PES UNIVERSITY

PES University, Bengaluru

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UE18CS331

JULY 2021: END SEMESTER ASSESSMENT (ESA) B.TECH. VI SEMESTER

UE18CS331 – GENERIC PROGRAMMING

Instructions: You may bring any written matter. You cannot have any printed matter. You cannot exchange any material during the exam.

Time: 3 Hr | Answer All Questions. Neglect syntax errors | Max Marks: 100

1. a) a) answer pricisely. **[10]**

i) Why are template functions defined in a header file and not in an implementation file? **[2]**

ii) How does the compiler and linker take care of multiply instantiated template functions? **[2]**

iii) What is the overhead of template function invocation at runtime? Why? **[2]**

iv)

```
template<typename T1, typename T2>
T2 foo(T1);
```

This function requires explicit instantiation.

State true or false. Give reasons. **[2]**

v) How does type deduction with the auto keyword work? Is it compile time or runtime mechanism? **[2]**

b) **[6]**

```
void what(int a[], int n)
{
        for(int i = 0; i < n - 1; ++i)
        {
                a[i + 1] += a[i];
        }
}
```

i) What does this function do?

ii) make this generic; do not change the logic

iii) What operations should the component type of the array support? state the required operations only. Stating unnecessary operations will result in loss of marks. **[2 + 2 + 2]**

c) **[4]**

```
template<typename T1, typename T2>
void what(T1 a, T2 b);
```

What will be the generic types deduced in the following calls?

```
what<int>(2.5, 3.5);
what(false, true);
```

Why? **[2 + 2]**

2. a) **[6]**

```
class MyNum
{
        public:
        MyNum(int n) : n_(n) { }
        private:
        int n_;
};
```

i) make this a template class.

	ii) MyNum<int>* x = new MyNum<int>[4]; Why would this code not compile? iii) Support the required operation by providing the required function in the class [2+2+2]	

b)	class MyContainer
	{
	public:
	MyContainer(int n) : n_(n), p_(new int [n_]) { }
	~MyContainer() { delete p_; }
	private:
	int* p_;
	int n_;
	};
	i) Fix the bugs in constructor and destructor. Give reasons.
	ii) Make the class generic.
		6
		[4
		+
		2]

c)	class MyContainer
	{
	
	private:
	int* p_;
	int n_;
	};
	The constructor allocates an array of n_ elements and initializes p_ with the pointer to the allocated array.
	i) write copy constructor
	ii) Write move assignment operator
	for this class.
		4

d)	Write the swap function to swap two objects of MyContainer using resource stealing using move. Assume that MyContainer supports move assignment and move constructor	4

a)	template<typename ptr_t>
	ptr_t find_mid(ptr_t first, ptr_t last)
	{
	// TODO
	}
	Find an iterator to the middle of a sequence defined by a pair of iterators.
	Write the code for the following cases
	i) ptr_t is an input iterator
	ii) ptr_t is a bidirectional iterator - do use the iterator which can move backwards.
		8[
		4
		+
		4]

b)	template<typename ptr1_t, typename ptr2_t, typename fun_t>
	void modify(ptr1_t first1, ptr1_t last1, ptr2_t first2, fun_t fun)
	{
	// TODO
	}
	
	Requirement:
	Walk through the first sequence. apply fun on each element of the first sequence and copy to the second sequence starting from first2.
	i) complete the code
		8
		[4
		+
		2
		+
		2]

		ii) how many arguments can fun take? why? iii) Why the second sequence is identified by a single iterator?	
	c)	Develop a generic predicate functor class to check whether the given value is between a pair of given values. Ex: Bet(10, 20)(15) should be true as 15 is in between 10 and 20.	4
4	a)	i) what does pop_back on vector return? why? ii) Why we cannot implement queue using a vector? iii) What all gets invalidated on change in size of vector? Why? iv) What is the difference between [] and at member functions on vector v) Why set does not provide indexing operator?	10

	b)	find the number of unique elements in a given sequence. You cannot modify the given sequence. You can assume that < is supported on the component type.
		template<typename ptr_t>
		Hint: You may have to find the component type
		int count_uniq(ptr_t first, ptr_t last)
		{
		// ToDo
		}
			5

	c)	struct Term
		{
		int coeff_;
		int expo_;
		};
		List<Term> poly;
		Poly represents a polynomial stored in a list form with each node having coefficient and exponent.
		Given a polynomial, differentiate the polynomial.
		void diff(const List<Term>& src, List<Term>& dst)
		{
		// TODO
		}
			5

5	a)	can we support the following in java? Give reasons.
		i) class A<T> { ... }
		A<int> x = new A<int>;
		ii) class A<T> {
		static int x;
		}
		iii) class A<T> { ... }
		A<Double> a1 = new A<Double>;
		A<Double> a2 = new A<Double>;
		A<Double> a3 = a1 + a2; [6]
			6

5	b)	How are the following supported in C#? i) operator[] ii) read only property give a simple example	4
5	c)	Write template metaprogram to find a to the power m.	4

		Assume m >= 0	
5	d)	This is the definition of unordered map. template < class Key, class T, class Hash = ... , class Pred = ... , class Alloc = ... > class unordered_map; i) what is the significance of the type Hash? ii) Why do we require Pred? iii) What would each element of unordered map contain?	6[2+ 2+ 2]