UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2008/09

NAMA MATA PELAJARAN	:	SISTEM KAWALAN
KOD MATA PELAJARAN	:	DEK 3123
KURSUS	:	3 DEE/ DET
TARIKH PEPERIKSAAN	:	APRIL/ MEI 2009
JANGKA MASA	:	2 ½ JAM
ARAHAN	:	JAWAB EMPAT (4) SOALAN SAHAJA DARIPADA ENAM (6) SOALAN.

KERTAS SOALAN INI MENGANDUNGI SEMBILAN (9) MUKA SURAT

SOALAN DALAM BAHASA MELAYU

S1 (a) Dengan mengambil kira sistem kawalan gelung tutup,

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

(15 markah)

(b) Berikan kelebihan dan kekurangan bagi jenis sistem kawalan berikut:

(i) Sistem kawalan gelung buka
(ii) Sistem kawalan gelung tutup

(10 markah)

S2 (a) Berdasarkan persamaan pembezaan berikut,

$$\frac{d^2y(t)}{dt^2} + 21\frac{dy(t)}{dt} + 110y(t) = 10u(t)$$

(i) Dapatkan y(t) jika keadaan awal sistem adalah sifar.
(ii) Tentukan kestabilan sistem berdasarkan lakaran satah-s.

(14 markah)

(b) Dapatkan rangkap pindah bagi litar penapis yang diberikan di dalam Rajah S2(b).

(6 markah)

(c) Dapatkan rangkap pindah, G(s) bagi sistem mekanikal seperti yang ditunjukkan di dalam Rajah S2(c).

(5 markah)

S3 (a) Berdasarkan Rajah S3(a), dapatkan rangkap pindah bagi sistem tersebut.

(5 markah)

(b) Rangkap pindah bagi satu sistem kawalan kedudukan diberikan seperti berikut:

$$\frac{\theta_o(s)}{\theta_i(s)} = \frac{100}{s^2 + 18s + 100}$$

Dapatkan nisbah redaman ζ, dan frekuensi tabii teredam, ω_n, nyatakan jenis sambutan sistem tersebut seterusnya tentukan nilai parameter-parameter berikut:

(i) Masa lajak maksimum, T_p.

(ii) Peratus lajakan maksimum, M_p%.

(iii) Masa menaik, T_r.

(iv) Masa pengenapan, T_s.

(20 markah)

S4 (a) Terangkan sistem kawalan gelung tutup analog dan digital menggunakan gambarajah blok.

(15 markah)

(b) Berikan 6 kelebihan menggunakan sistem kawalan digital berbanding sistem kawalan analog.

(6 markah)

(c) Berdasarkan Rajah S4(c), namakan 4 jenis isyarat yang digunakan di dalam sistem kawalan digital.

(4 markah)

S5 (a) Terangkan sistem perolehan data berdasarkan gambarajah blok yang lengkap bagi proses tersebut.

(16 markah)

(b) Berikan 3 jenis gelung kawalan proses selain dari gelung buka dan gelung tutup.

(3 markah)

(c) Senaraikan 3 jenis pengukuran suhu dan berikan contoh bagi setiap jenis pengukuran.

(6 markah)

S6 (a) Terangkan tindakan elementari buka/tutup dan tindakan kawalan berterusan di dalam sistem kawalan jenis berterusan dengan memberikan lakaran proses bagi setiap sistem tersebut.

(14 markah)

(b) Berdasarkan Rajah S6(b), berikan jenis sistem kawalan proses yang digunakan dan terangkan proses tersebut dijalankan.

(11 markah)

SOALAN DALAM BAHASA INGGERIS

Q1 (a) Based on closed loop control system,

(i) Sketch the block diagram of the system.
(ii) Explain the element involved.

(17 marks)

(b) Give the advantages and disadvantages of the following type of control system:

(i) Open loop control system
(ii) Close loop control system

(8 marks)

Q2 (a) Based on the following differential equation,

$$\frac{d^2y(t)}{dt^2} + 21\frac{dy(t)}{dt} + 110y(t) = 10u(t)$$

(i) Find y(t) if the initial condition is zero.
(ii) Determine the system stability based on s-plane sketch.

(14 marks)

(b) Find the transfer function for the filter circuit as shown in Figure Q2(b).

