What to Read Series
for
GATE CSE

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GATE Topper Algorithm

1. Check topics from this document
2. Study them from any standard textbook, else go to NPTEL
3. Try a couple of simple questions from end chapters to know if you understand basics of that topic
4. Try GATE previous years related questions
5. If you find some questions in GATE papers not related to the topic you studied, go back to Step 2.

Before using the book

1. The books and video lectures mentioned are the best possible sources for the subject and you can choose one of them or as needed. For doubts regarding books and videos check GATECSE - Books and GATECSE - Video Lectures or better write your query on the Facebook groups.

2. **Types of Problems** section has been made after analyzing through many previous year GATE question papers. It does not guarantee the questions will only come from those mentioned, but gives you an idea how and from questions have been asked. But if you aim high, then please complete full syllabus.

3. [XYZ] is a short tag for the book mentioned so that we don't have to write full names of the authors. So don't get confused when you see them in the Topics and Chapters table.

MATHEMATICS

Syllabus

Discrete Mathematics : Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions.

Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.

Calculus: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.

Probability: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

Reference Books

- Discrete Mathematics and its applications by Kenneth H Rosen 7th Ed.
- Discrete Mathematics with Applications by Susanna S Epp
- Advanced Engineering Mathematics by Erwin Kryszig - 9th edition
- Graph Theory by Narsingh Deo
- A first course in Probability by Sheldon Ross

Optional Books

- Kolman-Busby-Ross - Group and Semigroup - 9.1 to 9.5
- Ralph P Grimaldi - Discrete & Combinatorial Math - Ring : 14.1 and 14.2

Video Lectures :

- Lectures on Discrete Mathematical Structures by Kamala Kritivasan, IITM
- LU Decomposition
- Linear Algebra and Calculus by Techtud

Topics and Chapters :

- Propositional and first order logic - Rosen Chapter 1 - 1.1 to 1.6
  - Propositional Logic - Page 1 to 12. page 16 and 17
  - Propositional Equivalences - Page 25 to 31
  - Predicates and Quantifiers - page 37 to 49
  - Nested Quantifiers - page 57 to 63
  - Rules of Inference - page 69 to 78
- Sets - Rosen Chapter 2 : 2.1 , 2.2 Relations - Rosen Chapter 9 , 9.1 to 9.5 Functions - Rosen Chapter 2.3
- Partial orders and lattices - Rosen Chapter 9.6
- Groups : Group, Abelian Group, Semigroup, Monoid, Ring, Integral domain fields from IITM lectures 35, 36, 37
- Graphs : connectivity, matching, coloring is there in syllabus
  - Rosen - connectivity, euler and hamilton paths , coloring is in chapter 10 – 10.4, 10.5, 10.8
  - Narsingh Deo Chapter 2 - 2-5, 2-6, Chapter 4 - 4-5 [connectivity], Chapter 8 - 8-1, 8-2, 8-4, 8-6.
- Counting, recurrence relations, generating functions - Rosen Chapter 6, 8
- Linear Algebra : Kreyszig - 9th edition Chapter 7.1 to 7.7, 8.1 to 8.3, video lectures
- Calculus : mean value theorem page 402 Kreyszig , and also from above video link
- Probability : Sheldon Ross,8th edition, chapter 1, 2, 3, 4 [exclude 4.8] ,5 [exclude 5.6]

Types of Problems

- Simple problems on logic. Sets Related Questions. Properties of relation, function. Partial and Total Ordering.
- Hasse Diagrams, Group Theory.
- Different types of graph and their properties : vertex and edge connectivity , separable graph , k-connected graph, connected component, matching , graph coloring (4-color theorem), Euler and Hamiltonian Graphs, Konigsberg Bridge problem, Independent set of vertices, chromatic number are important.
- Tricky Problems on Permutations and Combinations. Pigeonhole principle.

- LA : Eigen values and eigen vectors question. Simple questions related to matrix. Finding Values of variable with some properties of linear equations like infinite no ofsolutions or unique solution.
- Calculus : Finding Maxima and Minima. Properties of limit, Continuity and differentiability. Finding values by Mean Value Theorem. Integration.
- Probability : practice Bayes theorem, Normal and Poisson distribution, mean and variance of different distributions, standard deviation.

DIGITAL LOGIC

Syllabus

Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Reference Book

Digital Design – Morris Mano 3rd Edition

Video Lectures

- IITM S Srinivasan [Lectures 1-30]
- MOOC : IIT - M

Topics :

Boolean algebra : Laws of Boolean algebra, Theorems of Boolean algebra, Switching functions, Methods for specification of switching functions - Truth tables and Algebraic forms, Realization of functions using logic gates.

Combinational and sequential circuits :

I. Design of Combinational Logic Circuits:

- Gate level design of Small Scale Integration (SSI) circuits, Modular combinational logic elements - Decoders, Encoders, Priority encoders, Multiplexers and Demultiplexers.
- Design of Integer Arithmetic Circuits using Combinational Logic: (Application)
- Integer adders - Ripple carry adder and Carry look ahead adder, Integer subtractors using adders, Unsigned integer multipliers - Combinational array circuits, Signed integer multipliers - Booth's coding, Bit-pair recoding, Carry save addition and Wallace tree multiplier.
- Signed integer division circuits - Combinational array circuits, Complexity and propagation delay, analysis of circuits.

