
UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang Akademik 2004/2005
*First Semester Examination
2004/2005 Academic Session*

Oktober 2004
October 2004

ESA 371/3 – Elemen Sub-sistem Kapal Terbang
(Aircraft Sub-system Elements)

Masa : [3 jam]
Hour : [3 hour]

ARAHAN KEPADA CALON :
INSTRUCTION TO CANDIDATES:

Sila pastikan bahawa kertas soalan ini mengandungi **LAPAN (8)** mukasurat dan **LIMA (5)** soalan sebelum anda memulakan peperiksaan.

*Please ensure that this paper contains **EIGHT (8)** printed pages and **FIVE (5)** questions before you begin examination.*

Jawab **EMPAT (4)** soalan sahaja.

*Answer **FOUR (4)** the questions only.*

Jawab semua soalan dalam Bahasa Melayu.

Answer all questions in Bahasa Melayu .

Setiap soalan mestilah dimulakan pada mukasurat yang baru.

Each questions must begin from a new page.

1. Soalan-soalan ringkas/ *short questions* :

- (a) Sila sebutkan komponen-komponen sistem pesawat terbang (minimal 5 komponen)

Please mention the components of aircraft system (minimum 5 components)

(10 markah/marks)

- (b) Sebutkan tingkatan dalam integrasi sistem pesawat terbang

Please mentions the stages of aircraft system integration

(10 markah/marks)

- (c) Mengapa bidang kawalan elevator, aileron dan rudder digolongkan sebagai bidang kawalan utama ?

Why are the control surfaces elevator, rudder, and aileron classified as the primary control surfaces ?

(10 markah/marks)

- (d) Apa fungsi-fungsi dari flaps, spoilers and trim horizontal stabilizer ?

What functions have the flaps, spoiler and the trim horizontal stabilizer ?

(10 markah/marks)

- (e) Apa yang dimaksud dengan sistem kawalan penerbangan "reversible" dan sebutkan contohnya

What does the reversible flight control system mean and mention the examples of this control system ?

(10 markah/marks)

- (f) Apa yang dimaksud dengan sistem kawalan penerbangan “irreversible” dan sebutkan contohnya

What does the irreversible flight control system mean and mention the examples of this control system ?

(10 markah/marks)

- (g) Sila sebutkan jenis-jenis sistem penghubung sistem kawalan pada pesawat terbang ?

Please mention the types of flight control linkage system of aircraft ?

(10 markah/marks))

- (h) Apa fungsi-fungsi dari push-pull rod, bell-crank lever dan idler lever yang digunakan pada sistem kawalan “push-pull control rod sistem” ?

What functions have the components the push-pull rod, the bell-crank lever and the idler lever used in the push-pull control rod system ?

(10 markah/ marks)

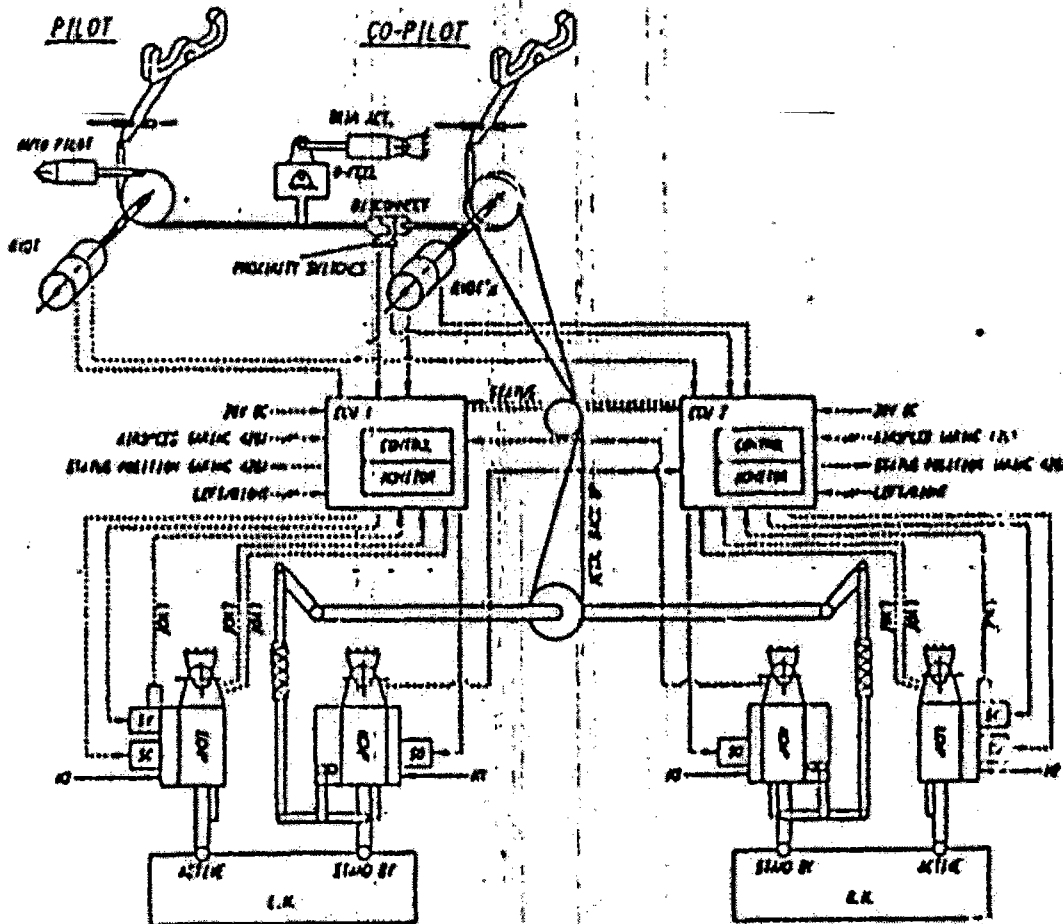
- (i) Sila terangkan cara kerja sebuah servo actuator

