Institute of Information Technology
Jahangirnagar University
2nd Year 1st Semester B.Sc. (Hons.) Final Examination, 2017

Course Code: IT-2103 Course Title: Computer Architecture and Organization
Time: 3 Hours Full marks: 60

Answer any **Five (05)** from the following questions
All parts of a particular question must be answered consecutively

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1. **a.** Draw and explain a conceptual block diagram of typical embedded system. **4**
   b. Describe Moor's Law and Amdahl's law in brief. **3**
   c. Write the 'stored program concept of' John Von Neumann. Draw the structure of Von Neumann machine. **3**
   d. Write down the evolution of x86 microprocessors in brief starting from 8080. **2**

2. **a.** For the MIPS assembly instructions below, what is the corresponding C statement? Assume that the variables f, g, h, i, and j are assigned to registers $s0, $s1, $s2, $s3, and $s4, respectively. Assume that the base address of the arrays A and B are in registers $s6 and $s7respectively. **4**

```
sll  $t0, $s0, 2     # $t0 = f * 4
add  $t0, $s6, $t0   # $t0 = &A[f]
sll  $t1, $s1, 2     # $t1 = g * 4
add  $t1, $s7, $t1   # $t1 = &B[g]
lw   $s0, 0($t0)     # f = A[f]
addi $t2, $t0, 4
lw   $t0, 0($t2)
add  $t0, $t0, $s0
sw   $t0, 0($t1)
```

   b. What are the possible approaches that are taken to speed up the performance of a computer? Draw and explain the block diagram of IAS structure. **3**
   c. Write down relative advantage and disadvantages of using Assembly language programming. Draw the steps of a translation hierarchy for C to convert a C program to a machine language program. **3**
   d. Consider a hypothetical microprocessor generating a 16 bit address and having a 16 bit data bus. What are the maximum memory address spaces that the processor can access directly if it is connected to 16 bit memory and 8 bit memory respectively? **2**

3. **a.** A recursive C procedure has been shown below which can calculate factorial of a given number. What is the MIPS instruction for this? **4**

```
int fact (int n)
{
    if (n < 1) return (1);
        else return (n * fact(n - 1));
}
```

   b. What is Interrupt? Describe Interrupt cycle in brief mentioning the role of PC during interrupt. Draw and explain program flow control diagram for no interrupt, interrupt with short I/O wait. **3**

c. What are the buses available in computer architecture and describe their functions in brief. Show asynchronous read and write operation of a computer. 3

d. Describe the multiple bus hierarchy. 2

4. a. Write down the differences between RISC and CISC processors. 4

b. What is cache memory? Describe the read operation of cache memory. 5

c. On a hypothetical microprocessor, a cache access takes two clock cycles. Data access from main memory over the bus to the processor takes three clock cycles even in the case of no wait state insertion; the data are delivered to the processor in parallel with delivery to the cache. 3

i. Calculate the effective length of a memory cycle given a hit ratio of 0.9 and a clocking rate of 20 MHz.

ii. Repeat the calculation assuming insertion of two wait states of one cycle each per memory cycle. What conclusion can you draw from the results?

5. a. What is the burst feature of RAM? Draw and describe basic block diagram of a synchronous SRAM with burst feature. 4

b. For a DRAM, draw and explain the circuit diagram for writing 1 & 0 into a memory cell and reading 0 & 1 from memory cell. 3

c. What is ROM? Differentiate among different types of ROMs. 3

d. What is flash memory? Draw a circuit diagram of 3×3 flash memory array. 2

6. a. What is RAID? Describe RAID 0, RAID 1 and RAID 2 operation in brief. 4

b. Write down the advantage, disadvantage and application of different RAID. 3

c. Explain how a magnetic disc works? What are the benefits of sequential access over random access and why? 3

d. Differentiate between CD-ROM and DVD-ROM in brief with figure. 2

7. a. Describe different types of registers found in a CPU. 4

b. Draw and explain the Block Diagram of an I/O Module. What are the differences of programmed I/O and interrupt driven I/O. 3

c. What is scheduling? Describe different types of scheduling in brief. 3

d. Describe RISC pipelining in brief. 2

Institute of Information Technology (IIT)
2nd Year 1st Semester B.Sc. (Hons) Final Examination-2016
Subject: Information Technology

Course Code: IT-2103 Course Title: Computer Architecture and Organization

Time: 3 Hours Full Marks: 60

There are 7 sets of questions, answer any **FIVE** sets

1.	a)	Define computer architecture. Give a functional overview of a typical computer system.	5
	b)	What do you mean by upward and downward compatibility?	3
	c)	How does the CPU write data into and read data from memory?	4
2.	a)	Draw the structure of IAS computer.	4
	b)	Differentiate between RISC and CISC processors.	4
	c)	Give the evolution of Intel processor.	4
3.	a)	What is Moore's law?	2
	b)	What are the differences among sequential access, direct access and random access?	5
	c)	Define: Word, Access time, Memory cycle time.	5
4.	a)	Write down the relation among average time to read access time and transfer rate equation for n number of bits.	2
	b)	What are the differences among direct mapping, associative mapping and set-associative mapping?	4
	c)	Explain the working principal of cache memory with diagram.	6
5.	a)	Explain the organization principle of Semiconductor memory.	2
	b)	Draw the classification of Semiconductor memory types.	3
	c)	Mention the differences between DRAM and SRAM.	2
	d)	Explain different types of ROM.	3
	e)	What are hard failure and soft error in error correction of semiconductor memory?	2
6.	a)	Define : Operating System and Swapping.	4
	b)	What are the differences between process and programs?	3
	c)	Use and define major types of Scheduling.	5
7	a)	Draw a generic block diagram of external I/O device and explain its interface components.	4
	b)	What is I/O module? Draw a generic structure of I/O module and then explain its functions.	3
	c)	What are the various external I/O devices used as a means of communication to the outside world? State the common problems I/O is facing.	3
	d)	List the ways in which I/O function can be done. How does DMA transfer occur?	3

Institute of Information Technology
Jahangirnagar University
2nd Year 1st Semester B.Sc (Hons.) Final Examination, 2017
Subject: Algorithm Analysis Session: 2015-2016

Time: 3 Hours **Course Title**: IT-2101 Full Marks: 60

Answer any **Five (05)** from the following questions. Figures at the right indicate the marks.

