National Institute of Technology Silchar
Mid-Semester (UG) Examination, March 2022

Subject Code: CS 306,
Semester: 6th,
Duration: 1 hr 15 min,

Subject: Principles of Programming Language
Department: Computer Science and Engineering
Total Marks: 30

Figure in the right hand margin indicates full marks for the question.
All questions are compulsory.

1. Choose the correct option for the following:

   (a) Which of the following is not true about orthogonal feature of a language
   (A) easy to learn (B) easy to write
   (C) increases compilation complexity (D) Increases computational complexity.

   (b) A cost effective programming language would be one that has less
   (A) cost of program execution.
   (B) cost of program translation.
   (C) cost of program creation, testing, and use.
   (D) cost of program maintenance.

   (c) Which of the following is not a syntactic element of a language?
   (A) Expressions (B) Symbol-table (C) Free- and fixed-field formats (D) None of the above.

   (d) Ease of translation is related to high
   (A) readability (B) writability (C) regularity (D) orthogonality

   (e) Which of the following is not correct?
   (A) COBOL is a business processing language.
   (B) C language is designed for system programming but not for logic programming.
   (C) FORTRAN is for scientific programming but not for word processing.
   (D) C++ is for object oriented programming but not for business processing.

   (5×1)
   CO1

2. Consider the following subset of operators available in the C language:

Operator	Operator-name	Associativity
+, −, ++, −−, !, (type)	Unary operator	$R \to L$
∗, /, %	Multiplication, Division, Modulus	$L \to R$
+, −	Addition Subtraction	$L \to R$
<, <=, >, >=	Relational operators	$L \to R$
==, ! =	Equality Inequality	$L \to R$
&&	Logical AND	$L \to R$
||	Logical OR	$L \to R$
? :	Conditional operator	$R \to L$
=	Assignment operator	$R \to L$
,	Comma operator	$L \to R$

   Operators in the same row have the same precedence and down the table the precedence decreases. Considering *Assignment* as a syntactic category that acts as the start symbol, write extended BNF grammar rules for expressions containing these operators in both the

   (a) Ambiguous and

   (b) Unambiguous form.

   Consider operands as $\langle Identifiers \rangle$ and/ or $\langle Literals \rangle$ (3+5)
   CO3

3. (a) Using the grammar in 2(b) draw parse tree for the assignment statement:
   $c = c + (a > 0 \ \ \&\& \ \ ++a >= 10)?\ b/a : ++a\ ,\ --b\ ;$
   (b) Give the corresponding Abstract grammar for the extended BNF grammar given in 2(b).
   (c) Draw the abstract syntax tree giving the structure of the node for each operator involved in the Assignment statement given in 3(a).

   $(3+3+3)$
   CO2

4. Consider the following C program:

```
void swap_by_ref ( int *u, int *v)
{
int temp;
temp = *u;
*u = *v;
*v = temp;
return;
}
main ( )
{ int u = 9, v = 6;
swap_by_ref(&u, &v);
}
```

   (a) Write a complete extended BNF grammar that will derive the above program as a valid string of tokens. Start symbol is $\langle Program \rangle$.
   (b) State all the syntactic categories and terminal symbols in your grammar.

   $(5+3)$
   CO4

Course Outcome (CO):

1. Understand and interpret the principles of a programming language and increase their vocabulary of useful programming constructs.
2. Understand and analyze the underlying language design concepts and their impact on language implementation.
3. Use the knowledge of a variety of programming paradigms and assess the effectiveness of each programming paradigm for a particular problem.
4. Learn as well as design new languages with ease.
