EX/CSE/T/215A/2017

B.CSE 2nd YEAR 1st Semester Examination 2017

Computer Organization

Time : Three Hours

Full Marks : 100

Answer any ***five*** questions

All parts of a question are to be answered together

1a) What are the advantages of using normalized mantissa and biased exponents in floating point representation of binary numbers? What are the IEEE standards for representing floating point numbers ? Represent +1.0125 in both single precision and double precision IEEE formats.

b) Consider a 16-bit floating number with 6-bit exponent (excess 31 format) 9-bit normalized mantissa. The base is of scale factor 2. Find A + B , A - B and represent the results in the above format, use truncation method of rounding. A = 0 100001 111101111 B = 0 011111 011011011
(Consider an implicit 1 to the left of normalized mantissa as in IEEE format.) (10 + 10)

2. Consider the five stage pipelined processor specified by the following reservation table :

	1	2	3	4	5	6
S1	x					x
S2		x			x	
S3			x			
S4				x		
S5		x				

a) List the set of forbidden latencies and the collision vector
b) Draw the state transition diagram
c) List all the simple cycles from the state diagram
d) Identify the greedy cycles among the simple cycles
e) What is minimum average latency ?
f) What is minimum allowed constant cycle for this reservation table ?
g) What will be the maximum throughput if pipeline clock period be 20 micro seconds ?
h) Is the MAL obtained in (e) is the lower bound ? If not, what to do to achieve lowest MAL ? (20)

3. A typical computer system has 32K main memory and 2K fully associative cache memory. The cache block size is 128 bytes. (i) How many bits are there in the TAG field ? (ii) Find the successful hit ratio for the following program structure where LRU replacement policy is used. The program starts from address 25 and continues to address 2500 with a nested loop.

Start → 25 → 265 → 800 → 2200 → 2500 → End
↑ ↓

(20)

4a) Suggest a situation where it would be advantageous to define a virtual memory that may be smaller than available physical memory. Similarly suggest a situation where use of cache memory will be found detrimental.

b) Design an 8x8 multiplier circuit using minimal no of 4x4 multiplier circuits and 4 bit parallel adders. Properly label your diagram for clear understanding. (5+15)

5a) Describe Booth's modified algorithm and show that just N/2 partial products are required to multiply two N bit binary numbers. Illustrate the algorithm with the example of multiplication of +2.9 and -3.1

b) Describe Non-restoring binary division algorithm and the corresponding sequential circuit for implementing it. Next verify your circuit with the example of 23 divided by 7 (10+10)

6a) Draw the CSA organization to add 9 signed nos. of 6-bit each having CLA at last stage. Count the minimum no of full adders, basic adders and CLCs required for your design. Also calculate the gate delay in your addition process.

b) A non pipelined processor X has clock rate of 250 MHz and CPI (Cycles per instruction) of 4. Another processor Y , the successor of X is designed with 4 stage linear instruction pipeline. It is found that a program containing 10000 instructions took same time for both the processors to execute. What is the clock rate for processor Y ?

c) A virtual memory system has block size 4K bytes. There are 8 secondary blocks and 4 primary blocks. The associative memory page table contains the following entries :

Secondary Block	Primary Block
2	3
5	2
0	0
4	1

Make list of virtual address spaces (in decimal) that cause page fault if addressed by CPU. (10 + 5 + 5)

7. Write short notes on :

i) Pipeline Hazards ii) Virtual memory

iii) Associative memory iv) Series parallel adder (4x5 = 20)

8. Study the micro program given below. Draw the hardware configuration for implementing the micro program. Next design the corresponding control unit using D-flip flops as well as Control Memory. What will be the size of the required Control ROM ?

