13/12/2013 (Morning)

[This question paper contains 4 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **7402** **J**

Unique Paper Code : 32341102 OC

Name of the Course : **B.Sc.(Hons.) Computer Science**

Name of the Paper : Computer Systems Architecture

Semester : I

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt **all** questions from **Section-A**.

(c) Attempt any **four** questions from **Section-B**.

(d) Attempt all parts of a question together.

Section - A

1. (a) Draw a diagram showing the basic registers connected to a common bus. 4

(b) State reason, why each of the following micro operations cannot be executed during a single clock pulse. Specify a sequence of microoperations that will perform the operation : 4

(i) IR ← M[PC]

(ii) AC ← AC + TR

P.T.O.

(c) Convert the following numerical arithmetic expression into reverse Polish notation and show the stack operations for evaluating the numerical result : 4

(3+4) [10*(2+6) +8]

(d) Convert the following : 4

(i) $(1938)_{10}$ to $(?)_{16}$

(ii) $(50)_7$ to $(?)_{10}$

(e) Show that a JK flip flop can be converted to a D flip-flop with an inverter between the J and K inputs. 4

(f) Write micro-operations for the following memory reference instructions : 4

(i) BSA: Branch and Save Return Address

(ii) ADD: Add

(g) Convert the following infix expression to Reverse Polish Notation (RPN) : 4

(i)(A*B) +(C/D)–C

(ii) A+B*(C+D) / F+D*E

(h) Perform the following subtraction using the 2's complement (use eight bits for computation) : 4

(i) 100-110000

(ii) 11010-1101

(i) Represent $(-51)_{10}$ in sign magnitude form, sign 1's complement form using 8-bit representation. 3

Section-B

2. (a) Draw the flow chart for an interrupt cycle. 5

(b) A non-pipeline system takes 50 ns to process a task. The same task can be processed in a six-segment pipeline with a clock cycle of 10 ns. Determine the speed-up ratio of the pipeline for 100 tasks. What is the maximum achievable speed-up ? 5

3. (a) An instruction is stored at location 300 with its address field at location 301. The address field has the value 400. A processor register R1 contains the number 200. Evaluate the effective address if the addressing mode of the instruction is : 5

(i) Direct

(ii) Immediate

(iii) Relative

(iv) Register indirect

(v) Index with R1 as the index register

(b) List any **five** characteristics of CISC and RISC Architectures. 5

4. (a) Draw the block diagram of DMA controller and state the purpose of address register and control register in DMA controller. 5

(b) Give the differences between program controlled I/O and interrupt initiated I/O. 5

5. (a) What is the property of *locality of reference* ? How is the term *hit* ratio related to this property ? 5

(b) Show the step-by- step multiplication process using Booth's Algorithm for multiplicand =10111 and multiplier = 10011. 5

6. (a) What is Content Addressable Memory (CAM). Describe the hardware organization of a CAM with the help of a diagram. 5

(b) Draw a diagram showing the addressing relationship between main and cache memory using direct mapping. What is the disadvantage of direct mapping and how it can be minimized ? 5

7. (a) Given the following function F (X, Y, Z) = X' + YZ', 5

(i) Give the truth table of F.

(ii) Simplify F using Sum of Products (SOP) form and draw the corresponding logic diagram.

(iii) Simplify F using Product of Sum (POS) form and draw the corresponding logic diagram.

(b) What are the four major architectures identified by Flynn and describe each of them in one or two sentences. 5

This question paper contains 4 printed pages.

Your Roll No. .....

Sl. No. of Ques. Paper	: 8611	J
Unique Paper Code	: 32341102	
Name of Paper	: **Computer System Architecture**	
Name of Course	: **B.Sc. (Hons.) Computer Science**	
Semester	: **I**	
Duration	: **3 hours**	
Maximum Marks	: **75**	

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. 1 is compulsory.

*Attempt any **four** of Question Nos. 2 to 7.*

Parts of a question should be answered together.

1. (a) Give characteristic table and excitation table of SR flip-flop. What is the limitation of SR flipflop? 2+2+1

   (b) Given the Boolean expression F = x'y + xyz'. Derive an algebraic expression for the complement F'. 2

   (c) Convert the following numbers with the indicated bases to decimal:

   $(12121)_3, (4310)_5, (198)_{12}$ 3×2=6

   (d) What are the two instructions needed in the basic computer in order to set the E flip-flop to 1? 2

   (e) Draw the block diagram of a 4-to-1 line multiplexer and explain its operation by means of a function table. 4

P.T.O.