1. a. Compare the orders of growth of ½ n(n – 1) and n^2 3
   b. In an integer array, there is 1 to 100 numbers, out of one is duplicate, how to find? 3
   c. Show that the running time of insertion algorithm in worst case is a *quadratic function.* 4
   d. Describe the worst case running time of the following pseudocode functions in *Big O* notation in terms of the variable n 2

```
void silly(int n) {
    if (n <= 0) return;
    System.out.println("n = " + n);
    silly(n/2);
}
```

2. a. Show that *mergesort* has time complexity *O(nlogn).* 3
   b. Compute the worst case running time $T(n)$ for the following algorithm with respect to the input size n. Based on the computed running time give the best Big-Oh complexity characterization of $T(n)$. 2

```
Algorithm Count-Common(A,B,n)
Input: Two integer arrays A and B with both of size n
Output: Number of common elements in A and B
1.   sort B by merge-sort
2.   e =0 //number of common elements
3.   for i = 1 to n
4.       b = binarySearch(A[i],B)
5.       if b ≠ null
6.           e = e + 1
7.   return e
```

   c. Discuss the coin-row problem. Solve the instance 5, 1, 2, 10, 6 of the coin-row problem 4
   d. Consider the following list of integers: 3

5, 54, 125, 105, 25, 104, 20, 100, 50, 159

Perform a radix sort on the above list. What is the asymptotic running time for a radix sort on n numbers with d digits each?

3. a. What is the running time of HEAPSORT on an array A of length n that is already sorted in increasing order? What about decreasing order? 2
   b. Describe the backtracking solution to solve 8-Queens problem. 4
   c. Suppose S is the following list of 8 integers: 4

87, 36, 22, 15, 56, 85, 48, 90, 72, 6

Apply the PARTITION subroutine of quick sort algorithm to divide the list into two parts.

   d. Consider the following algorithm. 2

```
for i ← 1 to 100 do
    for k ←1 to n do
        j ← 1 ; m ← n
        while j < m do
            m ← (m + j) / 2
        end while
    end for
end for
for i ← 1 to 30 do
    for j ← 1 to n do
        k ← i + j + n
    end for
end for
for i ← 1 to 70 do
    j ← 2*n + i
end for
```

What is its *big O* running time with respect to n?

$= \langle x_1, x_2, \ldots, x_m \rangle$ and $Y = \langle y_1, y_2, \ldots, y_n \rangle$, and we want to find a maximum-length common subsequence. Write down the algorithm maximum-length common subsequence.

b. In which situation dynamic programming is preferred over divide-and-conquer approach? Explain with examples. 4

c. Write down the basic concept of relaxation. 3

d. Draw the AVL tree that results from inserting the keys: 3, 9, 2, 7, 4, 5, 8 in that order into an initially empty AVL tree. 2

5. a. Consider the following matrix with dimensions 5

Matrix	dimension
A_1	35x15
A_2	15x5
A_3	5x10
A_4	10x20

Calculate the minimum number of scalar multiplication.

b. The function f is defined recursively as follows: 3

$$f(n) = \begin{cases} 1 & \text{if } n = 0 \text{ or } n = 1 \\ f(n-1) + 2 * f(n-2) & \text{if } n > 1 \end{cases}$$

Compute *f(4)* by drawing a recursive tree showing all of the computation required and then use your tree to compute the answer.

c. Draw the Huffman tree to get an optimal Huffman code for the following set of frequencies, based on the first 8 Fibonacci numbers. 4

a:1 b:1 c:2 d:3 e:5 f:8 g:13 h:21

Generalize your Huffman tree to find the optimal code when the frequencies are the first n Fibonacci numbers.

6. a. Justify the statement — "Fractional knapsack problem has the greedy-choice property". 2

b. Show step by step execution of *Prim's algorithm* on the graph provided below in figure 1. 4

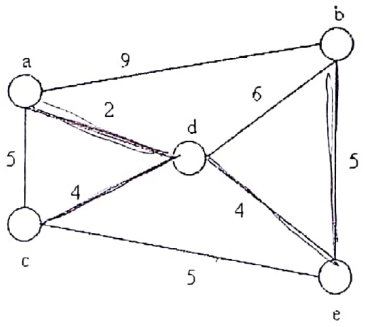


Figure: 1

c. Write down the *Dijkstra's algorithm* to calculate the single source shortest path. 3

d. How do you compare *dynamic programming* with *greedy*? 3

7. a. Suppose that the following keys are inserted in the order A B C D E F G into an initially empty linear-probing hash table of size 7, using the following hash function: 4

key	hash(key, 7)
A	3
B	1
C	4
D	1
E	5
F	2
G	5

What is the result of the linear-probing array?

b. Write down the differences between *NP-hard* and *NP-complete problem*. 3

c. Write down the *Bellman Ford algorithm* to calculate single source shortest path of a

Jahangirnagar University

Institute of Information Technology (IIT)
3rd Year 1st Semester B.Sc. (Hons.) Final Examination-2016
Subject: Information Technology