Rom address			Control Signals					Mode bits		Next Address		
A2	A1	A0	C4	C3	C2	C1	C0	M1	M0	A2	A1	A0
0	0	0	1	0	0	0	0	1	1	x	x	x
0	0	1	0	1	0	0	1	0	0	x	x	x
0	1	0	0	0	1	1	0	0	1	1	0	0
0	1	1	0	1	0	0	0	1	1	0	0	0
1	0	0	0	0	0	1	1	1	0	1	1	0
1	0	1	0	0	0	0	1	1	1	0	0	0
1	1	0	0	0	1	0	0	0	0	x	x	x
1	1	1	0	1	0	1	0	1	1	0	0	0

M1	M0	
0	0	Increment
0	1	Load if S0 = 1
1	0	Load if S1 = 1
1	1	Load

(20)

CSE/T/213A/2017

BACHELOR OF COMPUTER SC. & ENGINEERING EXAMINATION, 2017
(2nd Year, 1st Semester)
DATA STRUCTURES AND ALGORITHMS

Time : Three hours **Full Marks : 100**

Answer question no. 1 and any *four* from the rest.

1. (a) What do you mean by Abstract Data Type (ADT)? Define an ADT for Set.

4

(b) Define Synonyms in the context of Hashing. What problems are posed by them?

3

(c) What do you mean by a sentinel? Explain when you use sentinels.

2

(d) Explain how function pointers play a useful role in the implementation of Data Structures in C language.

4

(e) Show how the following array can be converted to a heap:

K L F T D Y M E A Z

4

(f) Show how the following array will be sorted in *decreasing order* using Selection Sort algorithm:

80 90 70 100 10 20 40 60 50.

3

2. Explain what you mean by the notation $f(n) = \Theta(g(n))$.
Define Time Complexity and Space Complexity of Algorithms. How does a structured algorithm representation help in computing time complexity of algorithms? Explain.

Name a comparison based Sorting Algorithm which runs in Linear Time for a special case.
Explain a sorting algorithm which does not use comparisons and runs in linear time. What are the constraints on the elements of the array to be sorted by such an algorithm? Explain how the following array will be sorted in increasing order by the algorithm:

5 3 1 2 5 3 1 2 6 4 1 2 6 4 8 9

4+3+6+1+2+2+2=20

3. A student was asked to write a program to solve the n-Queen problem for n = 1 million. He proposed to use a 1 million by 1 million integer array as the data structure for the Chess Board. Comment on the choice of data structure of the student and propose a better data structure for the problem. Does your chosen data structure increase the time complexity of the program? Explain.
Write an algorithm to find all possible permutations of the integers 3, 4, 5, 6, 7, 8, 9 taken three integers at a time. Characterize your algorithm.

5+3+8+4=20

4. Define the ADT Stack and explain its implementation using linked list.

   Explain the role of Stack in resolution of Scope of variables in C-like Programming languages. Explain how binary recursive calls are implemented using stack.

   4+8+3+5 = 20

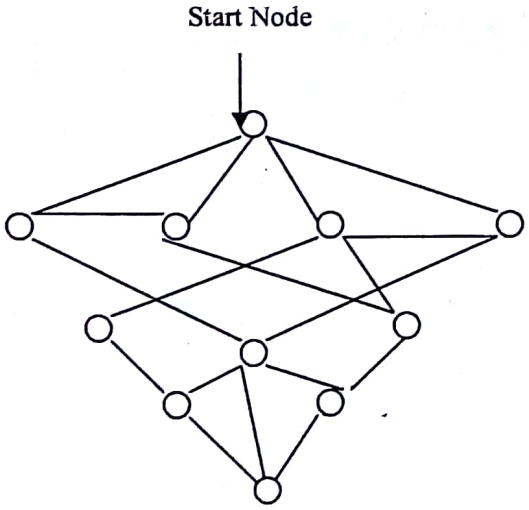
5. Explain the relationship between 2-3 Tree and B-Tree. How are they different from General Trees?
   Give the Data-type for a B-Tree of Order 7. Write an algorithm to search a key k in a B-Tree of Order 7.
   Explain, for a large number of records, how a B-Tree is stored and accessed in a Hard Disk? What is the advantage of storing such large number of records in Hard Disk in the form of a B-Tree?

