UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2011/2012

NAMA KURSUS	:	SISTEM KAWALAN
KOD KURSUS	:	DEK 3123 / DAE 32103
PROGRAM	:	3 DAE / DEE / DET
TARIKH PEPERIKSAAN	:	MAC 2012
JANGKA MASA	:	2½ JAM
ARAHAN	:	JAWAB **EMPAT** (4) SOALAN SAHAJA.

KERTAS SOALAN INI MENGANDUNGI SEBELAS (11) MUKA SURAT

SOALAN DALAM BAHASA MELAYU

S1 (a) Berdasarkan sistem kawalan terbuka,

(i) Lakarkan gambarajah blok umum bagi sistem tersebut.
(ii) Terangkan setiap elemen yang terlibat dalam membangunkan sistem tersebut.

(12 markah)

(b) Lakarkan gambarajah blok bagi sistem kawalan halaju gelung tertutup.

(4 markah)

(c) Huraikan sistem suap balik dan terangkan mengapa ia digunakan.

(4 markah)

(d) Senaraikan lima (5) klasifikasi sistem kawalan.

(5 markah)

S2 (a) Dapatkan rangkap pindah yang sepadan bagi persamaan pembezaan berikut dan nyatakan keadaan awal yang anda tentukan.

$$4\frac{d^3c}{dt^3} - 6\frac{d^2c}{dt^2} + 3\frac{dc}{dt} + 12c = 15\frac{d^2r}{dt^2} + 5\frac{dr}{dt} - 7r$$

(4 markah)

(b) Senaraikan tiga (3) jenis fungsi masukan domain masa dan lakarkan graf setiap masukan tersebut.

(6 markah)

(c) Selesaikan sambutan tanjakan bagi sebuah sistem yang mempunyai rangkap pindah berikut:

$$G(s) = \frac{s}{(s+4)(s-6)}$$

(15 markah)

S3 (a) Dapatkan rangkap pindah bagi rangkaian RLC dalam Rajah S3(a).

(10 markah)

(b) Lakarkan satu graf yang menunjukkan sambutan yang berbeza dengan nilai nisbah redaman (ζ) yang berbeza bagi setiap sambutan tersebut.

(6 markah)

(c) Bagi rangkap pindah berikut, kira :

$$\frac{\theta_o(s)}{\theta_i(s)} = \frac{100}{s^2 + 15s + 100}$$

(i) Frekuensi tabii teredam (ω_n)
(ii) Nisbah redaman (ζ)
(iii) Nyatakan jenis sambutan

(9 markah)

S4 (a) Nyatakan perbezaan asas di antara sistem kawalan analog dan sistem kawalan digital.

(1 markah)

(b) Rajah S4(b) menunjukkan gambarajah blok sistem kawalan analog. Berdasarkan Rajah S4(b), lakarkan sistem kawalan digital untuk menggantikan sistem kawalan analog tersebut.

(10 markah)

(c) Berikan enam (6) kebaikan sistem kawalan digital berbanding sistem kawalan analog.

(6 markah)

(d) Lakarkan empat (4) jenis isyarat di dalam sistem kawalan digital.

(8 markah)

S5 (a) Rajah S5 (a) adalah satu contoh gambarajah blok untuk membentuk isyarat dalam sistem kawalan digital. Ia merupakan gambar rajah blok yang mempunyai lapan komponen. Terangkan operasi setiap komponen
tersebut.

(16 markah)

(b) Lukiskan satu rajah litar bagi dua jenis kaedah DAC.

(i) Perintang wajaran
(ii) R-2R litar bertangga

(9 markah)

S6 (a) Senaraikan enam (6) jenis pengukuran tahap.

(6 markah)

(b) Rajah S6(b) menunjukkan contoh kaedah radar. Terangkan secara ringkas operasi kerja sistem pengukur radar tersebut.

(10 markah)

(c) (i) Lakarkan gambarajah blok Operasi Unsur Kawalan Akhir.
(ii) Terangkan secara ringkas operasi setiap blok.

(9 markah)

SOALAN DALAM BAHASA INGGERIS

Q1 (a) Based on an open loop control system,

(i) Sketch the general block diagram of the system.
(ii) Briefly explain all the elements involved in constructing the system.

(12 marks)

(c) Sketch a block diagram of closed loop speed control system.

(4 marks)

(c) Describe a feedback system and explain why it is used.

(4 marks)

(d) List five (5) control system classifications.

(5 marks)

Q2 (a) Find the transfer function, corresponding to the differential equation and state your initial condition.

$$4\frac{d^3c}{dt^3}-6\frac{d^2c}{dt^2}+3\frac{dc}{dt}+12c=15\frac{d^2r}{dt^2}+5\frac{dr}{dt}-7r$$

(4 marks)

(b) List three (3) types of time domain input function and sketch the graph respectively.

(6 marks)

(c) Solve the ramp response for a system whose transfer function is

$$G(s)=\frac{s}{(s+4)(s-6)}$$

(15 marks)

Q3 (a) Find the transfer function, $G(s) = V_o(s)/V_i(s)$ for the following RLC network in Figure Q3 (a).

