



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

1. a) Explain Efficiency of an algorithm with example. Deduce the running time efficiency of Sequential search algorithm. 4
 b) What is Asymptotic Complexity? Give a short description about Θ -notation and Ω - notation. 3
 c) Analyze Insertion Sort. 2
 d) Compare the orders of growth of $\frac{1}{2}n(n-1)$ and n^2 . 3
2. a) Show that the largest element in a sub tree of a heap is at the root of the sub tree. 2
 b) Write down the algorithm *Heapify* to maintain the heap property. Illustrate the operation of the *Heapify* (A,3) on the array $a=\{27,17,3,16,13,10,1,5,7,12,4,8,9,0\}$. 3+3
 c) Calculate the running time of *quick sort algorithm* in case of worst-case partitioning and best case partitioning. 4
3. a) What is the difference between the *binary search tree property* and the *heap property*? Can the heap property be used to print out the keys of an n -node tree in sorted order in $O(n)$ time? 2+3
 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." 3
4. a) Write down the algorithm to find the minimum number of scalar multiplication of a given n matrices. 3
 b) Consider the following matrix with dimensions 5

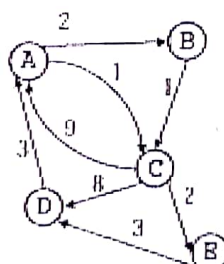
Matrix	A ₁	A ₂	A ₃	A ₄
Dimensions	10x20	20x5	5x15	15x50

Calculate the minimum number of scalar multiplication.

- c) a) Write the Greedy Recursive Activity selection algorithm. Show the operation of this algorithm using the following set S of activities. 4

i	1	2	3	4	5	6	7	8	9	10	11
s_i	1	3	0	5	3	5	6	8	8	2	12
f_i	4	5	6	7	8	9	10	11	12	13	14

5. a) What is meant by *back tracking method*? Draw a possible solution space for a 4- queen problem. 1+3
 b) Write down the basic concept of *relaxation*. 2
 c) Find the single source shortest path for the following graph using *Dijkstra's algorithm*. 3



- d) How do you define *greedy choice property*? Prove that the 0/1 knapsack problem cannot be solved using greedy method. 3

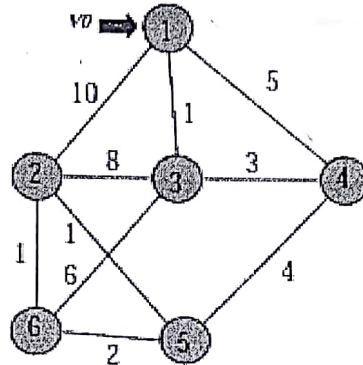
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6. a) What are the *0-1 knapsack* and *fractional knapsack* problem? How do you explain whether *dynamic programming* or *greedy* would be applicable for computing the optimal solutions for these two problems and the other algorithm would fail.
- b) Consider a data file with 35000 characters. The characters in the file occur with the frequencies given by:

	C	d	g	h	j	k
Frequency (in thousand)	6	9	3	4	7	6

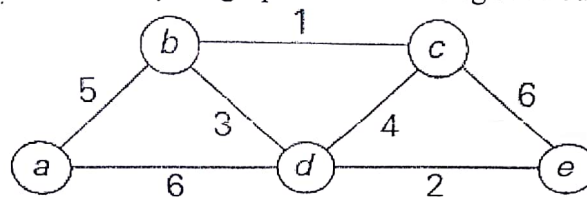
Generate the variable length code word using *Huffman code algorithm*.

- c) What down the algorithm of *activity selection problem* 3
7. a) Write down the *Prim's algorithm* to calculate the *minimum spanning tree (MST)* of a graph. 3
- b) Consider the following graph. 4



Compute the minimum spanning tree for the above mentioned graph using *Prim's algorithm*.