Course Code: IT-3101 Course Title: Algorithm Analysis

Time: 3 Hours Full Marks: 60

There are 7 sets of questions, answer any FIVE sets

4(a). What is meant by *algorithm*? How do you analyze an algorithm? 1+2
(b). Describe what is meant by big Ω notation in algorithm analysis. 2
(c). What is the time complexity of an algorithm? Show that the running time of insertion algorithm in best case is a *linear function*. 1+3
(d). Show that the expression $10\,N^2 + 1000\,N + 1000000$ is $O(N^2)$. 3

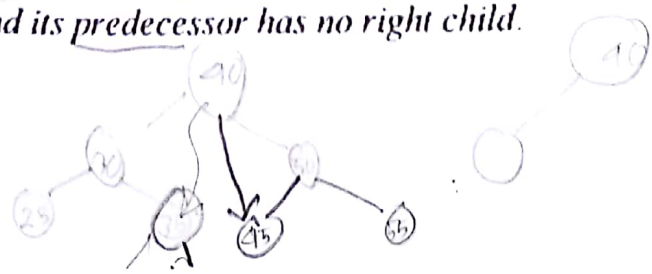
2(a). Consider the following algorithm. 2+2

```
for i ← 1 to 100 do
    for k ←1 to n do
        j ← 1 ; m ← n
        while j < m do
            m ← (m + j) / 2
        end while
    end for
end for
for i ← 1 to 30 do
    for j ← 1 to n do
        k ← i + j + n
    end for
end for
for i ← 1 to 70 do
    j ← 2*n + i
end for
```

i) What is its exact running time with respect to n?
ii) What is its *big O* running time? Prove it using its mathematical definition.

(b). Explain Longest Common Subsequence (LCS) recursive solution. 4
(c). Suppose you are given an array $A[1..n]$ of sorted integers that has been circularly shifted k positions to the right. For example, *[35, 42, 5, 15, 27, 29]* is a sorted array that has been circularly shifted $k = 2$ positions, while *[27, 29, 35, 42, 5, 15]* has been shifted $k = 4$ positions. We can obviously find the largest element in A in $O(n)$ time. Describe an $O(\log n)$ algorithm. 4

3(a). Draw binary search trees of height 2, 3, and 4 on the set of keys {1, 4, 5, 10, 16, 17, 21} 2x3
(b). Write down the algorithm to *delete an item from the binary search tree*. 4
(c). Show that *if a node in a binary search tree has two children, then its successor has no left child and its predecessor has no right child*. 2



4(a) How do you compare *dynamic programming* with *greedy*? What are their *similarities, and what are the differences?* 2+2

(b) Consider the following matrix with dimensions 6

Matrix	dimension
A_1	30x10
A_2	10x15
A_3	15x10
A_4	10x25

$m[i,k)+m[k,j]+p_{i-1}$

Calculate the minimum number of scalar multiplication

(c) Briefly explain the elements of a dynamic programming. 2

5(a). Prove that $1/2)n(n-1) \in O(n^2)$ 3

(b). Proof by Mathematical Induction, *for n≥1*, 3

$$\sum_{k=1}^{n} k^2 = \frac{n(n+1)(n+2)}{6}$$

(c). Proof that $F(n)=\frac{\sqrt{5}}{5}\{(\frac{1+\sqrt{5}}{2})^n-(\frac{1-\sqrt{5}}{2})^n\}$. Also show the golden ratio. 3

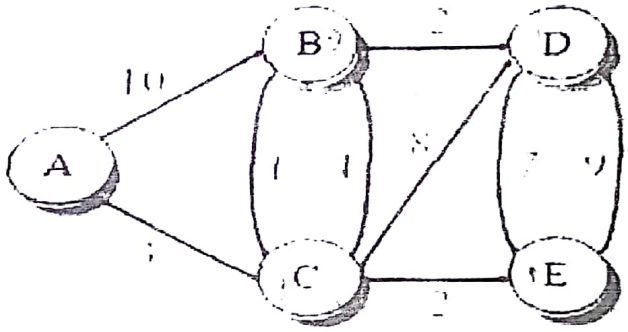
(d). Proof from TOWER OF HANOI, $s(n)=2^n-1$. 3

6(a). Does Bucket sort algorithm work for Real Numbers? If yes, then give an example mentioning basic idea. 3

(b). Explain some of the problem types used in the design of algorithm. 3

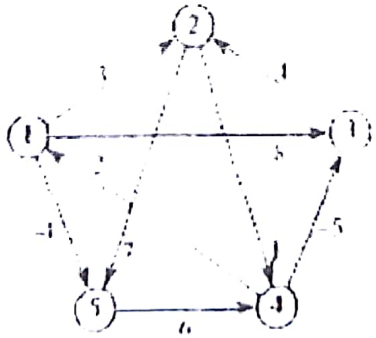
(c). Explain about greedy technique 3

(d). Write the Dijkstra's algorithm and implement for the following graph. 3



7(a). Write down the SLOW-ALL-PAIRS-SHORTEST-PATHS algorithm to *calculate all pair shortest paths of a graph.* 3

(b). Consider the following graph 5



Calculate the all pair shortest path by using SLOW-ALL-PAIRS-SHORTEST-PATHS algorithm.