   5+2+2+5+3+3 = 20

6. What do you mean by Hashing? What is the complexity of insertion, deletion and search in a hash table? What are the Collision Resolution Strategies in open Addressing hashing? Explain their details with advantages and disadvantages of each.

   4+2+3+11=20

7. What is a Graph? How is it represented as a data structure?
   Write an algorithm for Depth First Search of a Graph. What kind of an algorithm you have written?
   Show how the algorithm works on the following graph after naming the vertices as per your choice:



   2+4+6+2+6=20

8. Write the following functions in C with proper comments. Define the data types you have used:
   a. To append a queue *P* at the end of a queue *Q* using the ADT operations of Queue only.
   b. To delete a node pointed to by a pointer *P* from a doubly-linked list with the first node of the list pointed to by the head pointer *H*. *P* may point to the first or last or any intermediate node.
   c. To find the In-order successor of the root of a binary tree.
   d. To compute the Transitive Closure Matrix for a Directed Graph. .

   6+6+3+5=20

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BACHELOR OF COMPUTER SC. ENGG. EXAMINATION, 2017

(2nd Year, 1st Semester)

Digital Circuits

Time : Three hours | Full Marks : 100

Answer any ***five*** questions

1. (a) What is semiconductor? Why Si and Ge are semiconductors, and C and Sn are not semiconductors though they belong to same group in periodic table?
   (b) Draw the I_C versus V_{CE} curves with respect to different I_B in an npn transistor. Show the active, saturation and cut-off regions. Generally, the concept of saturation implies that the curves are becoming flat with respect to some parameter. What is happening in this case? Which is being saturated and with respect to whom and how?
   (c) Explain the terms I_{CO}, I_{EO}, V_{BE}, V_T, α_N,α_I. Deduce the expression for I_C and I_E for an npn transistor with respect to I_{CO}, I_{EO}, V_{BE}, V_T, α_N,α_I. Deduce the expression for $V_{CE}(sat)$ in terms of V_T, h_{FE},h_{FC},σ.

5+6+9

2. (a) How is the diode working as a switch?
   (b) Explain - how diode logic can be implemented as an AND gate? What are the problems of Diode logic?
   (c) Explain the current hogging problem in DCTL gate.
   (d) Draw the two inputs AND gate using RTL. Explain its operation.
   (e) What is the output of paralleling RTL gates.

4+5+4+5+2

3. (a) Draw an IIL gate. What is the advantage of IIL gate? Why is IIL gate called merged-transistor logic?
   (b) With the help of a circuit diagram explain the operation of a DTL gate.
   (c) How is the circuit of DTL modified for Integrated version? What are its advantages over the discrete version?

6+7+7

4. (a) Draw HTL gate. What is its advantage ?
   (b) Explain the operation of a TTL NAND gate. Compare DTL and TTL.
   (c) Explain the operation of an ECL gate. What is its advantage?

6+8+6

5. (a) Explain the operation of an NMOS inverter.
   (b) Prove that the ratio of impedances Z_{pu} and Z_{pd} of the pull-up to pull-down transistors of an nMOS inverter is 4 : 1.
   (c) An nMOS inverter is driven by another nMOS inverter having pull-up to pull-down ratio of 4·75 : 1, through three pass transistors each having threshold voltage of 0·275 VDD . Find the desired ratio of the pullup to pull-down impedance of the driven inverter.

4+11+5

6. (a) Explain the operation of the weighted-resistor D/A converter.
   (b) Explain the operation of a R-2R ladder type DAC.
   (c) Explain the operation of a 3 bit direct comparison type ADC.

7. Write short notes on
   (a) Transistor as a switch
   (b) RTL EXOR gate
   (c) CMOS Inverter
   (d) Sample-Hold circuit

Ref. No.: Ex/MATH/CSE/T/211/2017

B.CSE, 2ND YR. 1ST SEMS EXAM, 2017

Mathematics

(Paper-IV)

Full Marks:100 Time: Three Hours

Answer Question number 1. and any six from the rest.