- c) Apply *Kruskal's algorithm* to find a minimum spanning tree of the following graphs. Does *Kruskal's algorithm* work correctly on graphs that have negative edge weights? 5



END





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

1. (a) What is computer architecture? 2
 (b) Briefly describe the basic functional units of a computer with proper diagram. 5
 (c) Classify the types of instruction set. Briefly describe the 3 address instruction set and calculate the total number of bytes required for this type of instruction set. 5

2. (a) What are the types of ALU operations? Design a simple ALU which can do the following four operation 5
 i) Addition
 ii) Subtraction
 iii) AND
 iv) OR

- (b) Depict the relation between hardware, software and instruction set architecture. 3
 (c) Depict the memory hierarchy and briefly explain why we cannot use cache memory only though it is the faster then other memory. 4

3. (a) What do you understand by embedded systems? How do they differ from conventional computing? 3
 (b) What are the most common physical memories used today? Briefly describe them. 4
 (c) List some key characteristics of memory systems and briefly describe any two of them 5

4. (a) Depict the state diagram of instruction cycle with interrupts. 3
 (b) Depict and explain the branch control for two address field instruction. 3
 (c) Consider the 5 instruction sequence below. 6

```
lw    $t0, 20($t1)
sub    $t1, $t2, $t3
add    $t2, $t3, $t4
lw     $t3, 24($t1)
add    $t4, $t5, $t6
```

Depict the status of the pipelined data path at clock cycle 5.

5. (a) What is instruction cycle? Briefly explain three stages of an instruction cycle. 2
 (b) Write down the basic differences between single cycle and multi-cycle instruction set. 2
 (c) Show that the multi-cycle instruction utilizes the resources better than single cycle. 2
 (d) What is out of order execution? Write down its advantages. 3
 (e) Consider the following operations: 3
 1. $r1 \leftarrow r4/r7$
 2. $r8 \leftarrow r1 + r2$
 3. $r5 \leftarrow r5 + 1$
 4. $r6 \leftarrow r6 - r3$
 5. $r4 \leftarrow r5 + r6$
 6. $r7 \leftarrow r8 * r4$

Show the execution in both in-order and out-of order execution mode.

6. (a) Write down the differences between loosely-coupled and tightly-coupled multiprocessor. 4
 (b) Briefly describe NUMA multiprocessor system. 4
 (c) Differentiate between RISC and CISC processors. 4
 7. (a) Draw a generic block diagram of external I/O device and explain its interface components. 3
 (b) What is I/O module? Draw a generic structure of I/O module and 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 of I/O is facing. 3
 (d) List the ways in which I/O function can be done. How does DMA transfer occur? 3

END



Time: 3 Hours

Institute of Information Technology

Jahangirnagar University

2nd Year 1st Semester B.Sc. (Hons.) Final Examination, 2018

Subject: **Electronic Devices and Circuits**

Session: 2016-2017

Course Title: **IT-2105**

Full Marks: 60

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

1. (a) The hybrid parameters for a transistor used in CE configuration are $h_{ie} = 1000 \Omega$; $h_{fe} = 150$; $h_{re} = 1.2 \times 10^{-4}$; $h_{oe} = 25 \times 10^{-6} \Omega$. The transistor has a load resistance of $10 \text{ K}\Omega$ in the collector and is supplied from a signal source of resistance $5 \text{ K}\Omega$. Compute the value of input impedance, output impedance, current gain and voltage gain. 6
- ~~(b)~~ Give a detailed description of construction and operation of JFET. 3.5
- ~~(c)~~ Compare JFET and MOSFET. (any five) 2.5
2. (a) Discuss the construction and operation of a zener diode. Draw the I-V curve of the zener diode. Mention some applications of it. 3
- (b) Explain the difference between clipping and clamping circuits. 2
- (c) Draw the functional block representation of an ac-to-dc converter. 3
- (d) Draw the output waveform for the diode circuits given in figure 2 4

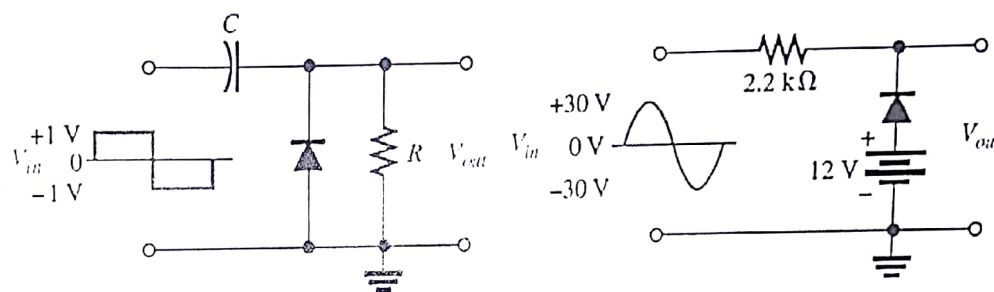
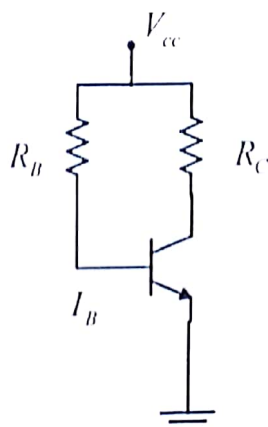