(f) What is SIMD class of parallel computers? Where do they find usage? 2

(g) What mechanism can be used to detect overflow condition while performing arithmetic computations on binary numbers? Give one example. 1+2

(h) In general register organization of a computer, specify the 14-bit binary control word format consisting of the fields SELA, SELB, SELD of 3 bits each, for selecting registers and OPR. Using this control word implement following micro-operation :

$$R1 \leftarrow (R1 - R2)$$

where binary code of OPR is 00011.code for selecting the register that corresponds to the register numbers. 3

(i) Draw a space-time diagram for a six-segment pipeline showing the time it takes to process eight tasks. 4

(j) Describe the sequence of micro-operations and give a flow chart showing register transfer statements for Fetch and Decode phases of instruction cycle of a typical CPU. 4

2. (a) Simplify the Boolean function F together with the don't-care conditions *d* in sum of products form :

$$F(w, x, y, z) = \sum(0, 1, 2, 3, 7, 8, 10)$$

$$d(w, x, y, z) = \sum(5, 6, 11, 15)$$ 6

(b) What is the register addressing mode? What is register indirect mode? What is the benefit of using register indirect mode? 2

(c) What is the base register addressing mode? What is its significance? 2

3. (a) A two word instruction is stored at locations 300 and 301. The instruction has a mode bit and opcode "load to AC" with its address field at location 301. The address field has the value 400. A processor register R1 contains the number 600. The index register XR contains the number 100. Evaluate the effective address if the addressing mode of the instruction is :

(i) Direct

(ii) Immediate

(iii) Relative

(iv) Register indirect

(v) Indexed addressing mode with XR as the index register. 5

(b) Write micro-operations for following instructions :

(i) ADD

(ii) ISZ

(iii) CLA 2+2+1=5

4. (a) The following memory units are specified by the number of words times the number of bits per word. How many address lines and input-output data lines are needed in each case?

(i) 61k × 8

(ii) 16M × 32 2+2=4

(b) Give the truth table of a 3-to-8 line decoder. Draw the logic diagram of the same. 6

5. (a) Convert the hexadecimal F3A7C2 to binary and octal. 2

(b) Perform the arithmetic operations (+42)+(−13) and (−42)−(−13) in binary using signed-2's complement representation for negative numbers. 2+2=4

(c) A non-pipeline system takes 50 ns to process a task. The same task can be processed in a six-segment pipeline with a clock cycle of 10 ns. Determine the speedup ratio of the pipeline for 100 tasks. What is the maximum speedup that can be achieved? 2+2=4

6. (a) A computer uses a memory unit with 256K words of 32 bits each. A binary instruction code is stored in one word of memory. The instruction has four parts: an indirect bit, an operation code, a register code part to specify one of 64 registers, and an address part.

(i) How many bits are there in the operation code, the register code part and the address part?

(ii) Draw the instruction word format and indicate the number of bits in each part.

(iii) How many bits are there in the data and address inputs of the memory? 6

(b) Write a program to evaluate following arithmetic expression:

$$X = (C - D)*(E - F)$$ 4

using a general register organization computer with two address instructions. 4

7. (a) What is Isolated I/O? Mention its two advantages and two disadvantages. 1+2+2

(b) Explain Direct Memory Access (DMA) technique with the help of block diagram. 5

[This question paper contains 16 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 8591 J

Unique Paper Code : 32341101

Name of the Paper : Programming Fundamentals using C++

Name of the Course : **B.Sc. (H) Computer Science**

Semester : I

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question **1** is compulsory in **Section A**.
3. Attempt any **four** questions from **Section B**.
4. Parts of a question should be attempted together.

SECTION A

1. (a) Consider the following declaration statements :

```
float  f;
int  *b  =  &f;
```

P.T.O.

Identify the error and write the code to correct it. (2)

(b) Assuming that the required header files have been included where required, what will be the output produced on execution of the following code segments :

(i)
```
double  z1;
double  y  =  56.7;
int  x  =  34;
if(x)
{
    z1  =  y++;
    cout<<z1<<"\n"<<y;
}
else
{
    z1  =  y+x/2;
    cout<<z1<<y;
}
```
(2)

(ii)
```
int  x  =  4,  y  =  3;
for(int  i  =  1;i<=x;  i++)
{
   for(int  j  =  y;  j>=1;j–)
     cout<<(i*j);
   cout<<"\n";
}
```
(4)

(iii)
```
int  v;
int  k  =  10;
v  =  (150%k  ?  k+5:  ++k);
cout<<"v="  <<v  <<"k="  <<k;
```
(2)

(iv)
```
int  i;
int  b[]={101,120,130,-340,-112,
-114};
for  (i  =  0;  b[i]>0;  i++)
;
cout  <<i;
```
(2)

(v)
```
int  i  =  890;
double  x  =  4.678;
cout<<setw(5)<<i<<"\n";
cout<<fixed;
cout<<setprecision(6);
cout<<"x="<<x<<"\n";
cout<<oct<<"Octal="<<i;
```
(4)

(vi)
```
string  s("The  basic  program
of  C  plus  plus");
int  j;
int  k=0;
int  count=0;
j  =  s.find('u',k);
```

```
while(j!=-1)
{
   count++;
   j  =  s.find('u',j+1);
}

cout<<count;
```

(4)

