### 2014-15
**B.TECH. (WINTER SEMESTER) EXAMINATION**  
**COMPUTER ENGINEERING**  
**SYSTEMS PROGRAMMING**  
**CO-306**

<table>
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<tr>
<th>M.M.</th>
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<td>05</td>
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Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

**Answer all the questions.**  
**Assume suitable data if missing.**  
**Notations used have their usual meaning.**

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<tr>
<th>Q.No.</th>
<th>Question</th>
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| 1(a)  | Write short notes on the following:  
(i) Systems Programming  
(ii) Language Processor |
|       | 04       |
| 1(b)  | What do you understand by intermediate representation of programs? What are its desirable properties? |
|       | 06       |
| 1(c)  | What is a forward reference? How is it solved using backpatching? Explain using an example. |
|       | 06       |

**OR**

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<tr>
<th>Q.No.</th>
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<tr>
<td>1(c')</td>
<td>What are advanced assembler directives? Explain any two with suitable example.</td>
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<tr>
<th>Q.No.</th>
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<tr>
<td>2(a)</td>
<td>What is a Macro? What are the advantages of using a Macro? How is a Macro different from a subroutine?</td>
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<tr>
<td>2(b)</td>
<td>List the key data structures of a macro pre-processor and briefly discuss their use.</td>
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<tr>
<td>2(c)</td>
<td>Write an efficient Macro in assembly language to find the largest of three elements.</td>
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<th>Q.No.</th>
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<tr>
<td>2'(a)</td>
<td>What are the different types of statements in a macro definition? Explain with the help of an example.</td>
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<tr>
<td>2'(b)</td>
<td>Differentiate between Lexical and Semantic expansion in the context of Macro Expansion. Use suitable example.</td>
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contd... 2
2(c) How macro expansion is performed in nested macro calls? Use suitable example.

3(a) What are the functions performed by a loader? With the help of a diagram, explain the general loader scheme.

OR

3(a') What is an overlay? Using a suitable diagram, explain overlay structured program and its execution.

3(b) Explain the concept of dynamic linking.

3(c) Discuss the benefits and limitations of direct linking loader scheme over absolute loader scheme.

4(a) What is a device driver? How does the operating system access device drivers.

4(b) Write short note on any ONE of the following:
   (i) Software Utility and its categories
   (ii) Unix Shell and its types

4(c) Write a shell script that receives any year from the keyboard and determines whether the year is leap or not.
2014-15  
B.TECH. (WINTER SEMESTER) EXAMINATION  
COMPUTER ENGINEERING  
COMPUTER NETWORKS  
CO-307/313

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer all the questions.  
Assume suitable data if missing.  
Notations used have their usual meanings.

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<tr>
<td>1(a)</td>
<td>What are the merits and drawbacks of protocol layering? Describe different layers of Internet protocol stack. Let there be two hosts A and B connected through a switch and a router. Draw a diagram to show the flow of messages through different layers from the source A to the destination B.</td>
<td>[06]</td>
</tr>
<tr>
<td>1(b)</td>
<td>Consider sending a large file of ( F ) bits from Host A to Host B. There are two links (and one switch) between A and B, and the links are uncongested (that is, no queuing delays). Host A segments the file into segments of ( S ) bits each and adds ( h ) bits of header to each segment, forming packets of ( L = (S+h) ) bits. Each link has a transmission rate of ( R ) bps. Find the value of ( S ) that minimizes the delay of moving the file from Host A to Host B. Disregard propagation delay.</td>
<td>[06]</td>
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<td>OR</td>
<td>1(b')</td>
<td>[06]</td>
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<td>Suppose there is a 10 Mbps microwave link between a geostationary satellite (altitude: 36000Km) and its base station on Earth. Every minute the satellite takes a digital photo and sends it to the base station. Assume a propagation speed of ( 2.4 \times 10^8 ) meters/sec.</td>
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<td></td>
<td>(i) What is the propagation delay of the link?</td>
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<td></td>
<td>(ii) What is the bandwidth-delay product, ( R \times T_{prop} )?</td>
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<td>(iii) Let ( x ) denotes the size of the photo. What is the minimum value of ( x ) for the microwave link to be continuously transmitting?</td>
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2(a) Suppose users share a 1 Mbps link. Also, suppose each user requires 100 kbps when transmitting, but each user transmits only 10 percent of the time.

