M. C. A.

(SEM. II) EXAMINATION, 2006-07

PARADIGMS OF PROGRAMMING

Time : 3 Hours] [Total Marks : 100

Note : Attempt all questions.

1 Answer any four parts : 5x4=20

a. Programming languages can be implemented via compilation or via interpretation. The output produced by a program should be the same regardless of which of these approaches is used. Why then might one prefer compilation over interpretation or vice-versa.

b. For the following statement of a programming language discuss various types of bindings and the time when these bindings are done.
   X := X + 10

c. What are the various phases in the structure of a compiler. Define semantic analysis in brief.

d. Describe the four basic computational models that describe most programming languages.

e. What is extended BNF notation? Illustrate through an example?

f. Discuss the pros and cons of virtual computer approach.

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2. Answer any four parts of the following: 5×4=20

a. Why use structuring concepts such as Cartesian product and power sets to define a language composite types? Explain the relationship between types and sets.

b. Consider the following code fragment

```cpp
void multiply (int m, int n)
{
    m = m * n;
    cout <<m<<","<<n;
}
```

Suppose the function is called with actual parameters i, j when i = 2, j = 3, what is printed when called with

(i) multiply (i, j) (ii) multiply (i, i) by using call by value and call-by-value-result parameter transmission scheme.

c. State the visibility, lifetime initialized value and purpose of local, global and static variables in programming languages.

d. Show the lifetimes of the variables in the following C programme and indicate which are statically vs. dynamically allocated

```cpp
int m;
void s() { 
    float z;
    Z=1.0;
}
void R(int n) {
    if (n>0)
        R(n-1)
    S();
}
int main() {
    m = 3;
    R(1);
    return 1;
}
```

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e. What is an activation record? Describe the role of current instruction pointer (CIP) and current environment pointer (CEP) in the implementation of recursive sub-programs.

f. In many programming languages strings are defined to be arrays of characters. Compare the consequences of this when a string variable is:
   1. a static array
   2. a dynamic array
   3. a flexible array.

3 Attempt any two parts of the following: 10\times2=20
   a. Define the following terms: 10
      i) object
      ii) class
      iii) polymorphism
      iv) inheritance
      v) abstraction
   b. Why virtual functions are required? Illustrate the use through an example in any object oriented language.
   c. Define a polymorphic function “reverse” in M/L that takes a list of objects of some type and reverses the order.

4 Attempt any two parts of the following: 10\times2=20
   a. What are eager, normal-order and lazy evaluation? Consider the following ML functions.
      Fun sgr (n: int) = n * n; and function call Sqr (p + q) with p=2 & q=5 show the binding and evaluation of the function in case of eager, normal – order and lazy evaluation.
b. What are curried functions in functional programming? Write a procedure to merge two sorted lists (with arbitrary lengths) producing a third list.

c. Discuss the advantages and disadvantages of functional programming.

5. Attempt any two parts of the following: \(10 \times 2 = 20\)

a. Given that:
   i) \(\forall x \ [\text{physician} (x) \rightarrow \text{knows surgery} (x)]\)
   ii) \(\text{physician} (\text{Bhaskar})\)
   Prove that \(\text{knows surgery} (\text{Bhaskar})\)

b. What is first order predicate logic? Convert the following formula into clause form.
\[
\forall x \left[ \forall y \ P(x, y) \rightarrow \forall y \left( Q(x, y) \rightarrow R(x, y) \right) \right]
\]

c. What is the unification algorithm? Find the most general unifier (MQU) of \(A(x, f(g(x)))\), \(9\) and \(A(b, y, z)\)