Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)
END SEMESTER EXAMINATIONS, JUNE 2018

SUBJECT: LINEAR CONTROL THEORY [AAE 2204]
REVISED CREDIT SYSTEM
(23/06/2018)

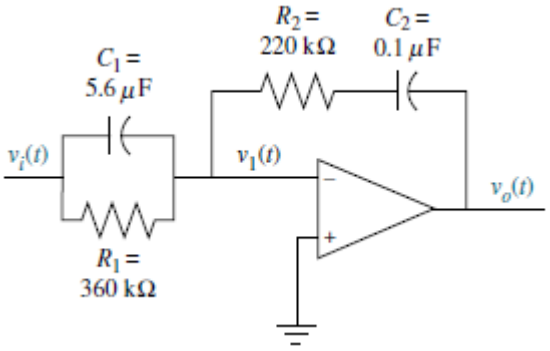
Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

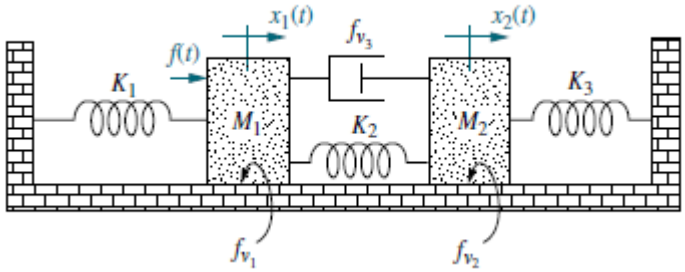
- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Find the transfer function of the system represented by $\frac{dc(t)}{dt} + 2c(t) = r(t)$ **(02)**

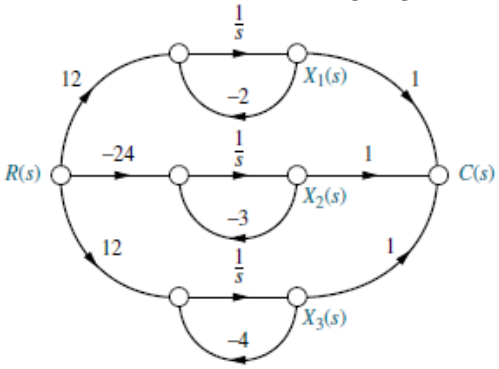
1B. Find the transfer function of the following amplifier circuit **(03)**



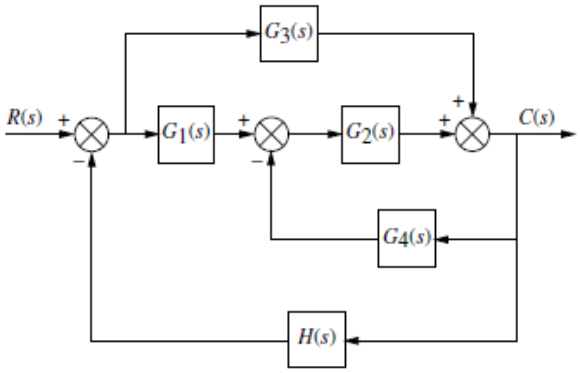
1C. Convert the following mechanical to the electrical analogous circuit and determine the transfer function. **(05)**



2A. Determine the transfer function of the following signal flow graph **(05)**



2B. Reduce the following block diagram and determine the transfer function **(03)**



2C. A unity feedback system has an open loop transfer function of $G(s)=\frac{25(s+4)}{s(s+0.5)(s+2)}$. Determine the steady-state error for a unit ramp input. **(02)**

3A. The open loop transfer function of a unity feedback system is given by $G(s)=\frac{k}{s(sT+1)}$, where *k* and *T* are positive constants. By what factor should the amplifier gain be reduced so that the peak overshoot of unit step response of the system is reduced from 75% to 25%. **(05)**

3B. A unity feedback control system has an open loop transfer function $G(s)=\frac{10}{s(s+2)}$. Find the rise time, peak time, percentage overshoot and settling time for a step input of 12 units. **(03)**

3C. Draw the typical Polar plot of a type 2 order 5 system. **(02)**

4A. Draw the Bode plot for the following system **(05)**

$$G(s)=\frac{e^{-0.2s}}{s(s+2)(s+8)}$$

4B. Give a brief account on the following with suitable diagrams. **(03)**

i. Divergent Instability
ii. Asymptotically Stable System
iii. Flutter Instability

4C. A system has a characteristic equation $s^3+Ks^2+(1+K)s+6=0$. Determine the range of K for the system to be stable. **(02)**

5A. Sketch the root locus of the system whose open loop transfer function is $G(S)=\frac{K}{S(S+2)(S+4)}$. Determine the value of K so the damping ratio of the closed-loop system is 0.5. **(05)**

5B. Using Routh – Hurwitz Criterion, determine the stability of the system which has the characteristic equation **(03)**

$s^6+9s^5+31.25s^4+61.25s^3+67.75s^2+14.75s+15=0$.

Determine the roots and locate the roots on the s-plane.

5C. Based on the location of poles, explain how the following system parameters can be identified **(02)**

i) Frequency
ii) Rate of decay