(6 marks)

(c) Find the transfer function, G(s) for a mechanical system as shown in Figure Q2(c).

(5 marks)

Q3 (a) Find the transfer function for the system in Figure Q3(a).

(5 marks)

(b) The transfer function for a position control system is given by the following equation:

$$\frac{\theta_o(s)}{\theta_i(s)} = \frac{100}{s^2 + 18s + 100}$$

Find the damping ratio, ζ and natural frequency, ω_n, state the type of system response and determine the value of the following parameters:

(i) Peak time, T_p.

(ii) Percent overshoot, M_p %

(iii) Rise time, T_r.

(iv) Setting time T_s.

(20 marks)

Q4 (a) Explain analog and digital closed loop control system based on a block diagram.

(15 marks)

(b) Give 6 advantages of digital control system over analog control system.

(6 marks)

(c) Based on Figure Q4(c), name 4 types of signal used in digital control system.

(4 marks)

Q5 (a) Explain data acquisition system based on a complete block diagram for the process.

(16 marks)

(b) Give 3 types of process control loop other than open loop and closed loop.

(3 marks)

(c) List 3 types of temperature measurement and give one example respectively.

(6 marks)

Q6 (a) Explain elementary on/off action and continuous control action in continuous type control system by giving a process sketch for each of the system.

(14 marks)

(b) Based on Figure Q6(b), determine the process control used and explain how the process is executed.

(11 marks)

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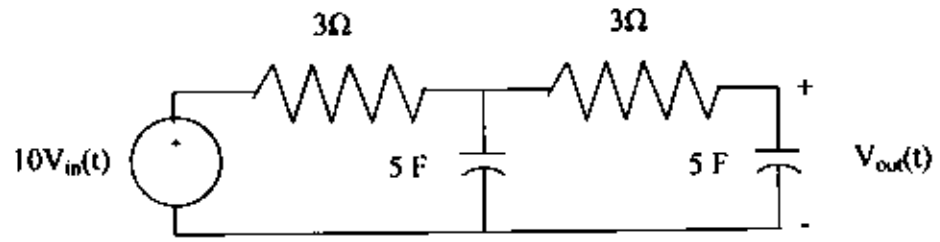
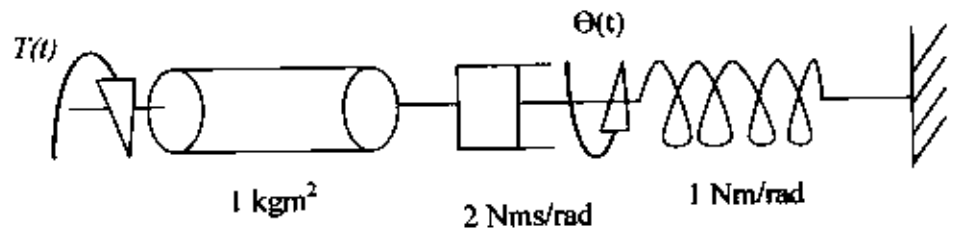
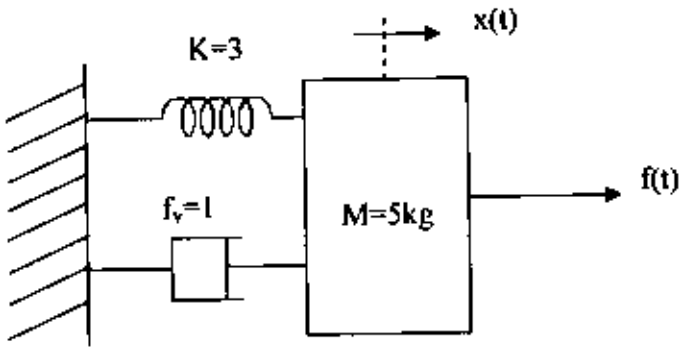


RAJAH S2(b)/ FIGURE Q2(b)



RAJAH S2(c)/ FIGURE Q2(c)



RAJAH S3(a)/ FIGURE Q3(a)