(vii)
```
class  Base
{
  public:
  Base()
  {
     cout<<"Inside  Base\n";
  }
};
class  Derived1:  public  Base
{
  public:
  Derived1()
  {
     cout<<"Inside  Derived1\n";
  }
};
```



```
class Derived2 : public Derived1
{
  public:
  Derived2()
  {
     cout<<"Inside Derived 2\n";
  }
};
void  main()
{
     Base  o1;
     Derived1  o2;
     Derived2  o3;
}
```

(3)

(c) Assuming that the required header files have been included where required, Find out the error in the following code fragments

(i)
```
void  f(int  *p)
{
   int  a;
   *p  =  a;
   *a  =  *a+1;
   return  a;
}
```

(3)

(ii)
```
void try(int a,int b)
{
  if(a<0) throws "Negative
  number";
}
```
(1)

(d) Write a function to remove duplicate element from one dimensional integer array A of size n. (5)

(e) Rewrite the following while statement as an equivalent for statement :

```
int x = 0;
while(x<10)
{
  cout<<x<<endl;
  x++;
}
```
(3)

SECTION B

2. (a) Write a program to count the number of vowels in a string entered as command line argument. (3)

(b) Consider four integer variables that has been initialized as : y = 5, z = 0 and t = -4. What is the value of each of the following expressions on evaluation (consider each part independent of other)?

(i) `t || z <(y+5) && y`

(ii) `3*y/4%5&&y`

(iii) `!(4+5*y>=z-4)&&(z-2)` (3)

(c) Write a C++ function that takes an array of characters to convert all lowercase characters to uppercase (without using *built-in* functions) and return type is void. (4)

3. (a) What will be the output produced on execution of the following code segment :

```
#include<iostream>
using namespace std;
void main()
{
  int i;
  int j = 11;
  int m = 6;
for(int i = 1;i<=m; i++)
```

```
    {
      for(int  t=1; t<=j;  t++)
        cout<<t;
      j  =  j-2;
      cout<<"\n";
    }
}
```

(5)

(b) Write a function `UpperTriangular()` that accept a matrix A of order n*n as an input argument as well as its order. The function should convert matrix A to uppertriangular matrix by assigning 0 to all elements below principal diagonal(diagonal left to right from top). (5)

4. (a) Consider the following class :

```
class  Rationalnumber
{
    int  p,q;
    ...
};
```

The above class is designed to define a rational number with numerator p and denominator q. For the above class write the definitions of the following member functions :

(i) Parameterized constructor

(ii) Overload + operator to add two rational numbers

(iii) Display function

Write the suitable statements to create three rational numbers r1, r2 & r3 having 5/7, 6/7 and 8/7. Use operator overloading to store the sum of two objects in third object r3. Use the display function to print the content of object r1, r2 and r3. (6)

(b) Write a program that reads a file and print the number of lines in it. (4)

5. (a) What will be the output produced on execution of the following code segment :

```
#include<iostream>
using  namespace  std;
void  main()
{
  int  arr[]={12,34,56,89};
  int  temp;
  int  size  =  4;
  for(int i=0,j=size-1;i<j; i++,j--)
    {
```

```
        temp = arr[i];
        arr[i] = arr[j];
        arr[j] = temp;
      }
    for(int i = 0;i<size;i++)
      cout<<arr[i]<<"\n";
}
```

(4)

(b) Consider a following class :

```
class X
{
   int i1;
 public:
 X()
 {
   i1 = 15;
 }
 virtual void display()
 {
   cout<<"i1="<<i1<<endl;
 }
 };
class Y :public X
{
 int j1;
```



```
 public:
 Y()
 {
   j1 = 10;
 }
 ...
};
class Z:public Y
{
 int k1;
 public:
 Z()
 {
   k1 = 20;
 }
 ...
};
```

Replace ellipses ... by appropriate C++ code to override method `display()` in class `Y` and `Z`. Use Runtime polymorphism to display the content of objects of class `X`, `Y` and `Z`. (6)

6. (a) Consider the following declarations:

```
string s1 = "Hello World";
string s2 = "Program in C++";
```

Write code fragments for the following :

(i) To compare the first four characters of s1 with the last two characters of s2

(ii) To extract the last six characters of s2 (5)

(b) Write the output on execution of the following code :

```
#include<iostream>
using namespace std;
 class myexception
   {
     string str;
     public:
     myexception(string p)
     {
       str=p;
     }
     void display()
     {
       cout<<str;
     }
```



```
   };
 void main()
 {
    int n,m;
  try
  {
    n = 5;
    m = -6;
    if (n<0)
      throw myexception("Negative
      number");
    cout<<n<<endl;
    if (m<0)
      throw myexception("Negative
      number");
    cout<<m;
  }
 catch(myexception o1)
 {
    o1.display();
 }
}
```

(5)

7. (a) Identify an error in the following code and give reasons for the same :

(i)
```
#include <iostream>
using namespace std;
class US1
{
  int p;
  protected:
  int q;
  public :
  int r;
};
class US2: public US1
{
  protected:
  float s,u;
};
void main()
{
  US1 o1;
  US2 o2;
  cout<<o1.p;
```



```
  cout<<o1.q;
  cout<<o1.r;
  cout<<o2.p;
  cout<<o2.q;
  cout<<o2.r;
  cout<<o2.s;
  cout<<o2.u;
}
```
(3)

(ii)
```
do
  {
    int ctr=0;
    cout<<ctr;
    ctr++;
  }while(ctr!=10);
```
(2)

(iii)
```
void f( int n )
  {
    if (n==0) return 1;
  }
```
(1)

(b) Write C++ declarations for the following : (2+2)

(i) A function that accepts an array of integers, a character variable and returning a pointer to an integer.