II. Sequential Circuit Elements:

Latches -RS latch and JK latch, Flip-flops-RS, JK, T and D flip flops, Master-slave flip-flops, Edge-triggered flip-flops.

III. Analysis and Design of Synchronous Sequential Circuits:

- Models of sequential circuits - Moore machine and Mealy machine
- Flip-flops - Characteristic table, Characteristic equation and Excitation table•
- Analysis of sequential circuits- Flipflop input expressions, Next state equations, Next state maps, State table and State transition diagram
- Modular sequential logic circuits - Shift registers, Registers, Counters and Random access memories

IV. Design of Arithmetic Circuits using Sequential Logic :

Serial adder for integers, Unsigned integer multiplier, Unsigned integer division circuits, Signed integer division, Floating-point adder/subtractor - Design of control circuit, Floating - point multiplier

V. Introduction to digital computer :

- Design of Arithmetic circuits – Adders, Multipliers
- Design of Memory – ROM/RAM
- Minimization (Simplification of Boolean Expressions and Functions) :
- Algebraic methods, Canonical forms of Boolean functions, Minimization of functions using
- Karnaugh maps, Minimization of functions using Quine-McClusky method.
- Number representations and computer arithmetic (fixed and floating point) :
    - Number systems and codes - (Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic)
    - Representation of unsigned and signed integers, Fixed-point representation of real numbers, Floating-point representation of real numbers

Types of Problems

- Practice K-Map minimization. SOP, POS forms and Don't care representation
- Practice questions related to Floating Point representation, integer representation,
- IEEE format, range and precision.
- Determining minimum number of NAND/NOR gates required to realize a boolean expression [2004, 2009]
- For a given truth table, find the function
- Important flip flops - J-K, D, T, R-S type of flip flops. For given flip-flops, modulus of counter is asked.
- Questions on J-K flip flop state sequence [2014, 2015]
- Calculate the propagation delay in flip flops
- 4 Input multiplexer 4 to 1, determine the output [2010,2014]
- For a given sequence, find out minimum number of j-k flip flip require to implement the counter [2016 , 2015] Questions on counters were asked in 2004, 2007, 2011, 2014
- Design of counter using flip flop [2015, 2016] Propagation delay of adder – [2004 - 62] , [2015 Set 1 – 47, Set 2 – 65]

COMPUTER ORGANIZATION AND ARCHITECTURE

Syllabus

Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory hierarchy, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.

Reference Books

- ***Hamacher and Zaky 5th Edition***
- Computer Organization by Morris Mano 3rd Edition
- William Stallings - International edition
- Fundamental of COA by Mostafa

Video Lectures

- IIT-M Computer Organization lectures by S Raman
- IISc High Performance Computing lectures by Matthew Jacob. Follow Lecture No. 1, 2, 3, 4, 5, 21, 22, 23, 24, 25, 26, 27, 28 for complete syllabus
- IIT-KGP Digital Computer Design by PK Biswas specifically for Pipeline
- IIT-D lectures for Henessey and Patterson followers

Topics and Chapters

Instruction set architecture : Instruction types, Instruction formats, addressing modes.	[Zaky] 2.4 and 2.5 [Mano] 8.4, 8.5 , 5.1,5.2 5.3, 5.4, 5.5
Arithmetic : Representation of fixed and floating-point numbers, 2's complement arithmetic.	[Zaky] 6.1,6.4 (Booth's algo), 6.7(IEEE standards) [Mano] 3.2,3.3,3.4 ,10.2,10.3(Booth),10.5
Control unit : Organization of a CPU, control and data paths, micro-operations, register-transfer level specifications	[Zaky] 7.1 , 7.2, 7.4, 7.5 [Mano] 4.1,4.2 , 7.4 For RTL : Page 37, read 2.1, 2.2, 2.3 transfer level specifications For Datapath : Page 414
Memory system : Typical signal lines in a ROM and RAM, building memory subsystems using smaller modules. Concept of memory hierarchy, cache memory, cache performance, cache-main memory mapping.	[Zaky] 5.1, 5.2.1, 5.2.2, 5.3, 5.4, 5.5, 5.6, 5.7 , 5.8,5.9 [Mano] 12.1, 12.2, 12.3, 12.5, 12.6 (optional)
Input-output systems : Programmed I/O, Interrupt-driven I/O, polling and vectored interrupt, basic concept of DMA transfer.	[Zaky] 2.7, 4.1,4.2,4.4,4.5,4.7 [Mano] 11-2, 11-4, 11-5[daisy chain] , 11-6
Pipelining : Basics of pipeline	[Zaky] 8.1 to 8.5, 8.8 [Mano] 9.2, 9.3, 9-4

Specific breakdown for Zaky and Hamacher (5th Edition)

- Chapter 2 (Machine Instr.) 2.1.1 to 2.1.4, 2.2 , 2.4, 2.5, 2.7, 2.9
- Chapter 4 (I/O organization) 4.2, 4.4, 4.5, 4.7.
- Chapter 5 (The memory system) 5.1 to 5.9.
- Chapter 6 (Arithmetic) 6.1, 6.3, 6.4(booth algo) , 6.6, 6.7 .
- Chapter 7 (Basic processing unit) 7.1, 7.2, 7.4, 7.5 .
- Chapter 8 (Pipelining) 8.1 to 8.5 and 8.8

Among these topics cache access policy, pipeline and m/c instructions are very important.

