UNIVERSITI SAINS MALAYSIA

First Semester Examination
2010/2011 Academic Session

November 2010

CPT114 - Logic & Applications
[Logik & Aplikasi]

Duration : 3 hours
[Masa : 3 jam]

INSTRUCTIONS TO CANDIDATE:
[ARAHAN KEPADA CALON:]

- Please ensure that this examination paper contains **FOUR** questions and **THREE** Appendices in **TEN** printed pages before you begin the examination.

  *[Sila pastikan bahawa kertas peperiksaan ini mengandungi **EMPAT** soalan dan **TIGA** Lampiran di dalam **SEPULUH** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

- Answer **ALL** questions.

  *[Jawab **SEMUA** soalan.]*

- You may answer the questions either in English or in Bahasa Malaysia.

  [Anda dibenarkan menjawab soalan sama ada dalam bahasa Inggeris atau bahasa Malaysia.]

- You may refer to the Appendix for guidance.

  [*Anda boleh merujuk kepada Lampiran sebagai panduan.]*

- In the event of any discrepancies, the English version shall be used.

  [Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi bahasa Inggeris hendaklah diguna pakai.]

1. (a) Explain the following terms, and give an example for each:

(i) Statement

(ii) Illustration

(iii) Cogent inductive argument

(iv) Unsound deductive argument

(v) Persuasive definition

(vi) Etymological definition

(14/100)

(b) Compare the following statements:

(i) $A \supset B$ $\sim B \supset \sim A$

(ii) $B \supset A$ $B \bullet \sim A$

(6/100)

(c) Convert the following logical forms to statements:

(i) $\sim A$

(ii) $\sim (A \vee B)$

(iii) $\sim (A \bullet B)$

(5/100)

2. (a) (i) Name one method for testing the consistency of arguments.

(2/100)

(ii) Use the method mentioned above to test the consistency of the following arguments:

$A \vee B$
$B \supset C \vee A$
$C \supset \sim B$
$\sim A$

(11/100)

(b) Use the eighteen rules of inference to determine the conclusion of the following symbolized argument:

1. $T \supset G$
2. $S \supset G$ / $(T \vee S) \supset G$

(12/100)

3. (a) Translate the following statements into symbolic form. The predicate letters are given in parentheses:

(i) Some students excel only if they study. (S, E, T)

(ii) Cameras and phones are expensive instruments. (C, P, E, I)

(iii) Some departments will get apex money if and only if some managers are overly generous. (D, A, M, O)

(7/100)

(b) Given the following symbolised arguments:

1. $(x)\ (Dx \supset Sx)$
2. $(x)\ (Dx \supset Fx)$ / $(x)\ [Dx \supset (Sx \bullet Fx)]$

(i) Convert the symbolised arguments into arguments (D = durian, S = sweet, F = fragrant).

(ii) Use the eighteen rules of inference to derive the conclusion. Do not use either conditional or indirect proof.

(10/100)

(c) Translate the following argument into symbolic form. Then use conditional or indirect proof to derive the conclusion.

All businessmen are wealthy. Furthermore, all politicians are clever. Therefore, all politicians and businessmen are clever and wealthy. (B, W, P, C)

(8/100)

4. (a) Translate the following sentences into Prolog clauses:

(i) All students like travelling.

(ii) Alisa is a student.

(5/100)

(b) Define the following predicates into Prolog programs:

(i) min (X, Y, Min)

so that Min is the smaller of two numbers X and Y.

(ii) travel (A, B)

such that travelling from city A to city B is possible if either direct-travelling from city A to city B is possible or direct-travelling from city A to some city C is possible, and travelling from city C to city B is possible.

This program has a list of facts giving the cities between which direct-travelling is possible.

(12/100)

(c) Write a rule `sum` in Prolog program that totals all the numbers up to a particular number.

