Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

V SEMESTER B.Tech (BME) DEGREE END SEM EXAMINATIONS NOV/DEC 2018

SUBJECT: PHYSIOLOGICAL CONTROL SYSTEMS (BME 4009)

(REVISED CREDIT SYSTEM)

Monday, 26th November 2018: 2 PM to 5 PM

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to Candidates:

1. **Answer all the questions.**
2. **Draw labeled diagrams wherever necessary.**

1. (a) The electric lamps in a patient ward are switched ON or OFF by the ward boy to change the level of illumination in the ward. Discuss the control scheme and draw the component block diagram of the feedback system. 03

(b) The system shown in **Fig.Q1b**, shows a block diagram representation of a feedback control system. Draw the SFG of this system and find the transfer function, $\frac{C(s)}{R(s)}$. 04

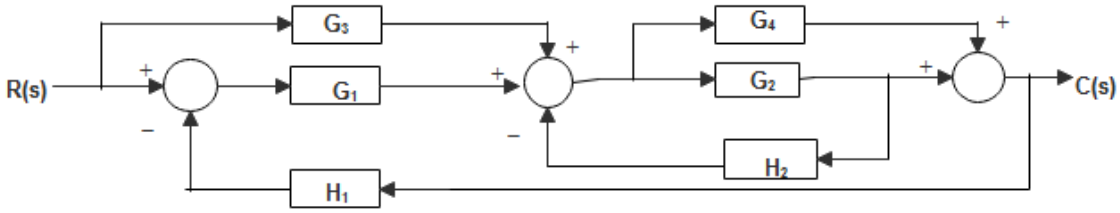

Fig. Q1b

(c) Discuss the effect of negative feed-back in systems on (i) Stability. (ii) Sensitivity. (iii) External noise. 03

2. (a) For the mechanical system shown in **Fig. Q2a**, write the system differential equations. Also construct the analogous electrical circuit based on force to current and force to voltage analogy and write the corresponding equations. 05

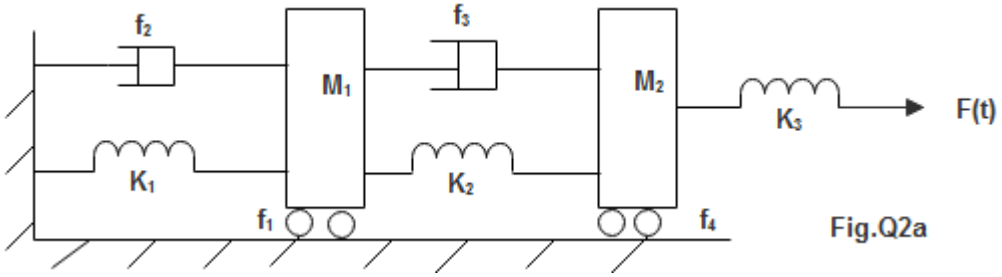

Fig.Q2a

(b) Given the expression $c(t) = 1 - \frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}} \sin[\omega_n \sqrt{1-\xi^2}\, t + \tan^{-1} \frac{\sqrt{1-\xi^2}}{\xi}]$ is the time response of unit step to a second order feed-back system. Obtain the expressions for (i) Rise time t_r (ii) Peak time t_P (iii) Peak overshoot M_P 05

3. (a) Consider the characteristic equation of a unity feed-back control system is given by $s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$. Using RH criterion discuss the stability of the system. 03

(b) A unity feedback control system is characterized by the open loop transfer function given by, 07

$$GH(s) = \frac{K}{s^3 + 6s^2 + 10s}$$

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.

4. (a) A unity feedback control system has the open loop transfer function 07

$$G(s) = \frac{4}{s(1 + 0.2s + 0.05s)}$$

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

(b) Discuss briefly, the differences between technological and physiological control systems. 03

5 (a) Discuss the transfer of substances between physiological compartments by fluid flow with necessary diagram and obtain the differential equation in terms of fluid concentration. 03

(b) With the help of necessary block diagrams, discuss the regulation of blood glucose in human body system. 04

(c) Discuss briefly, the various means by which the heat from the human body is lost to the external environment. 03