(i) When circuit switching is used, how many users can be supported?

(ii) For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.

(iii) Suppose there are 40 users. Find the probability that at any given time, exactly $n$ users are transmitting simultaneously.

(iv) Provide an expression to find the probability that 11 or more users are transmitting simultaneously.

OR

2(a') Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every $k$ time units, where $k$ is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer:

(i) Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?

(ii) Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?

2(b) Consider the queuing delay in a router buffer. Suppose all packets are of length $L$ bits and the transmission rate is $R$ bits per second. Answer the following questions.

(i) Consider the scenario where $N$ packets simultaneously arrive at the buffer every $LN/R$ seconds. Find the average queuing delay of a packet.

(ii) Now consider a different scenario where let $\rho$ be the traffic intensity; that is, $\rho = \frac{La}{R}$. Here, $a$ denotes the number of packets arriving per
second. Suppose that the queuing delay takes the form \( \frac{L}{R} \left( \frac{\rho}{1 - \rho} \right) \). Write an expression for the total delay, that is, queuing delay plus the transmission delay.

3(a) With the help of suitable diagrams, describe iterative query and recursive query used for resolving domain names to IP addresses.

3(b) Consider the TCP procedure for estimating RTT. Suppose that \( \alpha = 0.1 \). Let SampleRTT\(_1\), be the most recent sample RTT, let SampleRTT\(_2\), be the next most recent sample RTT, and so on.

(i) For a given TCP connection, suppose four acknowledgements have been returned with corresponding sample RTTs SampleRTT\(_4\), SampleRTT\(_3\), SampleRTT\(_2\), and SampleRTT\(_1\). Express EstimatedRTT in terms of the four sample RTTs.

(ii) Generalize your formula for \( n \) sample RTTs.

(iii) For the formula in part (ii) let \( n \) approach infinity. Comment on why this averaging procedure is called an exponential moving average.

OR

3(b') Consider Figure 1 (a), for which there is an institutional network connected to the Internet. Suppose that the average object size is 900,000 bits and that the average request rate from the institution’s browsers to the origin server is 1.5 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response in two seconds on an average. Model the total average response time as the sum of the average access delay (that is, the delay from the Internet router to institution router) and the average Internet delay. For the average access delay, use \( \frac{\Lambda}{1 - \Lambda \beta} \), where \( \Lambda \) is the average time required to send an object over the access link and \( \beta \) is the arrival rate of objects to the access link.

Contd...4.
(i) Find the total average response time.
(ii) Now suppose a cache is installed in the institutional-LAN as shown in Figure 1(b). Suppose the hit ratio is 0.4. Find the total response time.

4(a) What is meant by client-server, peer-to-peer (P2P), and hybrid architectures for a network application?

4(b) What is meant by an overlay network? Consider query flooding in P2P file sharing. Suppose that each peer is connected to at most N neighbors in the overlay network. Also, suppose that the node-count field is initially set to K. Suppose Alice makes a query. Find an upper bound on the number of query messages that are sent into the overlay network.

OR

4(b') In this problem, we explore designing a KaZaa-like system that has ordinary nodes, group leaders, and super group leaders.

(i) Suppose each super-group leader is roughly responsible for 200 group leaders, and each group leader is roughly responsible for 200 ordinary peers. How many super-group leaders would be necessary for a network of four million peers?

(ii) What information might each group leader store? What information might each super-group leader store? How might search be performed in such a three-tier design?

5(a) With the help of suitable diagrams, describe the design of Go-Back-N (GBN) protocol.