(10 marks)

(b) Sketch a graph showing a different type of responses with the value of the damping ratio (ζ) for each type of response.

(6 marks)

(c) For the following transfer function, calculate:

$$\frac{\theta_o(s)}{\theta_i(s)} = \frac{100}{s^2 + 25s + 100}$$

(i) The natural frequency (ω_n)
(ii) The damping ratio (ζ)
(iii) The type of response

(9 marks)

Q4 (a) Explain the fundamental difference between analog and digital control systems.

(1 marks)

(b) Figure Q4(b) shows a block diagram of an analog control system. Based on Figure Q4(b), sketch a digital control system to replace the analog control system.

(10 marks)

(c) Give six (6) advantages of digital control system compared to analog system.

(6 marks)

(d) Sketch four (4) types of signal in digital control system respectively.

(8 marks)

Q5 (a) Figure Q5(a) is an example of a block diagram for signal form in digital control system. This is a block diagram which has eight components. Describe the operation of each components.

(16 marks)

(b) Draw a circuit diagram for two types of DAC method.

(i) Weighted Resistor
(ii) R-2R Ladder Circuit

(9 marks)

Q6 (a) List six (6) types of level measurement.

(6 marks)

(b) Figure Q6(b) shows the example of a radar method. Briefly explain the working operation of the radar measuring system.

(10 marks)

(c) (i) Sketch a block diagram of the Final Control Element Operation.
(ii) Briefly explain its operation.

(9 marks)

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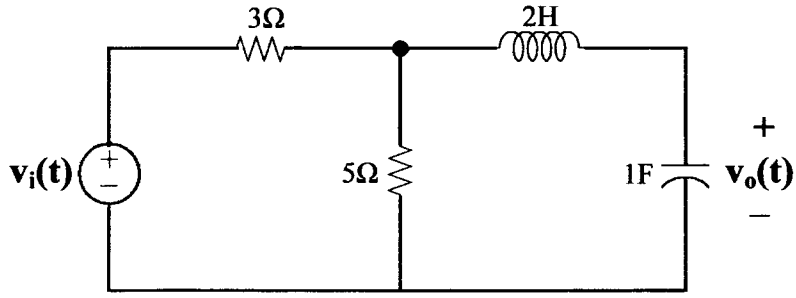
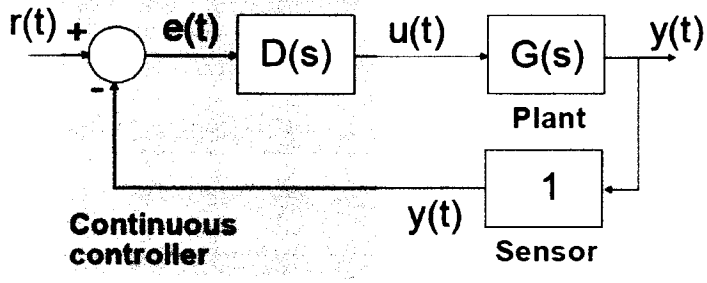
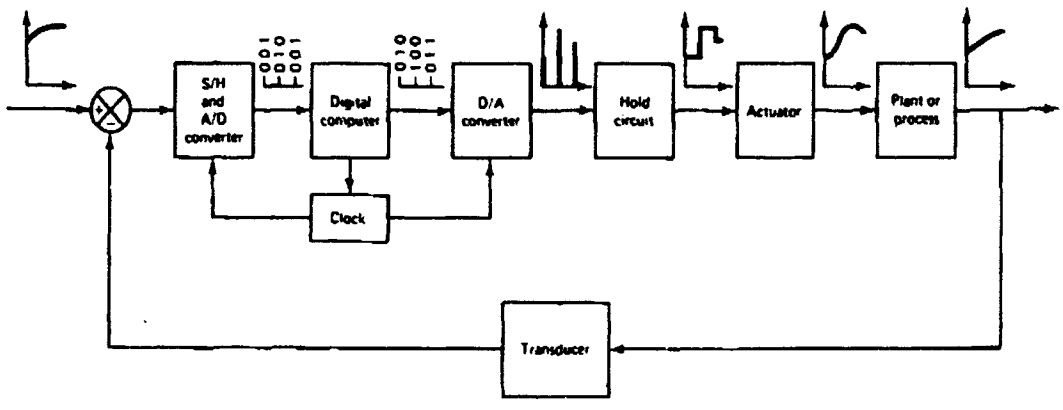


RAJAH S3(a) / FIGURE Q3(a)



RAJAH S4(b) / FIGURE Q4(b)



RAJAH S5(a) / FIGURE Q5(a)