Please explain the working mechanism of a servo actuator

(20 markah/marks)

2. Gambarajah 1 Sistem Kawalan 'Fly by Wire' Elevator Pesawat N250 yang digunakan untuk mengawal angguk (pitching) pesawat pada paksi -y dengan menggunakan permukaan kawalan utama elevators.

Figure 1 shows a "fly by wire" flight control system (FbW-FCS) of N250 for pitching by using the main control surfaces elevators.



Gambarajah 1: Sistem Kawalan 'Fly by Wire' Elevator Pesawat N250
Figure 1: FbW-Flight Control System of N250 for pitching

- (a) Berikan penjelasan dengan terperinci tentang makna sistem kawalan fly-by wire (FbW-FCS)

Describe in details the meaning of fly-by- wire control system (FbW-FCS)

(15 Markah/Marks)

- (b) Berikan penjelasan dengan terperinci tentang mekanisma bekerja sistem kawalan angguk yang disebut di atas.

Describe in details the work mechanism of the FbW-flight control system shown in figure 1.

(30 markah/marks)

- (c) Nyatakan elemen-elemen sistem penghubung yang digunakan dalam sistem kawalan ini dan fungsi-fungsinya.

Please name the elements of the control system used in the figure 1 and explain their functions.

(30 markah/marks)

- (d) Berasaskan daya/momen suapan balik dari permukaan kawalan kepada turus "column" kawalan juruterbang, sistem kawalan ini diklasifikasikan sebagai sistem kawalan penerbangan tak boleh balik "irreversibel flight control system". Apakah yang dimaksudkan dengan ayat di atas. Perlukah sistem ini mempunyai sistem rasa atau tidak dan mengapa?

