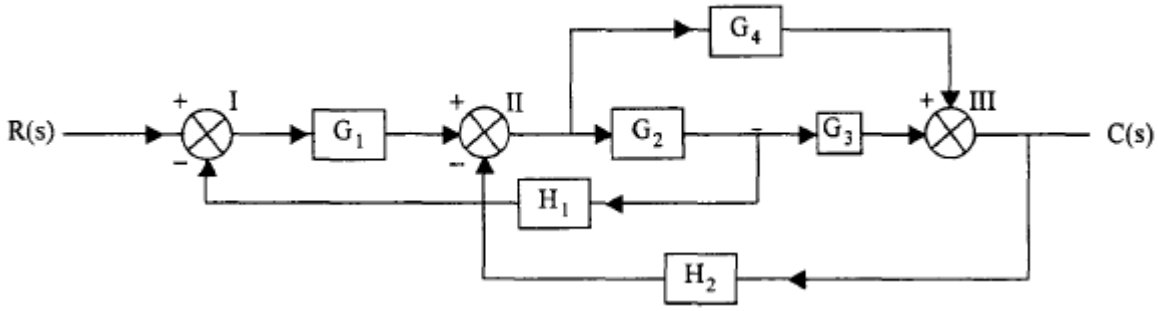

Fig Q2C

3A. Derive an expression for settling time of a standard second order system, assuming the expression for the unit step response. **2**

3B. The Closed loop transfer function of a second order system is given by $\frac{C(s)}{R(s)} = \frac{100}{s^6 + 3s^5 + 8s^4 + 18s^3 + 20s^2 + 24s + 16}$. Determine number of poles on the RHP, LHP and on the $j\omega$ axis and comment on the stability of the system. **3**

3C. For a feedback system the forward path transfer function is $G(s) = \frac{200(s+1)}{s^2(s+2)(s+10)}$ and feedback gain H(s) = 1. Determine the static error constants and steady state errors due to unit step, unit ramp and unit parabolic inputs. **5**

4A. State and explain Nyquist stability criterion **2**

4B. Sketch the polar plot of the transfer function $G(s) = \frac{12}{s(s+2)(s+4)}$ **3**

4C. Sketch the Bode magnitude plot and phase angle plot for the open loop transfer function $GH(s) = \frac{25}{s(1+0.0125s)(1+0.1s)}$ Find gain margin, phase margin, gain cross over frequency, phase cross over frequency and comment on the stability of the system. **5**

5A. Derive the transfer function of a lead compensator. **2**

5B. For the feedback system shown in Fig Q5B Find (i) break away point of the root locus (ii) and the range of k for stability . **3**

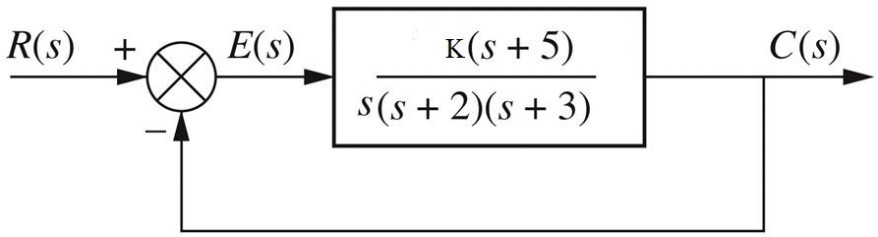

Fig Q5B

5C. Explain the procedure for designing a PID controller. **5**