5(b) Describe an algorithm for TCP sender. What is meant by a fast retransmit? Describe an algorithm for fast retransmit in case of TCP.

OR

5(b') What is inside a router? Discuss the components of a router in detail.
Figure 1(a): Institutional network connected to the Internet without a Web cache (Q3 (b')).

Figure 1 (b): Adding a cache to the institutional network (Q3(b')).
Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Question

Q.No. M.M.
1(a) While using Commercial-off-the-shelf (COTS) component, their integration issues are considered. Give few examples of integration issues. 7.5
1(b) Prototype contains only partial features of complete software. List guidelines that one should follow in deciding about the features for prototype. 7.5

OR

1'(a) Discuss limitations of Waterfall model. 7.5
1'(b) Along with justification, describe which development process model you would choose for the following project – A new movie editing product, which will have some basic features and some desirable features. 7.5

2(a) What is Data Dictionary? Prepare data dictionary for the information on your mark sheet. 7.5
2(b) List characteristics of SRS document. Write in brief about each. 7.5

OR

2'(a) Assume that you are developing a movie player. Briefly list its requirements. Subsequently calculate function point based upon your requirements. 7.5
2'(b) Prepare a comparison table to compare Hierarchical Team Organization and 7.5

3(a) List levels of cohesion. Write in brief about each. 7.5
3(b) What is graph impurity? What does it measure? In which phase of software development, this metric is used. 7.5

4(a) Generate test cases for ATM machine using cause effect graphing. 7.5
4(b) Write a short note on cyclomatic complexity. 7.5
2014-15
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
THEORY OF COMPUTATION
CO311/CO305

Maximum Marks: 60
Credits: 04/05
Duration: Three Hours

Answer all the questions.
Assume suitably if required.
Abbreviations and symbols have their usual meanings.

Q.No. Question M.M.  
1(a) State true or false, and give reason for each of the following: [2×5] 
(i) An NFA stores strings of any length it has seen.
(ii) \( \epsilon \)-NFA is the most powerful among the three finite automata, viz. DFA, NFA, and \( \epsilon \)-NFA.
(iii) DFA is the fastest among the three finite automata, when all are implemented on a sequential computer.
(iv) The states of state machines like FA, PDA, and TM represent only systems that have a finite number of states.
(v) It is possible for an NFA to be in an undefined state.

1(b) Write a regular expression for all strings in \( \{ 0, 1 \}^* \) in which every pair of adjacent 0's appears before any pair of adjacent 1's. [05]

2(a) Find the regular expression for the language of the following DFA using state elimination technique: [07]

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<td>( \rightarrow *q_0 )</td>
<td>( q_3 )</td>
<td>( q_0 )</td>
</tr>
<tr>
<td>( q_1 )</td>
<td>( q_0 )</td>
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<td>( q_2 )</td>
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<td>( q_3 )</td>
<td>( q_1 )</td>
<td>( q_2 )</td>
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2(b) Design a DFA accepting the set of all strings, where each string begins with a 1 and, [08]

contd...
interpreted as a binary integer, is a multiple of 5.

3(a) Design a CFG for the language of regular expression $0^*1(0+1)^*$. Show the leftmost and right-most derivations of the string 00101.

3(b) Write the statement of pumping lemma for CFLs and use it to prove that the language $\{ww \mid w \text{ is in } \{0, 1\}^* \}$ is not context free.

OR

3'(a) Write and explain the substitution theorem for CFLs. Explain how the theorem is used to prove that CFL's are closed under union and concatenation.

3'(b) Write a CFG for accepting palindromes of odd length (i.e., $w0w^R$ and $w1w^R$, $w$ is in $\{0, 1\}^*$), and design a push down automaton for this language.

4(a) Discuss the Church thesis, and recursive and recursively enumerable languages.

4(b) Prove that no program $H$ can tell whether or not a given program $P$ with input $I$ prints "Hello, world" as its first output.