(c) *Given a rod of length n inches and a table of prices p_i for $i = 1, 2, \ldots, n$, determine the maximum revenue r_n obtainable by cutting up the rod and selling the pieces. Note that if the price p_n for a rod of length n is large enough, an optimal solution may require no cutting at all* 2

(d). Write down the differences between *NP-hard* and *NP-complete problem.* 2

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Institute of Information Technology
Jahangirnagar University
2nd Year 1st Semester B.Sc. (Hons.) Final Examination, 2017

Course Code: IT-2105
Time: 3 Hours

Title: Electronic Devices & Circuits
Full Marks: 60

Answer any **Five (05)** from the following questions
All parts of a particular question must be answered consecutively

1. a) Explain the phenomenon of hole current in terms of energy band. 3

   b) Draw the circuit diagram of a full wave rectifier using centre trapped transformer and explain the operation. 5

   c) In the full wave bridge type circuit shown in Fig. 1, the diodes are assumed to be ideal. Find :
   (i) d.c. output voltage (ii) peak inverse voltage (iii) output frequency.
   Assume primary to secondary turns to be 4. 4

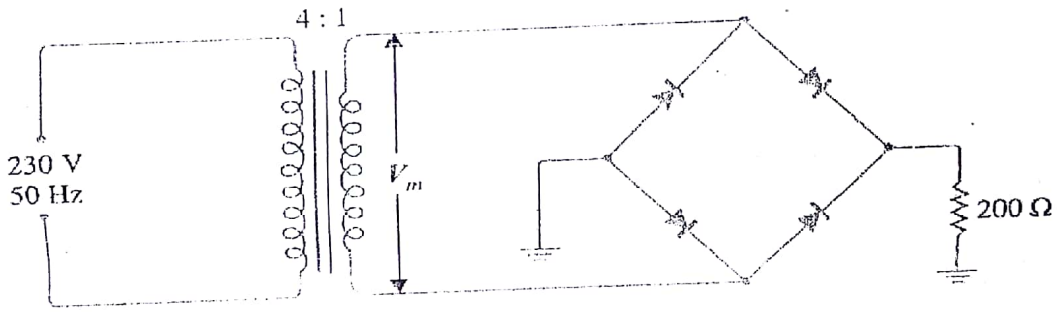

Fig-1: Full wave bridge type circuit

2. a) Derive the relation between α and β. 3

   b) Explain the output characteristics of a transistor in common emitter configuration. 6

   c) Find the α rating of the transistor shown in Fig. 2. Hence determine the value of I_C using both α and β rating of the transistor. 3

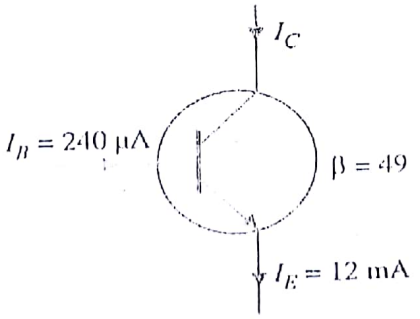

Fig-2:Common emitter transistor circuit

3. a) What is meant by multistage transistor amplifier? Draw its block diagram. 3

b) Define Hybrid Parameter. How can you determine hybrid parameter for a linear circuit? 5

c) A certain amplifier has voltage gain of 15 db. If the input signal voltage is 0.8V, what is the outputvoltage? 4

4. a) What is a transistor? what is BJT? Why BJT is a bipolar device? Explain how a BJT can be used as an amplifier. 5

b) Prove the following relation for CE transistor configuration 4

$$I_{CEO} = \beta I_B + (1+\beta) I_{CBO}$$

c) A transistor has I_{CBO}= 50 μA and α=0.99. If I_B =50 μA, determine 3

I. β, I_{CEO} and

II. I_C, neglecting leakage current.

5. a) What is meant by operational amplifier? Why it is so called? 3

b) Derive the gain equation of an inverting amplifier in terms of voltage attenuation and gain of the feedback circuit. 5

c) The IC 741 op-amp having following parameters is connected as a non-inverting amplifier with A=200000, R_i=2 MΩ, R_o=75 Ω, f_o= 5 Hz, R_1=1 KΩ, R_F=10 KΩ $+V_{cc}$=+15V, $-V_{EE}$=-15V and output voltage swing=± 14 V. Compute the values of A_F, R_{iF}, R_{oF}, f_F and V_{ooT}. 4

6. a) Explain why open loop op-amp is unsuitable for linear applications. 3

b) Derive the ideal voltage gain equation for a non- inverting feedback amplifier. 5

c) A differential amplifier has an output of 1V with a differential input of 10 mV and an output of 5 mV with a common-mode input of 10 mV. Find the CMRR in dB. 4

7. a) What is meant by negative feedback? Write down some advantages of it. 3

b) Explain the circuit operation of the Tuned collector oscillator with circuit diagram. 5

c) Determine the maximum and minimum peak-point voltage for a UJT with VBB =25 V. Given that UJT has a range of η = 0.74 to 0.86. 4

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Institute of Information Technology (IIT)
Jahangirnagar University, Savar Dhaka
2nd Year 1st Semester B Sc. (Hons) Final Examination-2016
Subject: Information Technology

Course Code: IT-2105 Course Title: Electronic Devices & Circuit

Time: 3 Hours Full Marks: 60

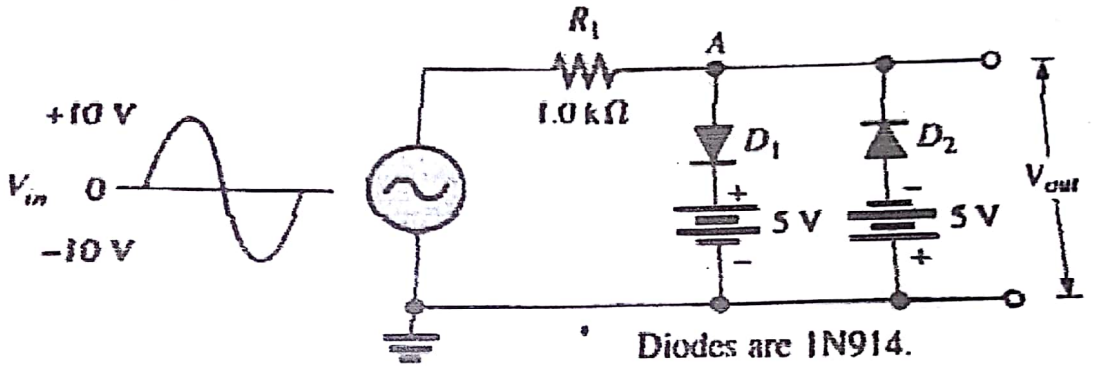
There are 7 sets of questions, answer any **FIVE** sets