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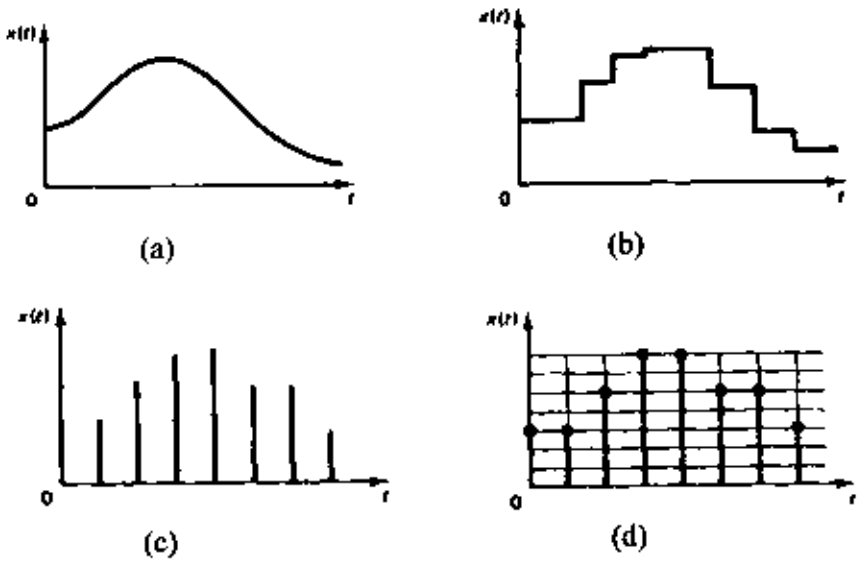
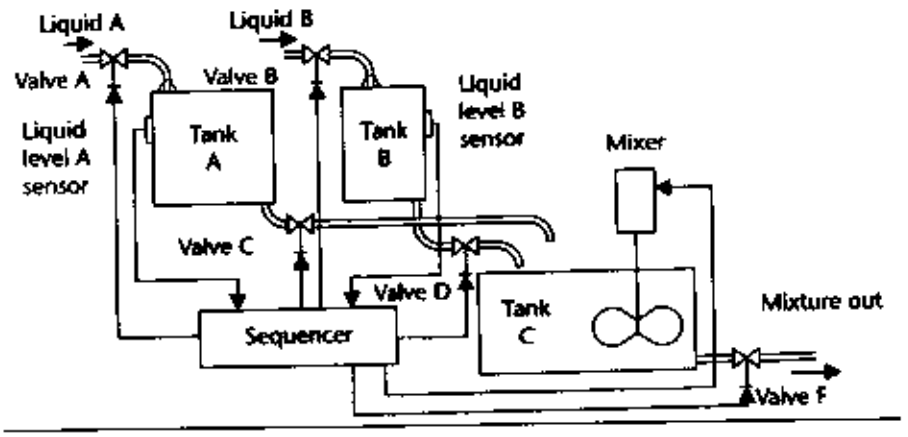


RAJAH S4(c)/ FIGURE Q4(c)



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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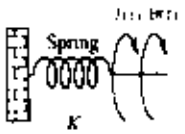
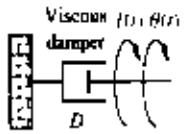
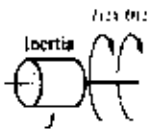
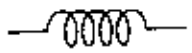
Jadual 3/ Table 3: Jadual Mekanikal Putaran / Rotational Mechanical Table

Component	Torque-angular velocity	Torque-angular displacement	Impedance $Z_m(s) = T(s)/\theta(s)$
	$T(t) = K\int_0^t \omega(\tau)\,d\tau$	$T(t) = K\theta(t)$	K
	$T(t) = D\omega(t)$	$T(t) = D\frac{d\theta(t)}{dt}$	Ds
	$T(t) = J\frac{d\omega(t)}{dt}$	$T(t) = J\frac{d^2\theta(t)}{dt^2}$	Js^2

Note: The following set of symbols and units is used throughout this book: $T(t)$ = N-m (newton-meters), $\theta(t)$ = rad (radians), $\omega(t)$ = rad/s (radians/second), K = N-m/rad (newton-meters/radian), D = N-m-s/rad (newton-meters-seconds/radian), J = kg-m^2 (kilogram-meters^2 = newton-meters-seconds^2/radian).

Jadual 4/ Table 4: 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).