INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR
4TH SEMESTER (CS) MID TERMINAL EXAMINATION, March 2019
Computer Architecture and Organization - I (CS 402)

FULL MARKS: 50 TIME: 2 Hrs

1. (a) What are the limitations of manual computer?
(b) What is the role of IO equipment in the computing machine?
(c) Classify the following instructions among arithmetic, logical, data transfer, program control and IO groups.
(i) Absolute (ii) Negate (iii) Shift (iv) Convert (v) Load (vi) Exchange (vii) Jump (viii) Return (ix) Skip (x) Input (xi) Output (xii) Start IO [2+2+6]

2. (a) What are the hardware requirements for signed 2's complement addition and subtraction?
(b) Write the following multipliers after booth's encoding.
(i) 01110000 (ii) 01110110 (iii) 00000111 (iv) 01010101
(c) Why restore operation is required in division algorithm? [4+4+2]

3. (a) Design 32x8 RAM using 16x4 RAM.
(b) How many 16x8 memory chips are required to design 256 Kbytes memory?
(c) How the memory access time depends upon the mode of access?
(d) A ROM is used to store the table of multiplication of two 16 bit unsigned integers. What is the size of ROM? [4+2+2+2]

4. (a) What is the role of control unit?
(b) Suppose C5 control signal is required in the fetch cycle of all the instructions at time instant t2, during the execution of instruction I1 at time instant t4, during the execution of instruction I2 and I3 at time instant t6. The variable p is 0 for fetch and 1 for execution. Derive a logic function for the control signal C5.
(c) Why control memory optimization is required? Prove that microcode compaction reduces the size of control memory. [2+2+2+4]

5. (a) Consider a direct mapped cache memory of size 32 KB with block size 32 bytes. CPU generates 32 bit addresses. Find the number of bits needed for cache indexing and tag.
(b) How the number $-4\frac{3}{8}$ is represented in 32 bit floating point format?
(c) What do you mean by addressing mode? Define relative addressing mode. [4+3+1+2]

INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY

B. Tech, 4th Semester (CST), Mid-term Examination, 2019

Programming Paradigm (CS 403)

Full Marks: 50 Time: 2 Hours

Answer question no.1 and any three from the rest

1. Discuss the following with example/diagram/code segment wherever possible.

i. Scope resolution operator
ii. Multiple inheritance
iii. Virtual function
iv. Platform independence
v. Exception handling in Java (5x4=20)

2. Discuss different styles of programming with example. Where do C, C++, assembly language and SQL fit in? (8+2)

3. In C++, design a class 'Natural number' with a member function to find the greatest natural number obtained from set of digits available from a natural number. Hence, check from main() if the greatest number is equal to the number itself. 10

4. Illustrate different types of constructors used in C++ with appropriate code segment. 10

5. a) In Java, is it possible to overload main method?
b) What is Java package and which package is imported by default?
c) What is the difference between abstract class and interface? Discuss with code segment. (2+3+5)

Indian Institute of Engineering Science and Technology, Shibpur

B. Tech. (CST) 4th Semester Mid-Term Examination, March 2019

Full Marks: 100 — Theory of Computation (CS 404) — Time: 2 hours

- **Attempt all the questions.**
- **Answers should be precise and to the point.**
- **Make your own assumptions, if necessary, and state them at proper places.**

1. State whether the statement is true or false (1 mark)! Justify your answer (3 marks)!
   (a) The set $\{(0,1),(1,0)\}$ qualifies to be the alphabet Σ for some DFA $M = (K, \Sigma, \delta, s, F)$.
   (b) Each of the languages ϕ and $\{e\}$ over the alphabet $\Sigma = \{a, b\}$ can be generated by some regular grammar.
   (c) The set of regular languages over some alphabet Σ is uncountably infinite.
   (d) There will always be more than one DFAs accepting some regular language $L \subseteq \{a,b\}^*$.
   (e) Σ being an alphabet, Σ^* is a context-free language.