1(a) With a neat diagram, explain the working of a PN Junction diode in forward bias and in reverse bias. 6

(b). Explain the switching characteristics of PN Junction diode 3

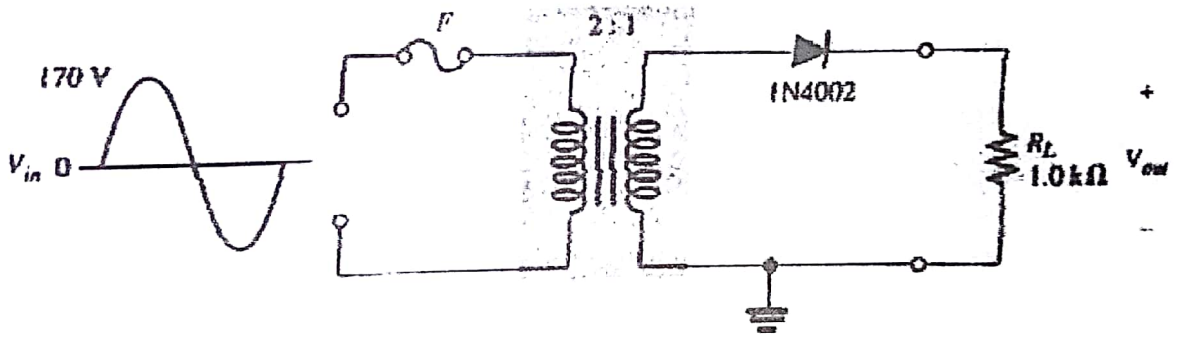
(c). Discuss the effect of doping on depletion region 3

2(a) Draw the output waveform. 4

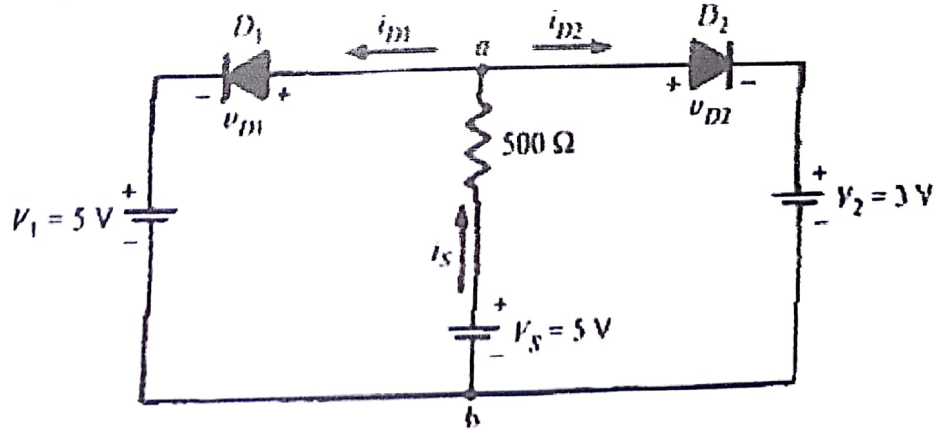


Diodes are 1N914.

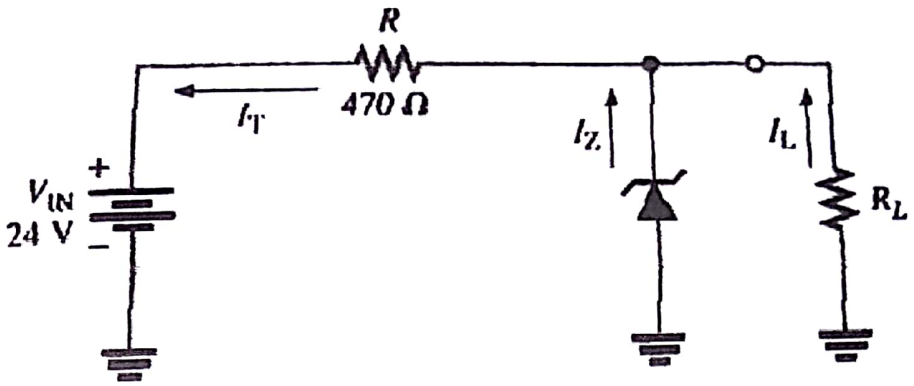
(b). Determine the peak value of the output voltage for the circuit below if the turns ratio is 0.5. 4



(c). Considering ideal diodes, Find i_{D1} and i_{D2}. 4



Determine the minimum and the maximum load currents for which the zenerdiode will maintain regulation. What is the minimum value of that can be used? Assume an ideal zenerdiode where remains a constant 12 V over the range of current values, for simplicity. Consider the following values: V_Z= 12V, I_{ZMin}=1mA, and I_{ZMax}= 50 mA. 3



(b). Derive the expressions for input impedance, output impedance and voltage gain of an ideal op-amp. 6

(c). What is summing amplifier? Construct a summing amplifier using Op-amp and explain its operation using appropriate expressions. 3