4(c) Design a TM that accepts $ww^R$ where $w$ is a string in $\{0, 1\}^*$.

OR

4'(a) Discuss: the time complexity of TM, the nondeterministic TM, and the $\mathcal{P}$ and $\mathcal{NP}$ classes.

4'(b) Explain the diagonalization language $L_d$ and prove that there is no TM that can accept $L_d$.

4'(c) Describe instantaneous description and moves made by a Turing machine, explaining any special cases.
2014-15
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
DATABASE MANAGEMENT SYSTEM
CO-312/304
Credits: 04/05
Duration: Three Hours

Maximum Marks: 60

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No | Question | MM
--- | --- | ---
1 | Attempt any two parts. | 
(a) Differentiate between primary, secondary and clustering indexes using suitable examples. Consider a table having supplier information. The status attribute values for suppliers are given below. Which type of index you would build on status attribute and why? 4, 7, 2, 13, 8, 14, 1, 10, 2, 11, 8, 9, 8 | 7.5
(b) What is a data model? What are the different types of data models? Explain each. How these data models are used at different levels of ANSI/SPARC architecture? | 7.5
(c) Discuss the capabilities that should be provided by a typical database management system. Discuss the circumstances when using a DBMS is not advantageous. | 7.5

2 | Attempt any two parts. | 
(a) What is the meaning of relational completeness of a query language? What is tuple relational calculus? Explain clearly how relational statements are written in relational calculus. | 7.5
(b) Discuss the properties of relations that make them different from ordinary tables and files. Differentiate between static and dynamic constraints. How static constraints are specified in SQL. | 7.5
(c) Write complete syntax of SQL INSERT, DELETE and UPDATE statements. What are different ways of doing database programming? State the advantages and disadvantages of each. | 7.5
3 Attempt any two parts.

(a) What is the cover of a set of functional dependencies? For the following two sets of functional dependencies for relation R(A,B, C, D, E), check if they are equivalent. If yes, why? Also find the primary key of R.
Set1: A→B, AB→C, D→AC, D→E
Set2: A→BC, D→AE

(b) Discuss the purpose of Boyce-Codd normal form. How is BCNF different from and stronger than 3NF. Illustrate your answer with a suitable example.

(c) What is locking protocol? Explain why a transaction that follows locking protocol is always serializable.

4 Attempt any two parts.

(a) Discuss the steps in query optimization in detail. Why SQL queries are converted into query tree before optimization is done?

(b) Differentiate between mandatory and discretionary access control mechanism. Discuss simple security and star properties and explain the justification behind these rules.

(c) Differentiate between classification and clustering using suitable examples. Explain the k-nearest neighbor algorithm for classification.
2014-15
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
DESIGN AND ANALYSIS OF ALGORITHMS
CO-314

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning.

Q.No. Question M.M.
1(a) What do you mean by best case, worst case and average case complexity? Write down the insertion sort algorithm and compute its best case, worst case and average case complexity. [09]

1(b) Solve the following recurrence equations
   (i) \( T(n) = 2T(n^{0.5}) + \log^2 n \)
   (ii) \( T(n) = 2T(n/4) + n^{\frac{3}{2}} \)
   OR

1(b') Determine whether the following equalities are correct or incorrect. [06]
   (i) \( n^2 + 62^n = \Theta(n^2) \)
   (ii) \( n^3 2^n + 6 n^2 3^n = O(n^3 2^n) \)

2(a) An evil king has a cellar containing \( n \) bottles of expensive wine, and his guards have just caught a spy trying to poison the king's wine. Fortunately, the guards caught the spy after he succeeded in poisoning only one bottle. Unfortunately, they don't know which one. To make matters worse, the poison the spy used was very deadly; just one drop diluted even a billion to one will kill someone. Even so, the poison works slowly; it takes a full month for the person to die. Design a scheme that allows the evil king to determine exactly which one of his wine bottles was poisoned in just one month's time while expending at most \( O(\log n) \) of his taste testers. [06]