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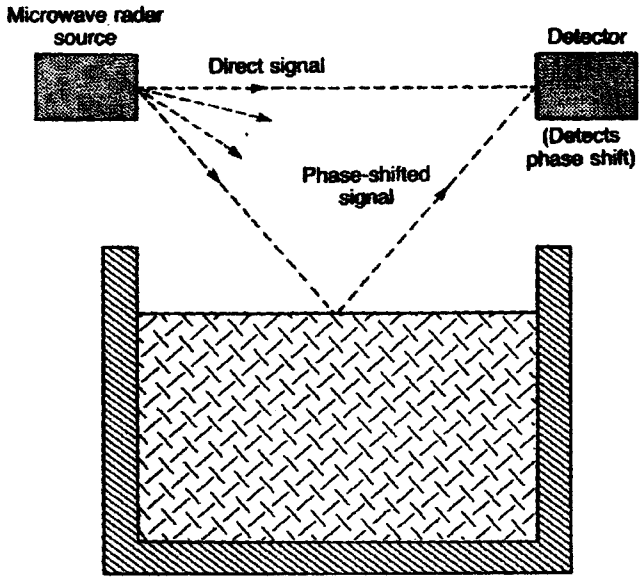

RAJAH S6(b) / FIGURE Q6(b)

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Jadual 1/ Table1: Jelmaan Laplace / Laplace Transform Table

Item no.	f(t)	F(s)
1.	$\delta(t)$	1
2.	$u(t)$	$\frac{1}{s}$
3.	$tu(t)$	$\frac{1}{s^2}$
4.	$t^n u(t)$	$\frac{n!}{s^{n+1}}$
5.	$e^{-at}u(t)$	$\frac{1}{s+a}$
6.	$\sin \omega t u(t)$	$\frac{\omega}{s^2+\omega^2}$
7.	$\cos \omega t u(t)$	$\frac{s}{s^2+\omega^2}$

Jadual 2/ Table 2: Teorem Jelmaan Laplace / Laplace Transform Theorem

Item no.	Theorem		Name
1.	$\mathcal{L}[f(t)] = F(s)$	$= \int_{0-}^{\infty} f(t)e^{-st}dt$	Definition
2.	$\mathcal{L}[kf(t)]$	$= kF(s)$	Linearity theorem
3.	$\mathcal{L}[f_1(t)+f_2(t)]$	$= F_1(s)+F_2(s)$	Linearity theorem
4.	$\mathcal{L}[e^{-at}f(t)]$	$= F(s+a)$	Frequency shift theorem
5.	$\mathcal{L}[f(t-T)]$	$= e^{-sT}F(s)$	Time shift theorem
6.	$\mathcal{L}[f(at)]$	$= \frac{1}{a}F\left(\frac{s}{a}\right)$	Scaling theorem
7.	$\mathcal{L}\left[\frac{df}{dt}\right]$	$= sF(s)-f(0-)$	Differentiation theorem
8.	$\mathcal{L}\left[\frac{d^2f}{dt^2}\right]$	$= s^2F(s)-sf(0-)-\dot{f}(0-)$	Differentiation theorem
9.	$\mathcal{L}\left[\frac{d^nf}{dt^n}\right]$	$= s^nF(s)-\sum_{k=1}^{n} s^{n-k}f^{k-1}(0-)$	Differentiation theorem
10.	$\mathcal{L}\left[\int_{0-}^{t} f(\tau)\,d\tau\right]$	$= \frac{F(s)}{s}$	Integration theorem
11.	$f(\infty)$	$= \lim_{s\to 0} sF(s)$	Final value theorem[1]
12.	$f(0+)$	$= \lim_{s\to \infty} sF(s)$	Initial value theorem[2]

[1] For this theorem to yield correct finite results, all roots of the denominator of $F(s)$ must have negative real parts and no more than one can be at the origin.
[2] For this theorem to be valid, $f(t)$ must be continuous or have a step discontinuity at $t = 0$ (i.e., no impulses or their derivatives at $t = 0$).

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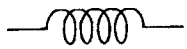
Jadual 3/ Table 3: Jadual Komponen Elektrik / Electrical Component Table

Component	Voltage-current	Current-voltage	Voltage-charge	Impedance $Z(s) = V(s)/I(s)$	Admittance $Y(s) = I(s)/V(s)$
 Capacitor	$v(t) = \frac{1}{C}\int_0^t i(\tau)\,d\tau$	$i(t) = C\frac{dv(t)}{dt}$	$v(t) = \frac{1}{C}q(t)$	$\frac{1}{Cs}$	Cs
 Resistor	$v(t) = Ri(t)$	$i(t) = \frac{1}{R}v(t)$	$v(t) = R\frac{dq(t)}{dt}$	R	$\frac{1}{R} = G$
 Inductor	$v(t) = L\frac{di(t)}{dt}$	$i(t) = \frac{1}{L}\int_0^t v(\tau)d\tau$	$v(t) = L\frac{d^2q(t)}{dt^2}$	Ls	$\frac{1}{Ls}$

Note: The following set of symbols and units is used throughout this book: $v(t)$ = V (volts), $i(t)$ = A (amps), $q(t)$ = Q (coulombs), C = F (farads), R = Ω (ohms), G = Ʊ (mhos), L = H (henries).