4(a) Explain the operation of UJT hence draw its VI characteristic. 6

(b). Draw the equivalent circuit of UJT and define the intrinsic standoff ration. 4

(c). Give an account for charge-coupled devices. 2

5(a) Explain the basic operation of enhancement type MOSFET. Use appropriate illustrations. 3

(b). Explain the source of oscillation in an electronic oscillator Use appropriate illustration if necessary. 4

(c). Draw and explain the working principle of a RC oscillator. 3

(d). What is leakage current? Explain leakage current in an N-P-N transistor. 2

6(a) What is h-parameter? Draw the h-parameter equivalent circuit for fixed bias circuit in CE configuration with unbypassed emitter. 6

(b). From 6(a), derive the equation for voltage gain. 6

7(a) What do you understand by feedback amplifier? Derive the expression of voltage gain for positive feedback amplifier with appropriate illustrations. 5

(b). Derive the expression for distortion of a negative feedback amplifier. 3

(c). Write short notes on: 4

i. LED

ii. Differential Amplifier

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Institute of Information Technology (IIT)
Jahangirnagar University, Savar Dhaka
2nd Year 1st Semester B.Sc. (Hons) Final Examination-2017

Course Code: IT 2107 Course Title: Complex Variable and Vector Algebra
Time: 3 Hours Full Marks: 60

Answer any **FIVE** of the following questions

1(a) Define scalar and vector products of two vectors. Give the geometrical interpretation of vector product of two vectors. 5

(b) Show that $(\underline{a}\times\underline{b})^2 = a^2b^2 - (\underline{a}.\underline{b})^2$. Given that $x\underline{a} = \underline{b}$, find x. 2

(c) If $\vec{a} = 3\hat{i} - \hat{j} - 2\hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} + \hat{k}$, find 5

(a) $\vec{a}\times\vec{b}$,

(b) $\left|(\vec{a}+\vec{b})\times(\vec{a}-\vec{b})\right|$.

2(a) Define gradient of a scalar, divergence and curl of a vector. 3

(b) Given that $\overline{F} = grad(x^3 + y^3 + z^3 - 3xyz)$. Obtain $div\overline{F}$ and $curl\overline{F}$. 5

(c) When a vector is said to be irrational? 4

Show that $\vec{V} = (6xy + z^3)\hat{i} + (3x^2 - z)\hat{j} + (3xz^2 - y)\hat{k}$ is irrational.

3(a). If $\vec{a}$ is any vector, prove that 4

1. $\vec{a} = (\vec{a}.\hat{i})\hat{i} + (\vec{a}.\hat{j})\hat{j} + (\vec{a}.\hat{k})\hat{k}$
2. $2a^2 = \left|\vec{a}\times\hat{i}\right|^2 + \left|\vec{a}\times\hat{j}\right|^2 + \left|\vec{a}\times\hat{k}\right|^2$

(b) If $\underline{a} + \underline{b} + \underline{c} = 0$, show that $\underline{a}\wedge\underline{b} = \underline{b}\wedge\underline{c} = \underline{c}\wedge\underline{a}$. Also interpret the results geometrically. 5

(c) If $|\underline{a} + \underline{b}| = |\underline{a} - \underline{b}|$, then show that $\underline{a}$ and $\underline{b}$ are perpendicular. 3

4(a). Illustrate the followings with example: 3

a) Complex variable
b) Complex Function
c) Singularity

(b) Express e^{-6z^2} in the form $f(z) = u(x,y) + iv(x,y)$. 2

(c) Express $\dfrac{\sec^2\theta - \tan^2\theta + \cos\theta + i\sin\theta}{\sec^2\phi - \tan^2\phi + \cos\phi + i\sin\phi}$ in the form $A + iB$. Also find its modulus. 4

(d) Obtain the poles of 3

$$f(z) = \frac{z + 7i}{(z^2 - 2iz - 1)^2(z^2 + 1)^3(z - 3i)}.$$

5(a). When a function is said to be analytic in a region R ? 2

(b). If $f(z) = u + iv$ is an analytic function, show that, in polar form, the Cauchy-Riemann equations are $\frac{\partial u}{\partial r} = \frac{1}{r}\frac{\partial v}{\partial \theta}$ and $\frac{\partial v}{\partial r} = -\frac{1}{r}\frac{\partial u}{\partial \theta}$. 5

(c). Prove that the function $u = 3x^2y + 2x^2 - y^3 - 2y^2$ is harmonic. Find its harmonic conjugate v and express $u + iv$ as an analytic function of z. 5

6(a). State Laurent's theorem. Expand $f(z) = \frac{1}{z(z-2)}$ in a Laurent series for the region 7

(i) $0<|z|<2$: (ii) $|z|>2$.

(b). State Taylor's theorem. Expand $log\left(\frac{1+z}{1-z}\right)$ in a Taylor series about $z = 0$. 5

7(a). Evaluate the following by using the method of contour integration: 12

i) $\int_0^{2\pi} \frac{d\theta}{5+4cos\theta}$

ii) $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+4)(x^2+9)} dx$

Subject: Information Technology

Course Code: IT 2107 Course Title: Complex Variable and Vector Algebra

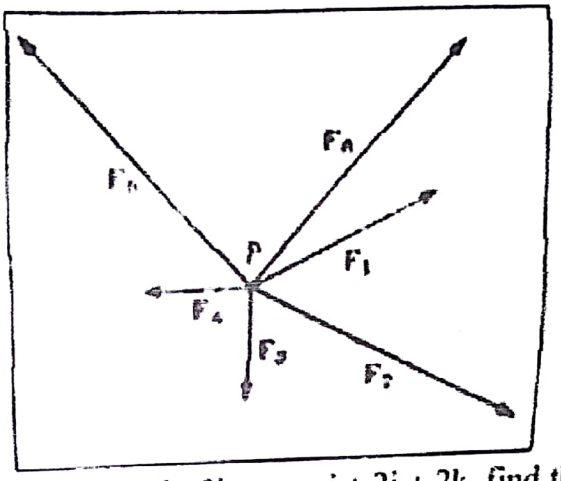
Time: 3 Hours Full Marks: 60

Answer any **FIVE** of the following questions

4(a). Graphically represent the operation of vectors addition, subtraction and multiplication. 3

