Section Points	
A	/ 15
B	/ 30
C	/ 55
Total	/100

EASTERN MEDITERRANEAN UNIVERSITY

Department of Computer Engineering

CMSE 318 -PRINCIPLES OF PROGRAMMING LANGUAGES

Final Examination

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Instructors:

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Name:_____ Surname:_____

Student Number:_____

Duration: 90 Minutes

Instructions

1. Answer all questions in Sections A and B, and any 5 questions in Section C.
2. Do not attempt to communicate with others during the period of the examination.
3. Smart devices MUST NOT be accessible to you during the examination.

SECTION A (Multiple choice) 15 Points

1. Consider the declaration of `int k = 0;` and `i = 4;` Describing the type of variable k is known as_____ declaration?

a. Implicit
b. Explicit
c. Definitive
d. Associated

2. If $h = f \circ g$, where $f(x) = x - 1$, and $g(x) = 2 * x + 4$. Find $h(4)$.

a. 11
b. 12
c. 15
d. 16

3. A functional form that takes a single function as a parameter and yields a list of values obtained by applying the given function to each element of a list of parameters is called?

a. Function Composition
b. Functional Transparency
c. Apply to all
d. Element-wise Evaluation

4. The C++ constructor defined below is a _____ constructor.

```
Stack (int size) {
        stk_ptr = new int [size];
        max_len = size - 1;
        top = -1;
      };
```

a. Default constructor
b. Overloaded constructor
c. Parameterized constructor
d. Reference constructor

5. What is the primary purpose of the Mark-Sweep algorithm?

a. To generalize the concept of operands and operators
b. To ensure operands of an operator are of compatible types
c. To perform stack-sweeping operations
d. To trace all pointers into the heap and free up disconnected pointers

6. Consider the following Java code;

```
int all=0, x=5;
        boolean d = true;
        if (x-->5)
            if (d)
                all+=4;
        else
            all=-1;
        System.out.println("="+all);
```

What is the output of `println`?

a. =0 b. =5

c. =4 d. =-1

7. What is a key difference between accessing elements in arrays and records?

a. Arrays use parentheses for access while records use curly braces

b. Arrays have static subscripts while records have dynamic field names

c. Arrays have dynamic subscripts while records have static field names

d. Arrays use brackets for access while records use subscripts

8. "If the order of evaluation is not important, the program should not specify one". This explains the concept of;

a. Encapsulation b. Guards

c. Decapsulation d. Higher order functions

9. Scalar variables are categorized as the following EXCEPT?

a. Stack abstract b. Stack dynamic

c. Explicit heap dynamic d. Implicit heap dynamic

10. Which of the following parameter passing model is not **Inout** mode?

a. Pass by Reference
b. Pass by Name
c. Pass by Value-Result
d. Pass by Value

SECTION B (Fill the blanks) 30 Points

1. Considering the number of operands, $A\ ?\ B : C$ is an example of _____ operator.

2. The output of the lambda expression `(λ(x) x * x * x)(3)` is _____.

3. The _____ is the encapsulation device in C++ abstract type implementation?

4. _____ are able to obtain access to private members in Abstract Data Types.

5. Consider the following Python subprogram, and its activation/call;

```
def Balance(expense, income):
    Worth=income-expense
    return Worth
A=100
B=49
C=Balance(income=A, expense=B)
```

_____ is the parameter correspondence approach used in the main program.

6. Variables can be characterized as a sextuple of attributes among which are_____ and _____.

7. Counter controlled loops have *initial*, *terminal*, and _____ values in the control statement.

8. A _____ is a dummy variable listed in the subprogram header and used in the subprogram.

9. _____ is the association of attributes with program entities.

10. What is the association of strongly typed languages and type errors in programming codes? _____

11. _____ of a variable is the time during which it is bound to a particular memory cell.

12. The result of an expression may be determined without evaluating all of the operands and/or operators due to _____ evaluation.

13. _____ type of array has rows with varying number of elements.

14. _____ is the use of an operator for more than one purpose.

15. What type of subprogram is **XY** if it could be called with ANY of the following activation: _____

```
XY(5, 6);
XY(5);
XY('E', 'A');
```

Section C (55 Points)

1. Using short, but very clear explanations, answer the following;

a. Differentiate between Strict and Non-Strict Languages.

b. What are coroutines, how are they different from functions?

c. What is functional side effect? How is it avoided in purely functional programming languages?

d. What are generic subprograms? Complete the generic subprogram definition by filling in the blank spaces:

```
template <class _____>
_____ max(_____first, _____second) {
return first > second ? first : second;
}
```

2. Consider the following piece of code,

```
int main(){
int x = 5
void A() {
    int y = 10
    B()}
void B() {
    C()}
void C() {
    print(y)}
A()}
```

If the environment pointer for `main` was at 0, `A` at 1000, `B` at 2000, `C` at 3000 in memory, and the local offset for `x` and `y` is 8bytes each. Compute the **dynamic chain length**, and **effective address** required to obtain `y` in `C`. Assume dynamic scoping.

3. What is the output of the expression **`fun [5, 4, 3, 2, 1] [3, 5]`** given the Haskell program:

```
fun [ ] a = [ ]
fun b [ ] = [1, 0]
fun (x : y)  (q : w)     | x > q = (x-q) :  fun(y w)
                         | otherwise  (x+q) :  fun(w y)
```

4. Zen is an imperative language similar to C. Assume that it is **statically** scoped and parameters are **passed by value**. Show the **content of the system stack** at the point of **print** statement, assuming that the first function called is the main function. Be sure to show and label **all** relevant pointers.

```
void main()
{
int x, y = 5, z = 1;

void g(int x)  {
     int y = 10;

     void f(int x)  {
          int z = 2;
          y++;
          h(z);
          print("f: " x+y+z);
                    }

     y = --z ? ++x : z++;
     f(y);
     print("g: " x+y+z);
               }

void h(int y)  {
     y += 10;
     print("h: " x+y+z); ;
               }
     x = y + 2;
     g(x);
     print("main: " x+y+z);
}
```

5. Ken is a **statically** scoped language similar to C. Find the output of the following program according to the parameter passing mechanism.

```
void main(){
     int x = 6, y = 5, z = 0;
     void g(int x){
          y = x > z ? ++x : ++z;
          h(x);
          print("g: " x+y+z);
     }
     void h(int y){
          y += 10;
          print("h: " x+y+z);
     }
          y = x > z ? ++x : ++z;
          g(x);
          print("main: " x+y+z);
}
```

a. Pass by value mechanism:

b. Pass by reference mechanism:

c. Pass by value-result mechanism:

6. The following code is written in Tau, a language similar to C.

```
void main(){
     int x, y = 5, z = 1;

     void g(int x){
          int y = 10;

          void f(int x){
               int z = 2;
               y++;
               h(z);
               print("f: " x+y+z);
          }

          y = --z ? ++x : z++;
          f(y);
          print("g: " x+y+z);
     }

     void h(int y){
          y += 10;
          print("h: " x+y+z); ;
     }
          x = y + 2;
          g(x);
          print("main: " x+y+z);
}
```

a. Find the output, if the program is statically scoped.

b. Find the output, if the program is dynamically scoped.