Figure 2: Question 2(d)

3. (a) Sketch a correctly biased P-N-P transistor. Also draw a sketch to show the various current components. Write an equation relating I_E , I_B and I_C 3
- (b) Draw the circuit diagram for common-base transistor characteristics using N-P-N transistor? 6
- ~~(c)~~ Draw the input and output characteristic curve? 3
- ~~(c)~~ Find the relationship between α and β . If the base current in a transistor is $30 \mu\text{A}$ when the emitter current is 2 mA . What are the values of α and β . 3
4. ~~(a)~~ Explain the operation of the voltage divider bias circuit. Show all the voltages polarities and current direction. 6
- (b) Design a base bias circuit, as shown in Figure 3, to have $V_{CE} = 5 \text{ volt}$ and $I_C = 5 \text{ mA}$. The supply voltage is 15 V and $h_{fe} = 100$. Also find the stability factor S . 4



5. (a) What are the advantages of FET over BJT? Explain the operation of n-channel JFET.
 (b) Sketch the h -parameter equivalent circuit for a transistor connected in CE configuration. Identify each component of the circuit and discuss its origin.
 (c) Plot the I_D vs V_{DS} characteristics for a JFET from the given data table obtained with $V_{GS} = 0$. Determine I_{DSS} vs V_P from the characteristic curve.

V_{DS} (V)	0	1	2	2.5	3	3.5	3.75	4	6	9
I_D (mA)	0	3	6	7	7.5	7.8	8	8	8	8

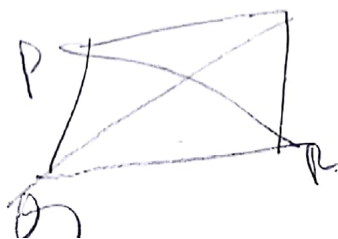
Use graph paper to plot the I_D vs V_{DS} characteristics curve

6. (a) Sketch a three input summing amplifier and explain its operation.
 (b) Draw the circuit diagram of an inverting and non-inverting amplifier. Find the gain equation.
 (c) Design and explain the operation of an Integrator.
7. (a) Describe the operation of a phototransistor.
 (b) Differentiate SCR and TRIAC.
 (c) With the energy band diagram, explain the VI characteristics of Tunnel diode.

END

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

1. (a) Define unit vector with an example. Obtain the unit vector that has the same direction as $\vec{v} = 2\hat{i} + 2\hat{j} - \hat{k}$. [5]
 (b) Give the definition of the dot product. Find the direction cosines of the vector $\vec{v} = 2\hat{i} - 4\hat{j} + 4\hat{k}$, and approximate the direction angles to the nearest degree. [7]
2. (a) A force of $\vec{F} = 3\hat{i} - \hat{j} + 2\hat{k}$ is applied to a point that moves on a line from $P(-1,1,2)$ to $Q(3,0,-2)$. If distance is measured in feet, how much work is done? [4]
 (b) If \vec{u} and \vec{v} are vectors in 3-space, then show that $\vec{v} \cdot (\vec{u} \times \vec{v}) = 0$. [4]
 (c) Find the area of the triangle that is determined by the points $P(2,2,0)$, $Q(-1,0,2)$ and $R(0,4,3)$. [4]
3. (a) Illustrate analytic function. State Cauchy-Riemann equations. [4]
 (b) Prove that $u = e^{-x}(x \sin y - y \cos y)$ is harmonic. Find v such that $f(z) = u + iv$ is analytic. [8]
4. (a) Locate and name all the singularities of $f(z) = \frac{z^8 + z^4 + 2}{(z-1)^2(3z+2)^2}$. Determine where $f(z)$ is analytic. [5]
 (b) Mention Cauchy's theorem. Evaluate $\oint_C \frac{dz}{z-a}$, where C is any simple closed curve and $z = a$ is (i) outside C ; (ii) inside C . [7]
5. (a) Describe Cauchy's integral formula. Define meromorphic function with an example. [4]
 (b) Evaluate the following integrals [8]
 (i) $\oint_C \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)(z-2)} dz$
 (ii) $\oint_C \frac{e^{2z}}{(z+1)^4} dz$,
 where C is the circle $|z| = 3$.
6. (a) What is residue of a complex function? Find the residues of $f(z) = \frac{z^2 - 2z}{(z+1)^2(z^2+4)}$ at all its poles in the finite plane. [6]
 (b) Evaluate $\int_0^\infty \frac{dx}{x^6+1}$. [6]
7. (a) State and prove Taylor's series theorem of an analytic function $f(z)$. [7]
 (b) Expand $f(z) = \sin z$ in a Taylor's series about $z = \frac{\pi}{4}$. Also determine the region of convergence of this series. [5]



