Instructions to Candidates:

Each question is Section A and Section B is worth 4 marks. An incorrect answer in Section A or B loses 20% of the correct mark. Marks for Section C are calculated based on the fraction of correct States identified in sequence. Enter your answers on the 3071 Optical Mark Recognition Answer Sheet provided. You may not start this examination until you are instructed to do so by the Invigilator. Exam Paper is not to be removed from venue.

Materials permitted for this examination:

Non-programmable calculators are permitted for this examination — please indicate the make and model of your calculator on each answer book used. To be accompanied by a 3071 Optical Mark Recognition Answer Sheet.
Section A

Q A.1 How many of the following 6 strings (whitespace and \n indicate a new string and are not part of the test data) are matched at least once, in part or whole, by the Flex regular expression hhh

(A) 4 (B) 2 (C) 3 (D) 5 (E) 6 (F) OTHER (4 marks)

Q A.2 How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data) are matched at least once, in part or whole, by the Flex regular expression q[A-Z]Y

(A) 2 (B) 10 (C) 11 (D) 4 (E) 7 (F) OTHER (4 marks)

Q A.3 How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data) are matched at least once, in part or whole, by the Flex regular expression b[a-zA-Z]F

(A) 6 (B) 5 (C) 7 (D) 2 (E) 3 (F) OTHER (4 marks)

Q A.4 How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data) are matched at least once, in part or whole, by the Flex regular expression dd[a-zA-Z][a-zA-Z]+u

(A) 3 (B) 7 (C) 15 (D) 9 (E) 14 (F) OTHER (4 marks)
Q A.5 How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

jrrrr FjF rFFFF jFFrrr rFFFF rrjjjjFF rjjjrr rjjjj rrrjjF rFF rFjj FrrFFFF FFFFFFr

are matched at least once, in part or whole, by the Flex regular expression

r[a-zA-Z][a-zA-Z]jj

(A) 10 (B) 12 (C) 4 (D) 8 (E) 6 (F) OTHER (4 marks)

Q A.6 How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

hhhhLLL LLoooh LLLLLL hhhLLL oooho LLohh ohhho ooohhhhh LLLLLhhh LLLLhh hhhhhhhh ooLLLhh oLLL hhhhoo LhhL

are matched at least once, in part or whole, by the Flex regular expression

o[a-zA-Z]{1,2}hh

(A) 11 (B) 2 (C) 12 (D) 10 (E) 5 (F) OTHER (4 marks)

Q A.7 How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

AAfA ffhhA hAAhh hhAAhh fAh hhff AAfff hAf hhfA hhh Ahhhh AAhff hffhh hffh AAh

are matched at least once, in part or whole, by the Flex regular expression

(f{2,3}|hhh?)

(A) 9 (B) 11 (C) 4 (D) 12 (E) 3 (F) OTHER (4 marks)

Q A.8 How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

Zzzzz zZZZZ zzzmmmmmmm mmmZZZZ zZZZz zmmz mmmZZZZ mZZ mmmzzmm zmmmm zzzmmmm ZZZmmmmmmm Zmmmm ZZZZZZZZ

are matched at least once, in part or whole, by the Flex regular expression

..zZ.

(A) 8 (B) 0 (C) 4 (D) 5 (E) 9 (F) OTHER (4 marks)
Q A.9 How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)
qvq Qvq vQq vQv Qqv qqq qQQ Qvq vqq qQv qvQ qQq
are matched at least once, in part or whole, by the Flex regular expression
^[a-z]
(A) 15 (B) 11 (C) 14 (D) 12 (E) 6 (F) OTHER (4 marks)

Q A.10 How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)
ookkoo Eok EEkk kEo kkok koooo oooooE kooEE EEkk kkEo kooE ooEEEE koo kkkE EoEE
are matched at least once, in part or whole, by the Flex regular expression
^(k|E|[A-Z]+)
(A) 10 (B) 11 (C) 7 (D) 12 (E) 15 (F) OTHER (4 marks)
Section B

Q B.1 How many of the following 8 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

EEEEEE EE erQ8in1 EEEE EEE sentence EEEEEEE EEEE

are in the language defined by the Bison Context Free Grammar

%token E
%
sentence: E | E sentence
;

(A) 2 (B) 5 (C) 3 (D) 6 (E) 8 (F) OTHER (4 marks)

Q B.2 How many of the following 8 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

7IExavI M MMM MMMMM sentence MMMMMM MMMM MM

are in the language defined by the Bison Context Free Grammar

%token M
%
sentence: M | sentence M
;