For example, Prolog returns 10 because 4 + 3 + 2 + 1 = 10.

```
? –  sum (4, Sum).
     Sum = 10
```

(8/100)

1. (a) Terangkan istilah berikut, dan beri contoh bagi setiap satu:

(i) Kenyataan

(ii) Ilustrasi

(iii) Hujah aruhan meyakinkan

(iv) Hujah deduktif tak kukuh

(v) Takrifan persuasif

(vi) Takrifan etimologi

(14/100)

(b) Bandingkan kenyataan-kenyataan berikut:

(i) $A \supset B$ $\sim B \supset \sim A$

(ii) $B \supset A$ $B \bullet \sim A$

(6/100)

(c) Tukar bentuk logik berikut kepada kenyataan:

(i) $\sim A$

(ii) $\sim (A \vee B)$

(iii) $\sim (A \bullet B)$

(5/100)

2. (a) (i) Namakan satu kaedah untuk menguji kekonsistenan hujah.

(2/100)

(ii) Gunakan kaedah yang dinamakan di atas untuk menguji kekonsistenan hujah-hujah berikut:

$A \vee B$
$B \supset C \vee A$
$C \supset \sim B$
$\sim A$

(11/100)

(b) Gunakan lapan belas petua pentadbiran untuk menentukan kesimpulan bagi hujah bersimbol berikut:

1. $T \supset G$
2. $S \supset G$ / $(T \vee S) \supset G$

(12/100)

3. (a) Terjemahkan kenyataan-kenyataan berikut kepada bentuk simbolik. Huruf predikat diberi dalam kurungan:

(i) "Some students excel only if they study". (S, E, T)

(ii) "Cameras and phones are expensive instruments". (C, P, E, I)

(iii) "Some departments will get apex money if and only if some managers are overly generous". (D, A, M, O)

(7/100)

(b) Diberi hujah bersimbol seperti berikut:

1. $(x)\ (Dx \supset Sx)$
2. $(x)\ (Dx \supset Fx)$ / $(x)\ [Dx \supset (Sx \bullet Fx)]$

(i) Terjemahkan hujah bersimbol kepada hujah (D = *durian,* S = *sweet,* F = *fragrant*).

(ii) Guna lapan belas petua pentadbiran untuk mendapat kesimpulannya. Tidak boleh menggunakan bukti bersyarat atau bukti tidak langsung

(10/100)

(c) Terjemahkan hujah berikut kepada bentuk simbolik. Kemudian gunakan bukti bersyarat atau bukti tidak langsung untuk mendapat kesimpulannya.

"All businessmen are wealthy. Furthermore, all politicians are clever. Therefore, all politicians and businessmen are clever and wealthy". (B, W, P, C)

(8/100)

4. (a) Terjemahkan setiap ayat berikut kepada klausa Prolog:

(i) "All students like travelling".

(ii) "Alisa is a student".

(5/100)

(b) Takrif predikat berikut kepada atur cara Prolog:

(i) min (X, Y, Min)

supaya Min adalah lebih kecil antara dua nombor X dan Y.

(ii) travel (A, B)

di mana perjalanan dari bandar A ke bandar B adalah mungkin jika sama ada perjalanan-terus dari bandar A ke bandar B adalah mungkin atau perjalanan-terus dari bandar A ke mana-mana bandar C adalah mungkin, dan perjalanan dari bandar C ke bandar B adalah mungkin.

Atur cara ini mempunyai senarai fakta semua bandar yang antaranya mempunyai perjalanan-terus yang mungkin.

(12/100)

(c) Tulis petua Prolog `sum` yang akan menjumlahkan semua nombor sehingga nombor tertentu.