(b). An automobile travels 3km due north, then 5km northeast. Represent these displacements graphically and determine the resultant displacement (a) graphically, (b) analytically. 3

(c). Forces $F_1, F_2 \ldots, F_6$ act as shown on object P. What force is needed to prevent P from moving? 2



(d). i. Given $r_1 = 3i - 2j + k$, $r_2 = 2i - 4j - 3k$, $r_3 = -i + 2j + 2k$, find the magnitude of 4

(i) r_3, (ii) $r_1 + r_2 + r_3$ (iii) $2r_1 - 3r_2 - 5r_3$.

ii. If $r_1 = 2i - j + k$, $r_2 = i + 3j - 2k$, $r_3 = -2i + j - 3k$ and $r_4 = 3i + 2j + 5k$, find scalars a, b, c such that $r_4 = a r_1 + b r_2 + c r_3$.

2(a). If a, b, c are three vectors such that a x b = c and b x c = a, show that three vectors a, b, c are orthogonal in pairs and $|b| = 1$, $|c| = |a|$. 4

(b). Determine a unit vector perpendicular to the plane of $A = 2i - 6j - 3k$ and $B = 4i - 3j - k$. 4

(c). Show that $[a \times b, b \times c, c \times a] = [abc]^2$ 4

3(a). i. Differentiate between Collinear and Coplanar. 6

ii. Given P(4, 3, -2), Q(-3, -6, 10) and R(25, 30, -38), Prove $\overrightarrow{PQ}$ and $\overrightarrow{QR}$ are collinear.

iii. What are the values of a, b and c so that the points A = (1, 0, 1), B = (1, 1, 0), C = (0, 1, 1) and D = (a, b, c) are coplanar?

(b). i. Show that the vectors $A = 3i - 2j + k$, $B = i - 3j + 5k$, and $C = 2i + j - 4k$ form a right triangle and find its area. 6

ii. Find the projection of the vector $A = i - 2j + k$ on the vector $B = 4i - 4j + 7k$.

iii. Find the angle between $A = 2i + 2j - k$ and $B = 6i - 3j + 2k$.

iv. If $A = 3i - j + 2k$, $B = 2i + j - k$, and $C = i - 2j + 2k$, prove that $(A \times B) \times C \neq A \times (B \times C)$.

4(a). i. Let z = x + iy is a complex number – naming all terms and notation in respect to polar form.

ii. Establish a complex number into a polar, De Moivre's and Euler's form.

(b) Graphically express each of the following complex numbers in polar form. 5

(i) $2 + 2\sqrt{3}i$. (ii) $5 + 5i$. (iii) $-\sqrt{6} - \sqrt{2}i$. (iv) $-3i$

(c). State Cauchy – Riemann and Laplacian Equation. Prove the function 4
$f(z) = z^2 + 5iz + 3 - i$ satisfy Cauchy-Riemann equations.

(d). Show that the function $u = 2x - x^3 + 3xy^2$ is harmonic and also find that the harmonic conjugate if $f(z) = u + iv$ is analytic.

5(a). i. Define a single value and a multiple valued complex function.

ii. State Cauchy – Riemann and Laplacian Equation, and prove the function
$f(z) = z^2 + 5iz + 3 - i$ satisfy Cauchy-Riemann equations.

(b). Show that the function $u = 2x - x^3 + 3xy^2$ is harmonic and also find that the harmonic conjugate if $f(z) = u + iv$ is analytic.

(c). What is a line integral of f(z) along a curve.

Evaluate $\int_{(0,3)}^{(2,4)} (2y + x^2)dx + (3x - y)dy$ along:

i. The parabola $x = 2t$, $y = t^2 + 3$;

ii. Straight lines from (0, 3) to (2, 3) and then from (2, 3) to (2, 4);

iii. Straight line from (0, 3) to (2, 4).

6(a). State and prove Cauchy's integral formula for the first derivative.

(b). Evaluate $\frac{1}{2\pi i}\int_C \frac{e^z}{z-2}\,dz$ if C is (i) the circle $|z| = 3$ (ii) the circle $|z| = 1$

(c). State and prove Liouville's theorem.

7(a). State and prove Taylor's theorem of an analytic function $f(z)$.

(b). Expand $f(z) = \sin z$ in a Tailor series about $z = \pi/4$. Also determine the region of convergence of the series.