(A) 3 (B) 4 (C) 6 (D) 1 (E) 8 (F) OTHER (4 marks)

Q B.3 How many of the following 7 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

sentence hhhhhhhZ hhhhhZZZZ e5iPght hhhhZ hhhhZZZZ hhhhhhhZZ

are in the language defined by the Bison Context Free Grammar

%token h Z
%
sentence: sub | sub sentence
sub: h | Z
;

(A) 5 (B) 1 (C) 3 (D) 4 (E) 7 (F) OTHER (4 marks)
Q B.4 How many of the following 10 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

vvH HH vvHH vvH vvHHH vvH vvH v
are in the language defined by the Bison Context Free Grammar

%token v H

sentence: v | H | v sentence
;

(A) 2 (B) 5 (C) 3 (D) 8 (E) 4 (F) OTHER (4 marks)

Q B.5 How many of the following 10 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

iiiAAA iiiiiA iiiAA iiiA iAA ii iIA iA iiiAAAA AA
are in the language defined by the Bison Context Free Grammar

%token i A

sentence: i | A | sentence i
;

(A) 4 (B) 1 (C) 10 (D) 5 (E) 2 (F) OTHER (4 marks)

Q B.6 How many of the following 10 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

uuDD uuD uuDDDD uuD uuDDD D uDDD uuD uuDDDDD uuuuDD
are in the language defined by the Bison Context Free Grammar

%token u D

sentence: u | D | D sentence
;

(A) 1 (B) 2 (C) 7 (D) 5 (E) 9 (F) OTHER (4 marks)
Q B.7 How many of the following 10 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

cccVVVV VV ccccVV cVVV cVVVV ccc V c cccVVVV cccVVV

are in the language defined by the Bison Context Free Grammar

%token c V

sentence: c | V | sentence V
;

(A) 3 (B) 8 (C) 10 (D) 4 (E) 7 (F) OTHER (4 marks)

Q B.8 How many of the following 7 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

pp;ppp; PPPPP;P PPPPPP PPP;P pp;PP;P;PP P;PP

are in the language defined by the Bison Context Free Grammar

%token P

sentence: list | sentence list
list: listc ";"
listc: P | P listc
;

(A) 2 (B) 4 (C) 7 (D) 6 (E) 1 (F) OTHER (4 marks)

Q B.9 How many of the following 6 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

Q,QQQ,Q Q,Q,QQ,QQQQ QQQ, Q,QQQ,QQQ QQ,Q,QQQ, QQQQ,QQ,

are in the language defined by the Bison Context Free Grammar

%token Q

sentence: listc | listc "," sentence
listc: Q | Q listc
;

(A) 4 (B) 1 (C) 3 (D) 5 (E) 2 (F) OTHER (4 marks)
Q B.10 How many of the following 6 sentences (whitespace and \n indicate a
new sentence and are not part of the test data)

K,KK,K K,KKK; KK,KK,K,K; KKKK,K, KKKKK,K; KKKK,K

are in the language defined by the Bison Context Free Grammar

%token K

%%
sentence: commal ';'
commal: listc | listc ',' commal
listc: K | K listc
;

(A) 5 (B) 3 (C) 4 (D) 2 (E) 1 (F) OTHER (4 marks)
Section C

Q C.1 Given the following tokens
"+" { return PLUS; }
"-" { return MINUS; }
"=" { return ASSIGN; }
[a-z] { yylval = yytext[0]; return ID; }
\n { return EOL; }

and the following Bison Context Free Grammar
0 $accept: S $end
1 S: stmt EOL
2 stmt: ID ASSIGN expr
3 expr: expr PLUS ID
4 | expr MINUS ID
5 | ID

which generates the Bison Shift Reduce Parser

What sequence of states will the Bison Shift Reduce Parser go through parsing the sentence
a:=b+c

(10 marks)
Q C.2 Given the following tokens

```
"^" { return POWER; }
"-_" { return MINUS; }
":=" { return ASSIGN; }
[a-z] { yylval = yytext[0]; return ID; }
\n { return EOL; }
```

and the following Bison Context Free Grammar

```
0 $accept: S $end
1 S: stmt EOL
2 stmt: ID ASSIGN expr
3 expr: unary POWER expr
4     | unary
5 unary: MINUS unary
6     | ID
```

which generates the Bison Shift Reduce Parser

What sequence of states will the Bison Shift Reduce Parser go through parsing the sentence

```
a:=----c
```

(10 marks)