[Answer any **FIVE** of the following questions. Each set of questions carry equal marks]

1. (a) What do you mean by statistics? Write down the important applications of statistics in information technology. Define data with example. 4
(b) Define variable with example. Briefly explain the qualitative and quantitative variable. 4
(c) What is frequency distribution? Why do you use such distribution? Why graphical presentation is so important? 4

2. (a) What is dispersion? What are the measures of dispersion? 4
(b) Write down the merits and demerits of mean deviation and standard deviation. 4
(c) A frequency distribution of weights (in kg) of 45 students are given below:

Income in Taka	45-50	50-55	55-60	60-65	65-70	70-75	75-80
Frequency	5	6	6	8	10	6	4

Compute the mean deviation and coefficient of variation. 4

3. (a) What is coefficient of variation (CV)? Why coefficient of variation is so important? 4

- (b) Establish the relation between μ 's and v 's. 4

- (c) Compute the kurtosis (based upon the fourth moment about the mean) of the following frequency distribution. 4

Weight of student	0-99	100-199	200-299	300-399	400-499	500-599	600-699
Number of families	50	70	203	406	403	42	5

4. (a) Write down the uses of correlation coefficient. 3

- (b) The following table shows the data of the heights of father and his son : 9

Height of father(cm) (x)	165	166	167	168	167	169	170	172
Height of son(cm) (y)	167	168	165	172	168	172	169	171

- Fit the regression equation of the line of y on x.
- Fit the regression equation of the line of x on y.
- Calculate the correlation coefficient.

5. (a) Define the terms experiment, sample space and event with example. Write down the properties of the probability. 4

- (b) Two thousand randomly selected adults were asked if they think they are financially better off than their parents. The following table gives the two-way classification of the responses based on the education levels of the

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persons included in the survey and whether they are financially better off, the same as, or worse off than their parents. 8

	Less than high school(X)	High school(Y)	More than high school(Z)
Better off(A)	140	450	420
Same as (B)	60	250	110
Worse off(C)	200	300	70

If one adult is selected at random from these 2000 adults, find the probability that this adult is

- P(Financially better off given less than high school)
- P(High school given financially worse off)
- P(better off and high school)
- P(more than high school and worse off)

6. (a) Write down the conditions of a binomial experiment. 2

(b) According to a National Public Radio poll, 46% of American school principals believe that students pay little attention to science education provided in schools. Suppose that this result is true for the current population of American school principals. 10

- Let x be a binomial random variable denoting the number of American school principals in a random sample of 7 who do not believe that students pay little attention to science education taught in schools. Write the probability distribution of x and draw a graph of the probability distribution. Determine the mean and standard deviation of x .
- Find the probability that in a random sample of 7 American school principals, at most 4 believe that students pay little attention to science education taught in schools.

7. (a) Define hypothesis. What is null and alternative hypothesis? Define level of significance. 4

(b) What is power of the test and p-value? Define confidence interval with example. 3

(c) Suppose the manager of a textile industry suspects that the mean time lost due to the sickness of the night shift workers exceeds the mean time for the day shift workers. To check it, the manager randomly selected 12 workers in each shift category and record the number of days lost due to sickness within the past year.

Night Shift	12	10	20	15	18	9	12	10	21	25	13
Day Shift	8	10	15	9	12	16	15	20	5	18	12

If the number of days per year lost due to the sickness for the night shift

and day shift workers are normally distributed with mean μ_1 and μ_2 and variance σ_1^2 and σ_2^2 respectively, test the significance of the difference of population means if the population variances are not equal. The table value is at 5% level of significance is 1.72.