Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

V SEMESTER B.Tech (BME) DEGREE END SEMESTER EXAMINATIONS NOV/DEC 2016

SUBJECT: PHYSIOLOGICAL CONTROL SYSTEM (BME 4009)
(REVISED CREDIT SYSTEM)
Thursday, 1st December, 2016, 2 pm to 5 pm

TIME: 3 HOURS **Note: Answer ALL questions** **MAX. MARKS: 100**

Q1 **(a)** Describe the closed loop control system consisting of a human being reaching out for an object to be picked up. **5**

(b) Using block diagram reduction technique, determine the transfer function $\frac{C(s)}{R(s)}$ for the system represented by the block diagram shown in Fig. Q1b, **8**

if $G1 = \frac{s}{2}$, $G2 = \frac{s+10}{2}$, $G3 = \frac{5}{2s}$ and $H1 = \frac{s}{5}$

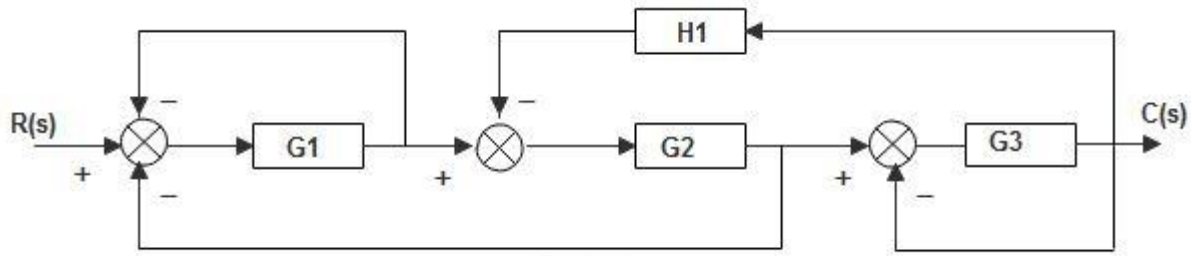

Fig.Q1b

(c) For the SFG shown in Fig.Q1c, find the transfer function $\frac{C(s)}{R(s)}$ **7**

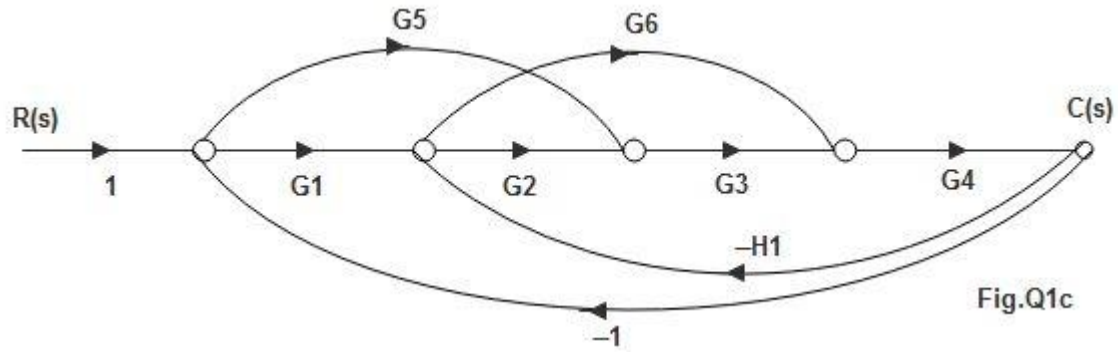

Fig.Q1c

Q2 **(a)** For the mechanical system shown in Fig. Q2a, write the system differential equations. Also obtain analogous electrical circuit based on force to current and write the corresponding equations. **8**