2(b) Describe the Hamiltonian cycle problem. Design a backtracking solution for the same. Use your algorithm to find all Hamiltonian cycles present in the following graph. [09]
2(a) We are given a set of \( n \) jobs. Associated with job \( i \) is an integer deadline \( d_i \geq 0 \) and a profit \( p_i > 0 \). For any job \( i \) the profit \( p_i \) is obtained iff the job is completed by its deadline. To complete a job, one has to process the job on a machine for one unit of time. Only one machine is available for processing the jobs. A feasible solution for this problem is a subset \( J \) of jobs such that each job in this subset can be completed by its deadline. An optimal solution is a feasible solution that maximizes the profit \( \sum_{i \in J} p_i \). Design a greedy solution for the problem. Use your algorithm to find the optimal solution for the following problem instance: \( n = 7 \), \( \{p_1, p_2, p_3, p_4, p_5, p_6, p_7\} = \{3, 5, 20, 18, 1, 6, 30\} \) and \( \{d_1, d_2, d_3, d_4, d_5, d_6, d_7\} = \{1, 3, 4, 3, 2, 1, 2\} \).

2(b) Describe the longest common subsequence problem. Design a dynamic programming solution for the same. Use your algorithm to find longest common subsequence of the two sequences “AILZPBAD” and “IXPXAYD”.

3(a) Design a rail network to connect all the cities shown in the following figure with the minimum cost. Design the network using minimum number of steps. If you are using an existing algorithm, mention the name of the algorithm too.

![Rail network diagram]

3(b) What do you mean by an articulation point? Write down an algorithm for finding articulation points of a given undirected graph. Use the algorithm to find articulation points of the following graph.

![Graph diagram]

4(a) Prove that the Circuit Satisfiability problem (CIRCUIT-SAT) is a NP-Complete problem.

4(b) What do you mean by unsolvable problems? List and describe five unsolvable problems.

4(b') What do you mean by NP-hard problems? List and describe five NP-hard problems.
1. Write brief answers for any Six of the following:
   i) Distinguish between random scan and raster scan displays
   ii) Differentiate between HD and FHD displays
   iii) Differentiate between a normal LCD and an LED display in the present context
   iv) Role of Colour Lookup Table in graphics processor
   v) Operating principle of Liquid Crystal Displays with illustrations
   vi) List three advantages as well as drawbacks of LCD devices.
   vii) Working principle and advantages of Capacitive Touch Screens
   viii) Possible applications of 3D Printers

2(a) What are geometric constraints? Explain Rubber band technique for positioning a circle.

2(b) Derive Bresenham’s line drawing algorithm. Using this algorithm plot a 3 pixels wide line between (1,5) and (7,8). Propose a method to select different line styles through line drawing algorithms.

OR

2'(a) Write a program in C to generate Bezier curves. What are its important properties?

2'(b) Describe De Casteljau’s algorithm for generation of curves. Also prove it by taking a set of four control points.
3(a) Determine the transformation that rotates an object by 60 degrees in anticlockwise direction about the line passing through the origin and the point (1, 2, 5).

3(b) Give the classification of Planar Geometric Projections and illustrate with suitable examples.

OR

3' Determine and plot the perspective projections on xy plane of a Pyramid placed in +ve octant with its unit square base aligned with xz-plane and apex of unit height (Figure 1) when the observer is at (a) (0,0,-1) and (b) (0,0,-10)

![Diagram of a pyramid with projections on the xy plane](image)

Figure 1.

4(a) Define clipping and explain Cohen-Sutherland Line clipping algorithm.

4(b) Describe Z-Buffer algorithm for hidden surface removal. What are its advantages and limitations?

5(a) What are the properties of light sources and material with reference to shading? Explain Phong Illumination model.

5(b) Distinguish between Gouraud and Phong shading techniques.