   [4 × 5]

2. For each of the following languages construct a (regular or context-free or context-sensitive or unrestricted) grammar that generates the language.
   (a) The language L contains all valid regular expressions over the alphabet $\{a, b\}$.
   (b) $\{a^{i}b^{j}c^{i} \mid i \geq 0\}$
   (c) $\{\omega \in \{a,b,c\}^* \mid \omega$ has more a's than b's and more b's than c's.$\}$
   (d) $\{a^n b^{2n} c^{3n} \mid n \geq 0\}$

   [5 × 4]

3. For each of the following languages construct a Finite Automaton (Deterministic or Non-Deterministic) that accepts the language.
   (a) $\{\omega \in \{a,b,c\}^* \mid \omega$ contains $abcba$ as a substring.$\}$
   (b) The language $L \subseteq \{0,1,2,3,4,5,6,7,8,9,.,+,-\}^*$ contains decimal representation of real numbers. For example, L contains $+09$, -2.450, 23.54 but not $2.-3$.
   (c) The language $L \subseteq \{a,b\}^*$ represented by the regular expression $((ab)^* \cup (ba)^*)aabb$. (The finite automaton must be constructed systematically from the given regular expression.)
   (d) The language $L \subseteq \{0,1,2,3,4,5,6,7,8,9\}^*$ contains decimal representation of +ve **even** integers which are divisible by 3. For example, L contains 36 but not 63.

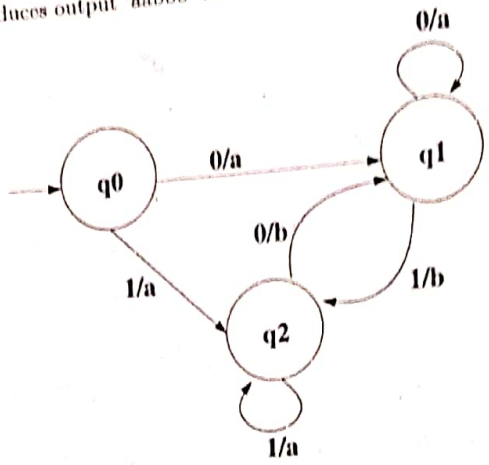
   [5 × 4]

4. (a) Construct a Grammar that computes the function $f : \mathcal{N}^2 \to \mathcal{N}$, $f(n_1, n_2) = n_1 * n_2$ (multiplication of two natural numbers).
   (b) Construct a Turing Machine (standard Turing Machine or any of its extensions) that computes the function $f : \{a,b\}^* \to \{a,b\}^*$, $f(\omega) = \omega^R$ (ω^R denotes reverse of the string ω.

   [10 × 2]

(Contd.)

5. A Mealy Machine is an automaton similar to Deterministic Finite Automaton in the sense that in every step it consumes an input symbol (say, a) from the input tape and depending on the present state (say, p) and the input symbol a, the machine goes to the (unique) next state (say, q). But, in addition to changing the state, in every step, a Mealy Machine also produces an output symbol which depends on the present state p of the machine and the input symbol a. For example, the Mealy Machine depicted by the state transition graph in the following figure has 3 states, namely, q0, q1, and q2. The label "0/a" for an arrow from state q0 to q1 signifies that if the machine is in state q0 and it consumes 0 from the input then it will produce 'a' as output and its next state will become q1. The Mealy Machine depicted in the figure produces output 'aabbb' for the input '00101'.



(a) Formalize the idea of Mealy Machine in terms of the following.
   i. A **Mealy Machine** M as a mathematical entity.
   ii. The **configuration** of a Mealy Machine M.
   iii. The **Yields in One Step Relation** $\vdash_M$ between 2 configurations of a Mealy Machine M.
   iv. The idea that a Mealy Machine M produces output v on input ω.
   v. The idea that a Mealy Machine M computes the function $f : \Sigma_1^* \to \Sigma_2^*$.

[3 × 5]

(b) Construct a Mealy Machine M that produces an '1' only when it encounters an occurrence of the substring '*abab*' in the input string $\omega \in \{a, b\}^*$. In all other cases M produces a '0'. For example, if ω is '*aababab*', M should produce '0000101'.