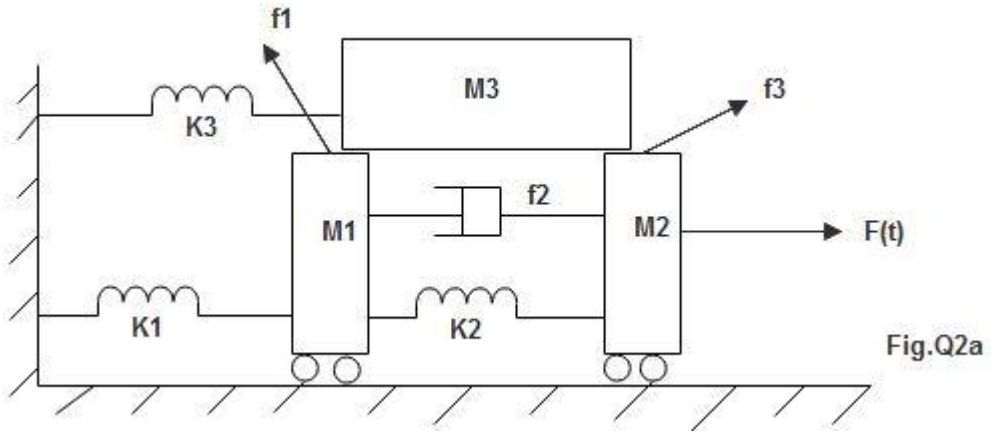

Fig.Q2a

(b) Obtain the time response and steady state error for a unit parabolic response of a first order feed-back system. **6**

(c) For a second order system described by the following transfer function, determine the frequencies of un-damped and damped oscillations, maximum overshoot, peak time, rise time and settling time for a tolerance of 5%. **6**

$$\frac{C(s)}{R(s)} = \frac{144}{s^2 + 9.6s + 144}$$

Q3 **(a)** A unity feed-back control system is characterized by the open loop transfer function **6**

$$G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$$

Using Routh criterion find the range of K for which the system is stable. Also determine value of K for which the system response is oscillatory and the value of frequency of oscillations at this value of K.

(b) A unity feedback control system is characterized by the open loop transfer function given by, **14**

$$G(s) = \frac{K}{(s^2 + 8s + 15)(s^2 + 2s + 2)}$$

Sketch the root locus diagram of the system for K ≥0 and determine the marginal value of K for stability. Also find the point of intersection of root locus on the $j\omega$ axis.

Q4 **(a)** (i) Discuss briefly, the gain margin and phase margin. **3**

(ii) An unity feedback control system has the open loop transfer function **12**

$$G(s) = \frac{100(s+1)}{s^2(1+0.1s)(1+0.05s)}$$

Construct the Bode plot, find the gain margin and the phase margin, and discuss the stability of the system.

(b) For the Bode magnitude plot shown in fig. Q4b, find the open loop transfer function G(s). **5**

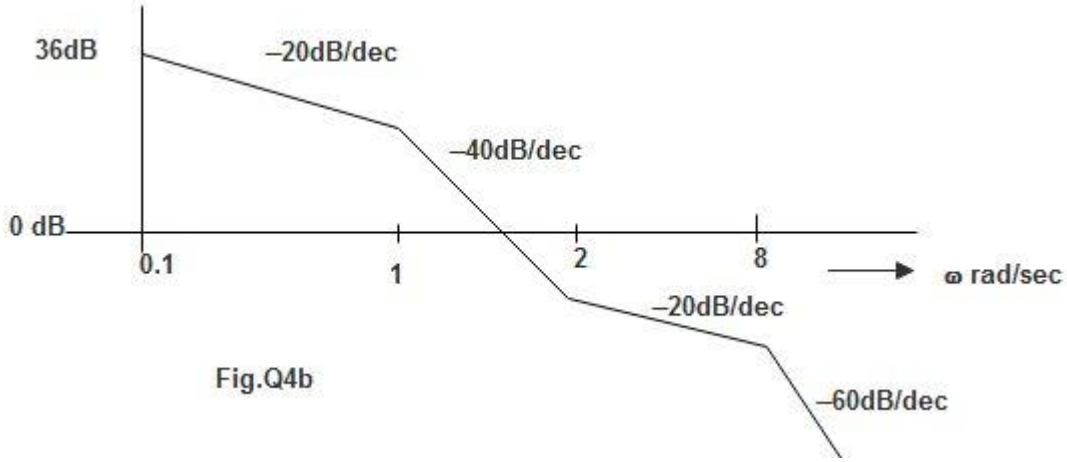

Fig.Q4b

Q5 **(a)** With the relevant examples discuss the differences of physiological and technological control systems. **8**

(b) Draw the block diagram and discuss, extracellular Calcium ion regulation in the human body. **6**

(c) With respect to visual control system of human Eye, explain accommodation mechanism. **6**