(ii) print integer x with field width as 10 and fill character as '*'.

[This question paper contains 7 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **7405** **J**

Unique Paper Code : 32341303

Name of the Course : **B.Sc.(Hons.) Computer Science**

Name of the Paper : Computer Networks

Semester : III

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) **Section-A** is compulsory and carries **35** marks.

(c) Attempt any **four** questions from **Section-B**.

Section-A

1. (a) A bit stream of **10111011** is to be transmitted using the standard CRC method having x^3+1 as the generator polynomial. Show the actual bits transmitted. Suppose the 4th bit from the left gets inverted due to an error, check whether the error can be caught. 4

P.T.O.

(b) Ethernet requires that valid frames must be at least 64 bytes long. Give reasons for choosing the minimum frame size as 64 bytes. 2

(c) Convert the IP address whose hexadecimal representation is **C22F1582** to dotted decimal representation. 1

(d) Explain briefly the following fields of the IP header : 4

(i) Internet Header Length (IHL)

(ii) Identification,

(iii) DF & MF, and

(iv) TTL

(e) Briefly discuss the following CSMA protocols : 6

(i) 1-persistence

(ii) p-persistence and

(iii) non-persistence

(f) Match the following to one or more layers of the TCP/IP model : 5

(i) Transmission of bit stream across physical medium

(ii) Defines frames

(iii) Reliable process-to-process message delivery

(iv) Route Selection

(v) Provides user services such as email and file transfer

(g) What is the baud rate of classic 10-Mbps Ethernet ? 2

(h) Five channels, each with a 100-kHz bandwidth, are to be multiplexed together. What is the minimum bandwidth of the link, if there is a need for a guard band of 10-kHz between the channels to prevent interference ? 3

(i) What does the following address mean and when are they used ? 3

(i) 0.0.0.0

(ii) 127.xx.yy.zz

(iii) 156.76.255.255

(b) Ethernet requires that valid frames must be at least 64 bytes long. Give reasons for choosing the minimum frame size as 64 bytes. 2

(c) Convert the IP address whose hexadecimal representation is **C22F1582** to dotted decimal representation. 1

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(iii) Reliable process-to-process message delivery

(iv) Route Selection

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(g) What is the baud rate of classic 10-Mbps Ethernet ? 2

(h) Five channels, each with a 100-kHz bandwidth, are to be multiplexed together. What is the minimum bandwidth of the link, if there is a need for a guard band of 10-kHz between the channels to prevent interference ? 3

(i) What does the following address mean and when are they used ? 3

(i) 0.0.0.0

(ii) 127.xx.yy.zz

(iii) 156.76.255.255

(j) Explain simplex, half-duplex, and full-duplex modes of communication. 3

(k) State the Nyquist sampling theorem for analog-to-digital conversion. 2

Section-B

2. (a) A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers ? 3

(b) Explain the concept of byte stuffing used for framing. 2

(c) Define bandwidth of a signal. A periodic signal has a bandwidth of 20 Hz. The highest frequency is 60 Hz. What is the lowest frequency ? 2

(d) What is the Nyquist sampling rate for each of the following signals ? 3

(i) A low-pass signal with bandwidth of 200 KHz ?

(ii) A band-pass signal with bandwidth of 200 KHz if the lowest frequency is 100 KHz ?

3. (a) Which characteristics of an analog signal are changed to represent the digital signal in each of the following digital-to-analog modulation ? 4

(i) ASK (ii) FSK

(iii) PSK (iv) QAM

(b) Why has the PCM sampling time been set at 125 μsec ? 2

(c) On which layer of the TCP/IP model does the following devices operate. Briefly state their functionality : 4

(i) Repeater

(ii) Router

(iii) Bridges

(iv) Switches

4. (a) Television channels are 6 MHz wide. How many bits/sec can be sent if four-level digital signals are used ? Assume a noiseless channel. 3

   (b) Explain briefly the terms : FDM, WDM, and TDM. 3

   (c) What is the significance of the twisting in twisted-pair cable ? 2

   (d) What is the purpose of cladding in an optical fiber ? 2

5. (a) Explain the binary exponential back-off algorithm used in CSMA/CD protocols. 3

   (b) There are five classes in IPv4 addressing. Give the identifiers for each of the classes. 3