Institute of Information Technology (IIT)
Jahangirnagar University, Savar Dhaka
2nd Year 1st Semester B.Sc. (Hons) Final Examination-2017

Course Code: IT-2109 **Time:** 3 hours
Course Title: Statistics and Probability Theory **Full Marks:** 60

Answer any FIVE Questions

1. a) Briefly explain different types of data collection method. 4
   b) What are the different types of measures of location? 4
   c) Write the three different situations where geometric mean, harmonic mean and arithmetic mean is appropriate? 4

2. a) Write two differences between Bar chart and Histogram. 2
   b) What do you mean by quartile and percentile? Assume that an examination was conducted on 80 students and their scores obtained in a course IT-2109 on 60. The Average is 48.5 with standard deviation 25.8, 3rd quartile is 53.2 and 25th percentile is 30.7, median is 45.2 and mode is 40.5. Explain the above results. 6
   c) Define the term standard deviation. Why do most researchers use standard deviation to measure dispersion of data? 4

3. a) What are the conditions of Binomial distribution? 4
   b) Write the function of this distribution. When a binomial distribution tends to a Poisson distribution? 4
   c) Vehicles pass through a junction on a busy road at an average rate of300 per hour. 4
      a. Find the probability that none passes in a given minute.
      b. What is the expected number passing in two minutes?
      c. Find the probability that this expected number actually pass through in a given two-minute period.

4. a) In what situations distribution of random variables follow Poisson distribution or exponential distribution? 4
   b) Why exponential distribution is called a memoryless distribution? 4
   c) The number of calls coming per minute into a hotels reservation center is Poisson random variable with mean. 4
      i. Find the probability that no calls come in a given 1 minute period.
      ii. Assume that the number of calls arriving in two different minutes is independent. Find the probability that at least two calls will arrive in a given two minute period.

5. a) Define hypothesis and types of hypotheses. Write down the steps (in flowchart) involved in the hypothesis testing procedure. Define type I and type II errors. 5

b) When coefficient of variation is an important tool? 2

c) An insurance broker believes that for a particular contract the probability of making a sale is 0.4. Suppose that the broker has five contracts. 5

(i) Find the probability that she makes at most one sale.

(ii) Find the probability that she makes between two and four sales (inclusive).

Graph the probability distribution function.

6. a) Define stochastic process, birth-death process and markoy chain with suitable example. 4

b) What do you mean by M/M/1, M/M/C and G/M/1? 3

c) Compute inter-quartile range and standard deviation from the following data. 5

Class interval	Frequency
10-15	13
15-20	17
20-25	27
25-30	15
30-35	16
35-40	9

7. a) What are the difference between regression and correlation? 2

b) Explain the situation when a correlation (r) =0, r=1, r<1 and r>1 4

c) A company wants to know how job performance relates to IQ. Data are give in the following table: 6

Serial #	Performance	IQ
1	60	31
2	61	36
3	62	38
4	63	40
5	65	41

Estimate the degree of association between job performance and IQ. Is this association significant?

Estimate a regression equation of Performance on IQ and comment on the results.

B.Sc. (Hons) Final Examination-2016
Subject: Information Technology

Course Code: IT 2109 Course Title: Statistics and Probability Theory

Time: 3 Hours Full Marks: 60

Answer any **FIVE** of the following questions

4(a). Define statistics and mention some of the application of statistics in information technology. What are the limitations of statistics? 4

(b). What do you mean by attributes and variables? Briefly explain discrete and continuous variable. 4

(c). What is tabulation? Write down the methods of data collection. 4

2(a). For the pictorial presentation of frequency distribution, we used to use histogram instead of Bar chart. Why? 2

(b). Marks obtained by 35 students in a course presents in Table 1. Calculate Mean, Median, Mode, standard deviation and coefficient of variation (CV) and draw comments 10

Marks interval	Mid Value (x)	Frequency (f)	fx	Cf	fx^2
20-30	25	5			
30-40	35	7			
40-50	45	?			
50-60	50	8			
60-70	65	2			

Table 1: Frequency table of age of patients

3(a). Define probability, experiment, events, outcomes and sample space with example. 4

(b). Define conditional probability and independence with example. Write down the theorem of total probability. What is random variable? 4

(c). An electrical firm manufactures light bulbs what have a life's before burn out that is normally distributed with mean equal to 800 hours and a standard deviation of 40 hours. Find the probability that a bulb burns between 778 and 834 hours. 4

4(a). What are the conditions of Binomial distribution? When a binomial distribution can be approximated by normal distribution? 4

(b). A manufacturer of meta pistons finds that on the average, 12% of his pistons are rejected because they are either oversize or undersize. What is the probability that a batch of 10 pistons will contain? 4

i. No more than 2 rejects.
ii. At least 2 reject.

(c). Vehicles pass through a junction on a busy road at an average rate of 300 per hour. 4

i. Find the probability that none passes in a given minute.
ii. What is the expected number passing in two minutes?
iii. Find the probability that this expected number actually pass through in a given two-minute period.

5(a). What is conceptual difference between Poisson distribution or exponential distribution? Explain with a suitable example. 4

(b). Why does exponential distribution is called a memoryless distribution? 4

(c). If the time between accidents follows an exponential distribution with a mean of 900 days, what is the probability that there will be less than 900 days between the next two accidents? 4

6(a). Write conceptual differences between correlation and regression. 2

(b). In an analysis, researchers want to see the relationship between student's anxiety level and test score in the examination. The data of 10 students are below: 8

Anxiety	10	8	2	1	5	6	9	7	6	4
Test Score	2	3	9	7	6	5	3	4	6	7

Calculate correlation coefficient and regress test score on anxiety. Also comment on your results.

(c). Explain the situation when a) correlation (r) =0, r=1, r<1 and r>1 2

7(a). Define statistical hypothesis and null hypothesis with example. 4

(b). What are the steps to test a hypothesis? 4

(c). In a survey on hearing levels of schoolchildren with normal hearing it was found that in the frequency 500 cycles per seconds, 62 children tested in the sound-proof room had a mean hearing threshold of 15.5 decibels with a standard deviation of 6.5. 76 comparable children who were tested in the fields had mean threshold of 20.0 decibels with a standard deviation of 6.1. Test, if there is any difference between the hearing levels recorded in the sound proof room and in the field. 4