1. Find the radius of convergence of the following series. (4)

(a) $y = 1 - \frac{n^2}{2!}x^2 + \frac{n^2(n^2-2^2)}{4!}x^4 - \frac{n^2(n^2-2^2)(n^2-4^2)}{6!}x^6 + \cdots,$
where n is not an integer.

(b) $y = 1 - \frac{2p}{2!}x^2 + \frac{2^2p(p-2)}{4!}x^4 - \frac{2^3p(p-2)(p-4)}{6!}x^6 + \cdots,$
where p is not an integer.

2. (a) Suppose that the power series $\sum_{n=0}^{\infty} a_n x^n$ has radius of convergence R. Prove that the power series $\sum_{n=1}^{\infty} n a_n x^n$ has the same radius of convergence R. (6)

(b) Find a power series solution of the initial value problem (10)

$$\frac{d^2y}{dx^2} + x^2\frac{dy}{dx} + x^2y = 0, \qquad y(0) = 2, \qquad y'(0) = 4$$

Write atleast first four nonzero terms in each series.

3. (a) Locate and classify the singular points of the following differential equation. (10)

$$x(1-x)\frac{d^2y}{dx^2} + [c - (a+b+1)x]\frac{dy}{dx} - aby = 0$$

where a, b, c are constants and the constant c is not zero or any positive integer. Find also the series solution of the above equation about $x = 0$. Write atleast first three nonzero terms of each series.

(b) Write the first three terms of the Legendre series of (6)

$$f(x) = \begin{cases} 0, & -1 \le x \le 0 \\ x, & 0 \le x \le 1 \end{cases}$$

4. (a) Prove that (5)

$$\frac{1-xt}{1-2xt+t^2} = \sum_{n=0}^{\infty} T_n(x)x^n$$

where $T_n(x)$ is the Tchebyshev polynomial of degree n.

(b) Prove that the coefficient of leading order term in $T_n(x)$ is 2^{n-1}. (5)

(c) Find all zeros and extremum points of $T_n(x)$. Find also the extremum values of it. (6)

5. (a) Use the method of variation of parameters to find general solution of the equation (8)

$$\frac{d^2y}{dx^2} + y = sec\ x$$

(b) Solve (8)

$$\frac{d^2y}{dx^2} - y = xe^x sin\ x$$

6. (a) Find mod z and amp z of (4)

i) $z = \dfrac{-1+i}{1-\sqrt{3}i}$ ii) $z = 1 + i\tan\theta \quad -\dfrac{\pi}{2} < \theta < \dfrac{\pi}{2}$

(b) Evaluate (6)

$$\int_i^{2-i} (3xy + iy^2)dz$$

along the straight line joining $z = i$ and $z = 2i$..

(c) Evaluate (6)

$$\int_C \bar{z}dz \text{ from } z = 0 \text{ to } z = 4 + 2i$$

along the curve C given by the straight line joining $z = 0$ and $z = 4 + 2i$.

7. (a) Find the residue of (5)

$$\frac{z^3}{(z-1)^4(z-2)(z-3)} \quad \text{at} \quad z = 1$$

(b) Evaluate (5)

$$\oint_C \frac{z}{(z-1)(z-2)^2}dz \quad \text{where } C \text{ is } |z-2| = \frac{1}{2}$$

(c) Find the Laurent series about the singularity and the nature of the singularity in each case (6)

i) $\dfrac{e^z}{(z-1)^3}$ ii) $e^{\frac{z}{z-2}}$

8. (a) Prove that (5)

$$\lim_{z\to 0}\left(\frac{\overline{z}}{z}\right) \quad \text{does not exist}$$

(b) Prove that (5)

$f(z) = |z|^2$ is differentiable at $z = 0$, but it is not analytic there.