   (c) Explain the TCP header fields : URG, PSH, SYN, and FIN. 4

6. (a) What is HTTP ? Explain briefly two of its message types. 4

   (b) What is an URL ? Give an example to explain its parts. 3

   (c) Briefly explain any **three** ICMP message types. 3

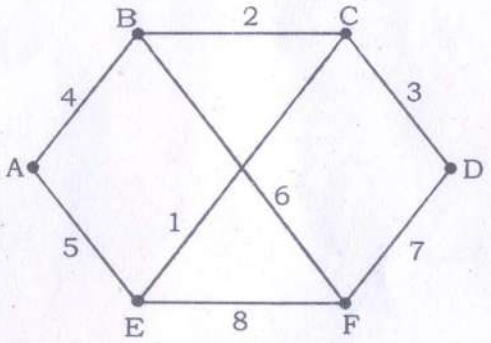
7. (a) Consider the following subnet where distance vector routing is used. The following information have just arrived at the router C : 4

   (i) From B : (5,0,8,12,6,2)

   (ii) From D : (16,12,6,0,9,10) and,

   (iii) From E : (7,6,3,9,0,4)

   The measured delays to B, D, and E, are 6, 3, and 5 respectively. Give the new routing table for C specifying both the delay and the outgoing line to use.



   (b) Compare ARP and RARP. 3

   (c) What is MIME ? What problems does it solve ? 3

[This question paper contains 7 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **7403** **J**

Unique Paper Code : 32341301

Name of the Course : **B.Sc.(Hons.) Computer Science**

Name of the Paper : Data Structures

Semester : III

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Question No. **1** is compulsory.

(c) Attempt any **four** questions out of the remaining Question No. **2** to **7**.

(d) Parts of a question must be answered together.

1. (a) Convert the following infix expression to postfix form using a stack : 5

(A – B / C) * (D * E – F)

Show the contents of the stack at every step.

P.T.O.

(g) Give the recursive version of the following function : 4+1=5

```
void cubes (int n)
{ for (int i =1; i<= n; i++)
        cout << i*i*I << ' ';
}
```

How will this recursive function be initially invoked for n = 5 ?

2. (a) Give template class definition for an ordered singly linked list of integers. Write a member function to insert a node in this linked list such that the list remains in order. 2+4=6

(b) Calculate the address of the element X[3][4] of the 2D array defined as int X[7][10], if the elements are stored in : 2+2=4

(i) row major order

(ii) column major order

The beginning address of the array is 100. Every element requires 4 bytes of storage.

3. (a) Write an algorithm that determines whether a given binary tree is complete. 5

(b) A binary tree has 10 nodes. The preorder and inorder traversals of the tree are shown below. Construct the tree. 5

I. Preorder : JCBADEFIGH

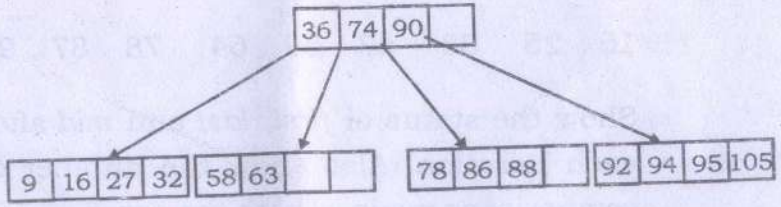
II. Inorder : ABCEDFJGIH

Also give the Postorder Traversal of the constructed tree.

4. (a) Insert the given keys one by one in the following B tree of order 5 : 5

55, 80, 40, 42, 99

Show the status of the tree after each insertion.



5

(b) Consider the following array of integers : 1+4=5

12, 14, 9, 18, 120, 30, 40, 35, 60

Which sorting algorithm will be best suited to sort this array ? Use this algorithm to sort it and show the contents of the array after every step.

5. (a) Given a queue of integers, write an algorithm that deletes all negative integers without changing the order of the remaining elements of the queue. 6

(b) Give an algorithm to display the minimum value in a Binary Search Tree. 4

6. (a) Apply binary search algorithm to search for 25 and 91, in the following array of integers : 3+3=6

16 25 33 43 59 64 78 87 99

Show the status of *first*, *last* and *mid* after each iteration. Also show the number of comparisons made in both the cases.

(b) A Tridiagonal matrix T of dimension n × n that has all non-zero entries on the three central diagonals is mapped to a one-dimensional array D by diagonals, starting with the lowest diagonal. Obtain the formula for the location of an element T(i, j) in D. 4

7. (a) Given a doubly linked list, write an algorithm to swap the kth node from the beginning of this list with the kth node from the end of the same list. The nodes have to be swapped and not their contents. 6

(b) Write a recursive function to find the sum of the elements of an array. 4

[This question paper contains 12 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **7404** **J**

Unique Paper Code : 32341302

Name of the Course : **B.Sc.(Hons.) Computer Science**

Name of the Paper : Operating Systems

Semester : III

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Question No. **1** of **35** marks is compulsory.

(c) Attempt any **four** questions from Question No. **2** to Question No. **7**.

1. (a) Fill in the blanks : 6

(i) ..... is a necessary condition for a deadlock according to which at least one resource is held in a non-sharable mode.