[5]

Indian Institute of Engineering Science and Technology, Shibpur
B. Tech Fourth Semester CST- EE-ETC-IT Mid-Term Examination, March 2019

Introduction to Management and Industrial Sociology (HU 3401)

Use separate answer scripts for each part

Time: 2 hrs. **Full Marks: 50**

PART – I (Introduction to Management)

Answer Q. No. 1 and any one from the rest

1. Most companies focus on the following objectives to be successful :
(a) Improving revenue
(b) Reducing costs
(c) Improving customer satisfaction
State a few activities that can be done - objectivewise, to achieve the same. (15)

2. Choose a company that you know well and explain the things that can be done to increase the points of difference. (10)

OR

Human Resource Management aims to place the right person in the right job. Explain with examples. (10)

OR

Write short notes (all):
- SWOT Analysis
- Marketing mix
- Outbound and inbound logistics.
- Distribution strategies. (10)

PART – II (Industrial Sociology)

Answer question 3 and **any two** from the rest

3. Case Study:

The Genesis: The civilizational development of agriculture had ushered in tumultuous changes in the structure of human society.

It is Counting: In comparison to hunting-gathering society, people needed to count bigger numbers in agrarian society. For this purpose, methods of writing larger numbers had to be figured out. Writing bigger numbers requires a "base". The Maya civilization of

(Continued from previous page)

South America used 20 as base, in Babylon people wrote numbers with base 60. The Arabs used 10 as base.

Then it is Time: Soon after the agriculture started, people noticed that each type of food-grain had to be sown at a particular time and had to be reaped at a specific time. Thus, the need arose to develop a method of timekeeping. A more refined understanding of the motions of sun and moon and their periodicities helped In the development of calendar system and then astronomy.

And You: How does the evolution of knowledge depicted above help in overcoming industrial stagnation? [10]

4. Communication plays an important role in the development of an industrial system. To system scientists, the world can be understood as a system of systems. Mention three generic elements of communication that are likely to help an industrial system to flourish. [7.5]

5. To what extent does the Time and Motion Study follow scientific principles? Answer illustratively following Frederick Winslow Taylor (1856-1915). [7.5]

6. What is the statistical explanation of Six-Sigma methodology? [7.5]

------xx------

INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR

B.TECH. 4th SEMESTER (CST) MidSem EXAMINATION, 2019

Analysis and Design of Algorithms (CS 401)

FULL MARKS: 50 TIME: 2 Hrs

Answer all questions.

1. Obtain the time complexity of the following using appropriate recurrence relations: **2x6=12**
   (a) Selection of i^{th} smallest element using median of medians as the pivotal element
   (b) Bucket sort of an array of floating point numbers

2. Obtain solutions for the following problems with brief description of the algorithms: **2x8=16**
   (a) Consider a file having six symbols (σ,β,γ,δ,μ,ε) with the following probabilities: ***0.32;0.25;0.16;0.12;0.10;0.05.*** Design Shannon-Fano code and Huffman code for data compression using variable length binary code. Compare the average codeword lengths. How is the optimality affected if probabilities of β and γ are interchanged?
   (b) Consider a scheduling problem where the challenge is to minimize the penalty for scheduling a set of unit execution time tasks with deadline and penalty for meeting the deadline is given in table below.

Task Id	Deadline	Penalty
T1	2	70
T2	3	60
T3	4	50
T4	3	40
T5	1	30
T6	3	20
T7	4	10

3. Explain the following and also give proper examples: **2x6=12**
   (a) Graph with set of vertices and edges can be represented as a matroid with hereditary property and exchange property.
   (b) Optimal parenthesization of a matrix chain (to minimize the number of operations in multiplication) can be found in cubic time complexity though all possible cases count to Catalan number.

4. *Write short notes with solution of given problems:* **2x5=10**
   (a) *Radix sort of dates – solve for the following elements:* ***26-Mar-1971; 21-Feb-1952; 16-Dec-1971; 06-Dec-1990; 06-Jan-2009.***
   (b) *Master theorem of complexity – solve for* $T(n) = T(n/4) + 3T(n/4) + n$