(c) Find the harmonic conjugates of (6)

$$(i)\ x^3 - 3xy^2 \qquad (ii)\ x^2 - y^2 + 2x - 4y$$

9. Find the Fourier series of the functions (16)

$$(a)\ f(x) = \begin{cases} 0, & -\pi \le x \le 0 \\ \pi, & 0 \le x \le \pi \end{cases}$$

$$(b)\ f(x) = x, \quad -\pi < x < \pi$$

Ref. No: Ex/Etech/EE/T/216A/2017

B. CSE 2ND YEAR 1ST SEM. EXAM.-2017

SUBJECT: ELECTRICAL TECHNOLOGY

Full Marks 100

Time : Three hours

No. of questions		Answer any *five* (5×20) questions	Marks
1.	(a)	A load with impedance (10+j15)Ω is connected across an AC voltage source, $v(t) = 110 \times \sqrt{2} \sin(\omega t + 15^0)V$. Find the current through the load expressed in the form, $I_m \sin(\omega t \pm \theta)A$. Find the real, apparent and reactive power. Show the phasor relationship of the voltage and current.	8
	(b)	Using suitable phasor diagram, explain power factor as applicable in AC circuits.	6
	(c)	Explain the phenomenon of parallel resonance in an AC network. Why a parallel resonant circuit is called a rejector circuit?	6
2.	(a)	Show that power in a balanced three phase AC circuit is time-invariant.	6
	(b)	What do you mean by phase sequence of a poly-phase system?	4
	(c)	A balanced delta connected load with per phase impedance (6+j8)Ω is connected to 400V three phase supply. Find (i) the line current (ii) power factor (iii) total power (iv) reactive power (v) readings shown by two wattmeters individually, when two wattmeters are connected to measure power in this system.	10
3.	(a)	Derive the relationship between flux and MMF for a simple magnetic circuit.	8
	(b)	An iron ring of 30cm mean diameter and circular cross section of $1cm^2$ has an air gap of 2mm. It is wound uniformly with 800 turns of suitable wire carrying a current of 2A. Assuming MMF across the iron part is 30% of the total MMF, Find (i) MMF (ii) flux density in the air gap (iii) reluctance of the structure (iv) Flux (v) relative permeability of the material (vii) Reluctance of iron part	12
4.	(a)	Classify self-excited DC generators in terms of armature and field connection. Draw the equivalent circuits.	6
	(b)	What are the conditions for proper voltage build-up in self-excited DC generators?	6
	(c)	A 6-pole DC machine has 300 conductors in the armature. Each conductor can carry 100A. Flux per pole in the machine is 20mWb. The machine is driven at a speed of 1600rpm. Find: (i) Total current (ii) emf generated by the armature (iii) Power developed by the armature when the machine is (A) Wave connected (B) Lap connected.	8
5.	(a)	How would you express a transformer rating? What are the significances of those points?	6
	(b)	Explain the test procedures to find the equivalent circuit parameters of a practical transformer.	8
	(c)	A 20kVA, 1100V/110V single phase transformer has the parameters: $R_1 = 3\Omega$, $R_2 = 0.04\Omega$, $X_1 = 8\Omega$, $X_2 = 0.09\Omega$. Draw the HV referred equivalent circuit of the transformer.	6
6.	(a)	Deduce and discuss the torque-speed characteristics of an induction machine. Mark the different regions of operation properly.	8
	(b)	What are the different types of starters used for starting squirrel cage induction motor?	6
	(c)	What is synchronous speed and slip of an induction motor?	3
	(d)	A 3-phase 4-pole 50Hz induction motor operates at 1475rpm. Find the slip at this speed.	3
7.	(a)	Discuss why a synchronous motor is not self starting. What are the methods employed to start a synchronous motor	6
	(b)	How can a synchronous motor be used to correct power factor of a system? Explain using equivalent circuit and proper phasor digram.	7
	(c)	Derive and draw the power-angle characteristics of a synchronous machine. Mark the regions of operation.	7

B.C.S.E. 2nd year 1st Semester Examination 2017

NUMERICAL METHODS

Time : 3 hours. Full Marks : 100

Answer question no.1 and any 4 from the rest.
All parts of same question should be answered together.