Sebagai contoh, Prolog mengembalikan 10 kerana 4 + 3 + 2 + 1 = 10.

```
? –  sum (4, Sum).
     Sum = 10
```

(8/100)

Logical Truth Table *(Jadual Kebenaran Logik)*

Conditional *(Bersyarat)*
(material implication)
(implikasi bahan)

p	*q*	$p \supset q$
T	T	T
T	F	F
F	T	T
F	F	T

Biconditional *(Dwisyarat)*
(material equivalence)
(kesetaraan bahan)

p	*q*	$p \equiv q$
T	T	T
T	F	F
F	T	F
F	F	T

Conjunction *(Konjungsi)*

p	*q*	$p \bullet q$
T	T	T
T	F	F
F	T	F
F	F	F

Disjunction *(Disjungsi)*

p	*q*	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

Negation *(Penafian)*

p	$\sim p$
T	F
F	T

EIGHTEEN RULES OF INFERENCE *[LAPAN BELAS PETUA PENTADBIRAN]*

Rules of Implication I (4 rules) *[Peraturan Implikasi I (4 peraturan)]*

MP

$p \supset q$
p
q

MT

$p \supset q$
$\sim q$
$\sim p$

HS

$p \supset q$
$q \supset r$
$p \supset r$

DS

$p \vee q$
$\sim p$
q

Rules of Implication II *[Peraturan Implikasi II]*

CD

$(p \supset q) \bullet (r \supset s)$
$p \vee r$
$q \vee s$

Conj

p
q
$p \bullet q$

Simp

$p \bullet q$
p

Add

p
$p \vee q$

Rules of Replacement I *[Peraturan Penggantian I]*

DM

$\sim(p \bullet q) :: (\sim p \vee \sim q)$
$\sim(p \vee q) :: (\sim p \bullet \sim q)$

Com

$(p \vee q) :: (q \vee p)$
$(p \bullet q) :: (q \bullet p)$

DN

$p :: \sim\sim p$

Assoc

$[p \vee (q \vee r)] :: [(p \vee q) \vee r]$
$[p \bullet (q \bullet r)] :: [(p \bullet q) \bullet r]$

Dist

$[p \bullet (q \vee r)] :: [(p \bullet q) \vee (p \bullet r)]$
$[p \vee (q \bullet r)] :: [(p \vee q) \bullet (p \vee r)]$

Rules of Replacement II *[Peraturan Penggantian II]*

Trans

$(p \supset q) :: (\sim q \supset \sim p)$

Impl

$(p \supset q) :: (\sim p \vee q)$

Taut

$p :: (p \vee p)$
$p :: (p \bullet p)$

Exp

$[(p \bullet q) \supset r] :: [p \supset (q \supset r)]$

Equiv

$(p \equiv q) :: [(p \supset q) \bullet (q \supset p)]$
$(p \equiv q) :: [(p \bullet q) \vee (\sim p \bullet \sim q)]$

Rules for Quantifiers *[Peraturan untuk Pengkuantiti]*

1.	Universal instantiation (UI) *[Spesifikasi Semesta]*	$\dfrac{(x)\,\mathcal{F}x}{\mathcal{F}y}$		$\dfrac{(x)\,\mathcal{F}x}{\mathcal{F}a}$
2.	Universal generalization (UG) *[Pengitlakan Semesta]*	$\dfrac{\mathcal{F}y}{(x)\,\mathcal{F}x}$	not allowed:	$\dfrac{\mathcal{F}a}{(x)\,\mathcal{F}x}$
3.	Existential instantiation (EI) *[Penggantian Wujudan]*	$\dfrac{(\exists x)\,\mathcal{F}x}{\mathcal{F}a}$	not allowed:	$\dfrac{(\exists x)\,\mathcal{F}x}{\mathcal{F}y}$
4.	Existential generalization (EG) *[Pengitlakan Wujudan]*	$\dfrac{\mathcal{F}a}{(\exists x)\,\mathcal{F}x}$		$\dfrac{\mathcal{F}y}{(\exists x)\,\mathcal{F}x}$

Change of Quantifier Rules *[Peraturan Perubahan Pengkuantiti]*

$(x)\ \mathcal{F}x :: \sim (\exists x) \sim \mathcal{F}x$ $\qquad$ $(\exists x)\ \mathcal{F}x :: \sim (x) \sim \mathcal{F}x$

$\sim (x)\ \mathcal{F}x :: (\exists x) \sim \mathcal{F}x$ $\qquad$ $\sim (\exists x)\ \mathcal{F}x :: (x) \sim \mathcal{F}x$