P.T.O.

(ii) Loading the pages of a process into memory only when they are needed is termed as ..... .

(iii) Updating the caches of all processors to reflect any modification of data in one cache is termed as ..... .

(iv) The time needed for the required sector to rotate to the disk head during a disk access is termed as ..... .

(v) ..... is the location within the directory structure where a file system is to be attached (in Unix system).

(vi) ..... provide an interface to the services made available by an operating system.

(b) Differentiate between : 2×4=8

(i) zombie and orphan process

(ii) mutex and binary semaphore

(iii) system and application program

(iv) symmetric and asymmetric multiprocessing

(c) What will be the output of the following code ? Explain your answer. 3

```
int main()
{
  int x = 1, p;
  p = fork();
  if(p == 0)
    x = 10;
  else
  {
    wait(NULL);
    printf("%d\n",x);
  }
}
```

(d) Given the logical address 0xAEF9 (in hexadecimal) with a page size of 256 bytes, determine (i) the page number (ii) page offset. 3

(e) What is file-open count ? Where is it stored ? When does its value become zero ? 3

(f) What will be the output of the following code ? 3

```
int main()
{
  pid_t pid;
  execlp("/bin/ls","ls", NULL);
  pid = fork();
  if(pid<0)
  {
    printf("fork failed");
    return 1;
  }
  else if(pid==0)
    execlp("/bin/ls","ls",NULL);
  else
  {
    wait(NULL);
    printf("child finished");
  }
  return 0;
}
```


(g) Distinguish between the following : turnaround time, waiting time, response time. 3

(h) How many disk accesses are required to access the i^{th} block of a file in case the file system uses : 3

(i) contiguous allocation scheme

(ii) linked allocation scheme

(i) What is thrashing ? How is it related to degree of multiprogramming ? 3

2. (a) What are traps ? Mention any **two** situations in which a user program would generate a trap. 3

(b) What will be the output of the following code fragment ? Justify your answer. 3

```
int a,b;
void *func();
int main()
{
  pthread_t tid;
  a=10;
  b=20;
```

```
    pthread_create(&tid,NULL,func,NULL);
    pthread_join(tid,NULL);
    printf("a = %d, b = %d \n",a,b);
}
void *func()
{ int b;
  a = 50;
  b = 100;
}
```

(c) (i) What is the purpose of inode in Unix operating system ? 2

(ii) Given memory partitions of 100 KB, 500 KB, 200 KB, 300 KB and 600 KB (in order), how would the best-fit algorithm place processes of 212 KB, 417 KB, 112 KB and 426 KB (in that order) ? 2

3. (a) A counting semaphore was initialized to 10. At a later point in time, the semaphore has value 6. At yet another point in time, it has value –3. What is the meaning of the three values ? 3

(b) List an advantage and a disadvantage of integrating the user interface into the operating system. 3

(c) In a demand-paged memory, the page table is held in registers. It takes 8 milliseconds to service a page fault if an empty page is available or the replaced page is not modified, and 20 milliseconds if the replaced page is modified. Memory access time is 100 nanoseconds. Assume that the page to be replaced is modified 70 percent of the time. What is the maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds ? 4

4. (a) What are the three classes of users of a file in Unix system ? 3

(b) Describe one drawback of priority based scheduling schemes. How can it be handled ? 3

(c) Consider the following lines of code from two processes P1 and P2 sharing the variable z. Explain how can the following code lead to a race condition ? 4

P1:	P2:
z += x;	z += y;

5. (a) Consider the following segment of code. Given that the goal is to print the value of variable g updated by the function func(), find and explain the flaw in the code and fix it. 3

```
int g;
void *func();
int main()
{
    pthread_t tid;
    pthread_create(&tid,NULL,func,NULL);
    printf("g = %d",g);
```



```
}
void *func()
{
g = 10;
}
```

(b) Mention **two** advantages and **one** disadvantage of the microkernel approach to system design. 3

(c) Consider the following set of processes with the length of CPU burst given in milliseconds : 4

Process	Burst time
P1	4
P2	2
P3	7
P4	5

The processes are assumed to have arrived in the order P1, P2, P3, P4, all at time zero.

(i) Draw a Gantt chart illustrating the execution of proceses using Round Robin scheduling algorithm. (Time quantum = 3)

(ii) What is the turnaround time of each process ?

(iii) What is the waiting time of each process ?

6. (a) Briefly describe the roles of short term, medium term and long term schedulers. 3

(b) Give an example demonstrating that presence of a cycle in a resource-allocation graph does not necessarily lead to a deadlock. 3

(c) (i) Assume the value of base and limit registers are 500 and 350 respectively. Is the access to following addresses legal – 355, 500 ? 2

(ii) Assuming linked allocation and block size of 4KB, calculate the number of disk accesses required for direct access to byte 20680. 2

7. (a) Consider a disk queue holding requests to the following cylinders in the listed order : 116, 22, 3, 11, 75, 185, 100, 87. Using the C-SCAN scheduling algorithm, what is the order in which the requests are serviced ? Assume that the disk head is at cylinder 88 and moving upwards through the cylinders. 3

(b) Assuming a page size of 8KB, and a 28 bit logical address, determine : 3

(i) number of bits used to represent the page offset ?