1. a) Define round-off and truncation errors. 2
   b) Derive Chebyshev formula for solution of nonlinear equations. 3
   c) Derive the expression of truncation error associated with modified Euler's method. 3
   d) Area of the cross sections (A) vs. distances (h X) from the base of a circular vase is given below:

h (in cm)	0	2.5	5.0	7.5	10.0
A (in cm^2)	44.375	110.625	25.00	38.125	60.00

   Find the approximate volume of the vase. 4

   e) Define eigenvalue and eigenvector. Derive the relationships among the eigenvalues and eigenvectors of two similar matrices. 4
   f) State the condition of convergence for Gauss- Seidel iterative method for solution of linear simultaneous equations. 1
   g) Compare the number of multiplications /divisions required in divided difference and Lagrange interpolation formulae. 3

2. a) Describe the method of false position for solution of non-linear equations. 8
   b) Derive the order of convergence for the above method. 7
   c) Solve the following equation using the method of simple iteration.

$$2x - \log_{10} x - 7 = 0$$

   Take $x_0 = 3$ and $x_1 = 4$. Solution is required to corrected upto 4 decimal Places. Take an appropriate form for iteration. 5

3. a) Prove that a n X n matrix has n different eigenvalues and corresponding n different eigenvectors. 4
   b) Find all the eigenvalues and eigenvectors of the following matrix by Jacobi's method. 10

$$\begin{bmatrix} 1 & \sqrt{3} & 4 \\ \sqrt{3} & 5 & \sqrt{3} \\ 4 & \sqrt{3} & 1 \end{bmatrix}$$

   c) Discuss curve fitting by the method least squares. 6

4. a) Discuss Euler's method for solution of ordinary differential equations. 6

b) Derive expression for truncation error associated with this method. Also comment on the stability of the method. 4

c) Solve the following initial value problem using Euler's method. 10

$$\frac{dy}{dx} = (x - y)/2 \text{ with } y(0) = 1$$

Solution is required over [0,1] with $h = \frac{1}{8}$.
Calculate the percentage error with the exact solution

$$y = 3e^{-x/2} + x - 2$$

5. a) Derive Newton Forward Difference interpolation polynomial for a given set of tabular values. 6

b) From the above polynomial, derive the expressions for evaluating first order and second order derivatives. 8

b) A particle is moving in a circular path. The following table gives the angle of rotation θ (radian) at time instant t (second).

t	0.0	0.2	0.4	0.6	0.8	1.0
θ	0.0	0.12	0.49	1.12	2.02	3.20

Calculate the angular velocity and angular acceleration of the particle at $t = 0.1$ second. 6

6. a) Discuss Gauss-Jordan method for finding the inverse of a square matrix. 6

b) Prove that the output of the above method is the true inverse. 8

c) Sole the following system of equations using Gauss-Seidel iterative method. Solution is required to be corrected up to 4 decimal places. 6

$$-2x + 3y + 10z = 22$$
$$10x + 2y + z = 9$$
$$x + 10y - z = -22$$

7. a) Discuss Gauss quadrature formula for evaluating the integral of the following form.

$$\int_b^a f(x)\,dx$$ 10

b) Evaluate the following integral by Romberg's method corrected upto 6 decimal places.

$$\int_0^{1/2} \frac{x}{\sin x}\,dx$$ 10

8. a) Define Divided difference operator and table. Derive divided difference formula for interpolation. How is it different from Newton's interpolation formula. 10

b) Population of a town in the census is given in the following table:

Year	1971	1981	1991	2001	2011
Population (in thousands)	46	66	81	93	101

Estimate the population in the year 2006. Use suitable interpolation formula. 5

c) Prove by the method induction

$$\Delta^m y_r = \nabla^m y_{r+m}$$ 5