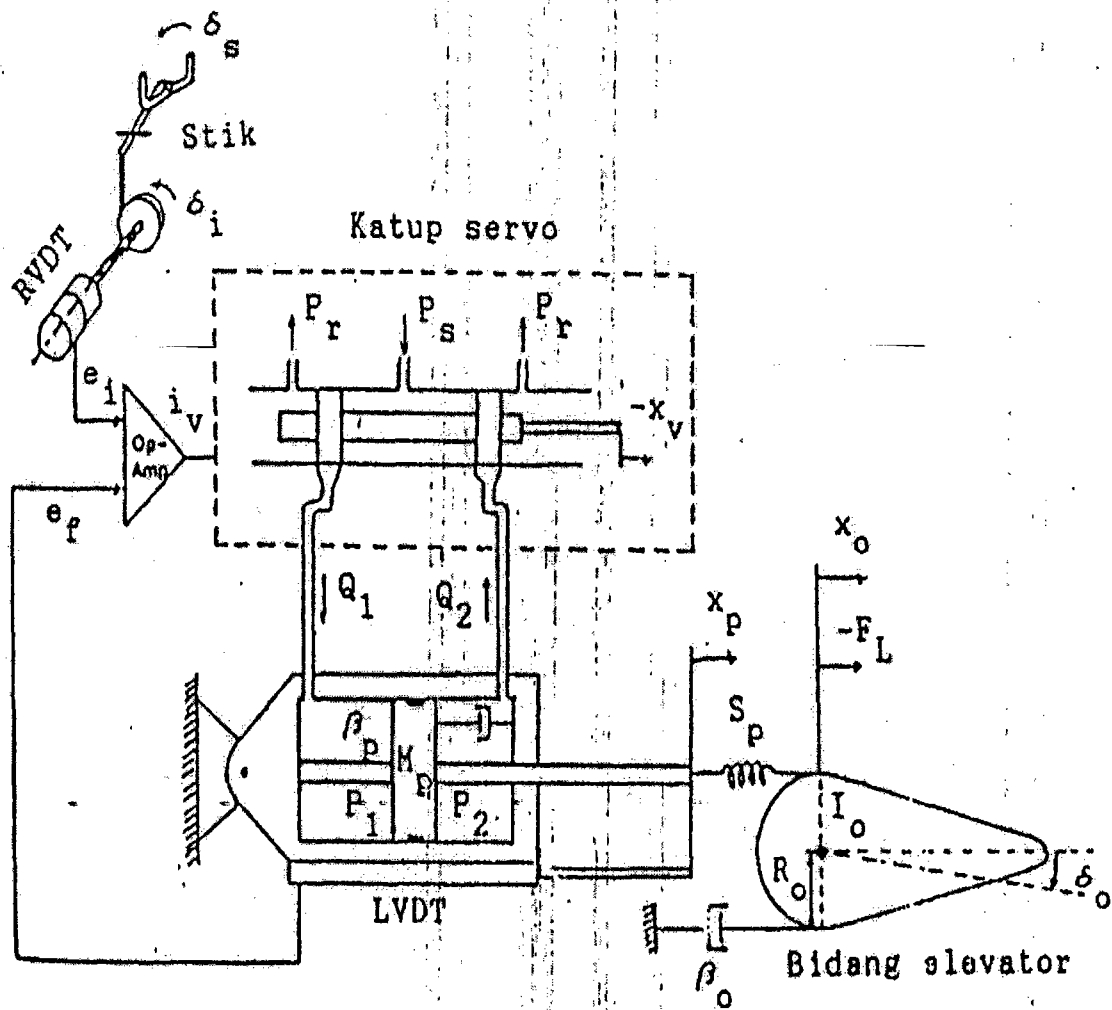
Based on the feedback-force/moment from the control surface elevator to the control column, the FbW-control system in figure 1 is classified as a irreversible control system. What is the meaning of that control system and is it necessary that control system is equipped with a Q-feel system ?

(15 Markah/marks)

- (e) Nyatakan dengan terperinci kelebihan-kelebihan (advantages) sistem kawalan secara "fly by wire" dibandingkan dengan "non -fly by wire"

Describe in the details the advantages of the FbW-control system compared with "non-FbW control system"

(10 Markah/marks)



Gambarajah 2 : Skematik sederhana dari system kawalan FbW untuk N250
 Figure 2 : Simplified Schematic of FbW – Flight Control System for N250.

3. Sila modelkan komponen-komponen dari sistem pada gambarajah 2 secara matematik :

- (a) control column,
- (b) RVDT,
- (c) LVDT,
- (d) OP-Amp

Please model following components of the system shown in Figure mathematically :

- (a) control column,*
- (b) RVDT,*
- (c) LVDT,*
- (d) OP-Amp*

(100 markah/marks)

4. Sila modelkan servo actuator ECHP, damping actuator MCHP dan bidang kawalan elevator pada gambarajah 2 secara matematik :

Please model the servo actuator ECHP, damping actuator MCHP and control surface elevator shown in Figure 2 mathematically :

(100 markah/marks)

**Catatan/Note: ECHP = Electrically Controlled, Hydraulically Powered
MCHP = Manually Controlled, Hydraulically Powered**

5. Sila Gabungkan model-model matematik diatas pada soalan 3 dan 4 untuk mendapatkan model system kawalan keseluruhan tersebut pada gambarajah 1 atau 2 dalam bentuk fungsi alih.

Please combine those mathematical models above at the 3rd and 4th questions to get a whole model for the FbW-flight control system shown in Figure 1 or 2 in form of the transfer functions.

(100 markah/marks)

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