(ii) number of entries in the page table ?

(c) (i) Determine the logical address given that the relocation register is set to 100 and a physical address 250 is generated. 2

(ii) Consider a linked allocation file system that has both logical and physical block sizes of 1-KB. If the head is currently at logical block four and the next logical block to be accessed is nine, how many physical blocks must be read from the disk ? Justify your answer. 2

[This question paper contains 6 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **8017** **J**

Unique Paper Code : 32347501

Name of the Course : **B.Sc.(Hons.) Computer Science : DSE - 2**

Name of the Paper : System Programming

Semester : V

Time : 3 Hours ***Maximum Marks : 75***

Instructions for candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) The paper is divided in **two Sections**. **Section-A** is compulsory (**35** marks).

(b) Attempt any **four** questions from **Section-B** (**10** marks each).

Section - A

1. (a) For a syntax directed definition, define (i) synthesized attributes, and (ii) inherited attributes. 2+2=4

P.T.O.

(b) What is Machine Opcode Table (MOT) ? State its structure. 3

(c) Write four string for each of the following regular expressions : 2

(i) $a(a|b)^*a$

(ii) $((\varepsilon|a)b^*)^*$

(d) List four actions of a shift reduce parser. 2

(e) Explain how a code generator performs register allocation. 3

(f) What are the primary functions of two passes of a linker ? 3

(g) Write a Lex program to count the number of lines and characters in input file. 4

(h) Briefly explain three types of loaders. 3

(i) With the help of examples, briefly explain alphabet, string and language. 3

(j) List four components of an assembly language program. 2

(k) Draw the syntax tree for the following expression : 2

a = b* – c + b * – c

(l) What is an activation record ? 2

(m) Give the structure of a Yacc program. 2

Section-B

2. (a) When is a CFG ambiguous ? Given the following grammar, parse the string "abab" and check if the grammar is ambiguous or not : 5

$S \rightarrow a$

$S \rightarrow aAb$

$S \rightarrow abSb$

$A \rightarrow aAAb$

$A \rightarrow bS$

(b) Generate three address code instruction for the following code snippet : 5

```
if (a < b + c)
        a = a – c;
    c = b * c;
```

3. (a) Create two level activation tree for the following program : 4

```
main( ) {
        int n;
        readarray();
        quicksort(1,n);
    }
quicksort(int m, int n) {
            int i= partition(m,n);
            quicksort(m,i-1);
        quicksort(i+1,n);
    }
```

(b) Consider the following augmented grammar : 6

$S \rightarrow AA$

$A \rightarrow aA$

$A \rightarrow b$

Create the LR(0) parsing table for above grammar.

4. (a) Draw the transition diagram to recognise a relational operator during lexical analysis. 5

Relop → <|>|<=|>=|=|<>

(b) Explain narrowing and widening type conversion with the help of examples. 5

5. (a) What is forward reference ? Explain why the problem of forward reference occurs in a single-pass assembler. How is it resolved ? 5

(b) Given the following three-address instruction, write the machine code for hypothetical machine : 5

p = r – s

6. For the following grammar, compute (i) FOLLOW(S), (ii) Canonical set of LR(0) items : 5+5 =10

$S \rightarrow abS$

$S \rightarrow acS$

$S \rightarrow c$

7. (a) Describe the structure of a symbol table of an assembler. What are the data structures that are used to create a symbol table ? 5

(b) Write the SDD for the following grammar : 5

$S \rightarrow E$
$E \rightarrow E_1 + T$
$E \rightarrow T$
$T \rightarrow T_1 * F$
$T \rightarrow F$
$F \rightarrow$ digit

1-1-16

3' - -

[This question paper contains 7 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **7407** **J**

Unique Paper Code : 32341502

Name of the Course : **B.Sc.(Hons.) Computer Science**

Name of the Paper : Theory of Computation

Semester : V

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) **All** questions in **Section-A** are compulsory.

(c) Attempt any **four** questions from **Section-B.**

(d) Parts of a question must be answered together.

(e) Assume alphabet $\Sigma = \{a,b\}$ unless stated otherwise.

P.T.O.

Section - A

1. (a) Do the following regular expressions represent the same language (give reason) : 2

$R_1 = ((a + b)(a + b))^* a$

$R_2 = (a + b)((a + b)(a + b))^* a$

(b) Write a regular expression and build a deterministic finite automata for the language containing all strings having **a** at every odd position. 2+3

(c) Describe in English the languages represented by the following regular expressions : 2+2

(i) $b^*ab^*ab^*ab^* + b^*ab^*ab^*$

(ii) $(a + b)^*aa(a + b)^*$

(d) Describe pumping lemma for regular languages. 2

(e) Based on the language S = {aa, ba, ab, bb}, describe the language S*. 2

(f) What are the languages generated by the following grammars : 3+3

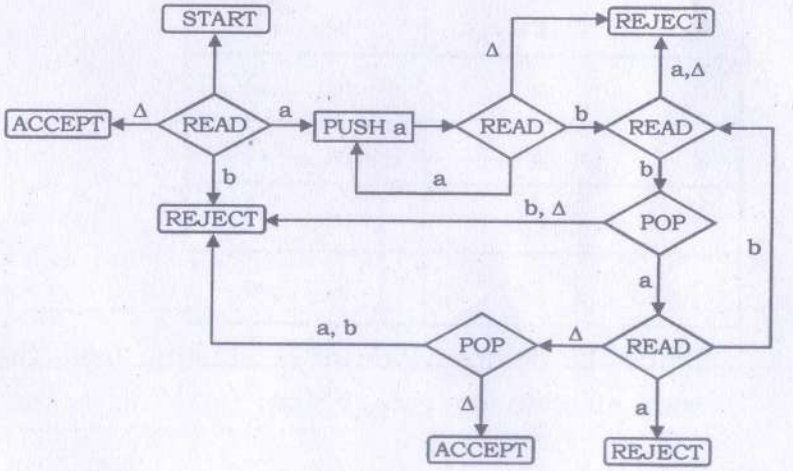
(i) $S \rightarrow XA$
$X \rightarrow aXb \mid \Lambda$
$A \rightarrow aA \mid \Lambda$

(ii) $S \rightarrow AB$
$A \rightarrow aA \mid \Lambda$
$B \rightarrow bB \mid \Lambda$

(g) Show that the following CFG is ambiguous : 3

$S \rightarrow X\,a\,X$
$X \rightarrow a\,X \mid b\,X \mid \Lambda$

(h) Describe the language (in English) accepted by the following PDA : 3



(i) Describe the halting problem. 3

(j) Let M=(K, Σ, δ, s, {h}), where 5

$K = \{q_0, q_1, h\}$

$\Sigma = \{a, b, \sqcup, \triangleright\}$

$S = q_0$

and δ is given by the following table :

q_i	σ	$\delta(q_i, \sigma)$
q_0	a	(q_1, b)
q_0	b	(q_1, a)
q_0	$\sqcup$	$(h, \sqcup)$
q_0	$\triangleright$	$(q_0, \rightarrow)$
q_1	a	$(q_0, \rightarrow)$
q_1	b	$(q_0, \rightarrow)$
q_1	$\sqcup$	$(q_0, \rightarrow)$
q_1	$\triangleright$	$(q_1, \rightarrow)$

Trace the computation of M starting from the configuration (q_0 , $\triangleright$ $\underline{a}$abbba).

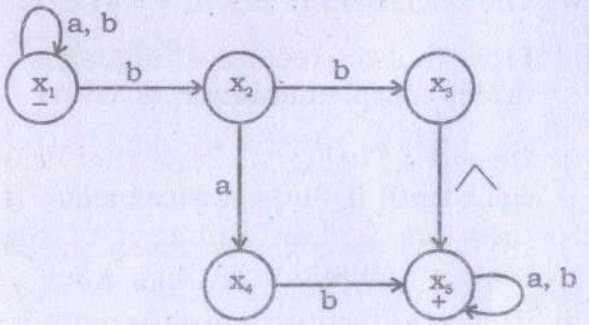
Section -B

2. (i) Let L=All strings that end with aa or bb. Construct DFAs for L and L' (i.e., Complement of L). 6

(ii) Is the language $\{a^m b^m ; m \geq 0\}$ regular? Justify using Pumping Theorem. 4

3. (i) Build an FA accepting the language comprising of all strings having first two characters same as the last two. 6

(ii) Convert the following Transition Graph (TG) into regular expression using Bypass algorithm. 4



4. (i) Give Context Free Grammar (CFG) for the following language : 5

$\{a^i b^j c^k \mid i + j = k; i, j, k \geq 0\}$ and $\sum = \{a,b,c\}$

(ii) Build pushdown automation (PDA) to accept the following language : 5

$\{ Sb^{n+1}$; S is a string of only a's, n=length(S), $n \geq 1 \}$

5. (i) Convert the following CFG to CNF : 5

$E \rightarrow E + E$

$E \rightarrow E * E$

$E \rightarrow (E)$

$E \rightarrow 6 \mid 7$

The terminals here are + * ( ) 6 7.

(ii) Prove that the recursive languages are closed under complementation. 5

6. (i) Design a Turing Machine that scans to the right until it finds two consecutive a's and then halts. The alphabet of the Turing machine should be {a, b, ⊔, Δ}. 5

(ii) Prove that context-free languages closed under Union and concatenation. 5

7. (i) Build FA for each of the following regular languages L_1 and L_2. 4

$L_1 = b(a+b)^*$ $L_2 = a(a+b)^*b + b(a+b)^*a$

(ii) Build FA for $L_1 \cap L_2$. 4

(iii) Describe in English the language represented by $L_1 \cap L_2$. 2