Types of Problems

- Addressing Modes : Theory and questions
- Numerical related to program counter after some instruction, no of one address-two address instructions, Values after shift and rotate instructions, horizontal and vertical programming related questions.
- Numerical Problems on Speed up of pipeline, time taken to complete instruction in pipeline and non-pipeline architectures, Hazards in pipeline, hazards removal, branch penalty etc.
- Numerical Problems on cache memory organization, mapping technique, multilevel caches, write through and write back technique

THEORY OF COMPUTATION

Syllabus

Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and contex-free languages, pumping lemma. Turing machines and undecidability.

Reference Books

- Peter Linz - [Chapter 1 to 12]
- Daniel Cohen - [Chapter 1 to 31]
- John C Martin - [Chapter 1 to 9]

Video Lectures

- IIT- K lectures by Dr. Somenath Biswas
- IIT- M lectures by Dr. Kamala Kritivasan

Topics and relevant chapters

**Regular Expressions	Linz : 3.1, 3.2, 3.3 Cohen : 3 , 4 Martin : 3.1 to 3.5
**Finite Automata	Linz : 2.1, 2.2, 2.3,2.4 Cohen : 5, 6, 7, 8, 9 Martin : 2.1 to 2.6
**Context-free Grammars	Linz : 5.1 , 5.2, 5.3 and 6.1, 6.2 Cohen : 13 ,14,15,16 Martin : 4.2
**Pushdown Automata	Linz : 7.1, 7.2, 7.3 Cohen : 17 and 18 Martin : 5.1 to 5.5
**Regular Language	Linz : 4.1, 4.2, 4.3 Cohen : 10, 11, 12 Martin : 3.1, 4.3
Context-Free languages	Linz : 8.2 Cohen : 19, 21 , 22, 23 Martin : 4.1, 4.2, 4.4, 4.5
Pumping Lemma	Linz : 8.1 Cohen : 20 Martin : 6.1 to 6.3
**Turing machines	Linz : 9.1, 9.2, 9.3 and 10, 11

	Cohen : 24, 25, 26 , 27 Martin : 7.1 to 7.8 and 8.1 to 8.5
Undecidability	Linz : 12.1 to 12.4 Cohen : 28, 29, 30, 31 Martin 9.1 to 9.5

Types of Problems

Finite Automata covers approximately 50% questions from TOC. This topic is very important

- Minimization of finite Automata , Closure Properties of finite automata .
- Finding minimum number of states, NFA to DFA conversion, Finding Regular Expressions, Mealy Moore machine .
- Regular Expression identification.
- Construction of finite Automata from regular Expression
- Generation of regular expression from finite Automata
- Equivalence of regular Expression

CFG and PDA : Practice more on problems on simplification of CFG, pushdown automata, closure properties etc.

Regular and Context Free Languages :

- Closure properties of regular language
- Decidability of regular language
- Check whether the given language is regular or not
- Do problems on finding category of any language or grammar.
- Concepts related to expressive power of different languages.

Turing Machine and Undecidability :

- Basic problems related to NP-Completeness.
- Properties of Recursive and Recursively Enumerable Languages.
- Turing machine design and expressive power of different types of Turing machine.

DATA STRUCTURES AND ALGORITHMS

Syllabus

- DS : Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.
- Algorithms : Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, shortest paths.

Reference Books

- [TAN] Data Structures Using C - Aaron M. Tanenbaum
- [MAW] Data Structures and Algorithm Analysis in C by Mark Allen Weiss
- [HOR] Fundamentals of Data Structures by Horowitz and Sahni
- [CLRS] (covers DSA completely)

Video Lectures

- NPTEL Web course on Data Structures by IIT-G
- NPTEL IIT-B Design and Analysis of Algorithms
- MIT 6.042J [SMA-2005] : taught by Charles Leiserson and Erik Demaine
- NPTEL IIT-D Lectures on Data Structures

Topics and Chapters

Data Structures

Arrays	[MAW] 3.2.1 [HOR] Chapter 2
Stacks	[MAW] 3.3 [CLRS] 10.1 [HOR] Chapter 3 [TAN] Chapter 2
Queues	[MAW] 3.4 [CLRS] 10.1 [HOR] Chapter 3 [TAN] 4.1 to 4.5
Linked Lists	[MAW] 3.2 [CLRS] 10.2 [HOR] Chapter 4
Trees	[MAW] Chapter 4 [CLRS] 10.4 [HOR] Chapter 5

	[TAN] 5.1 to 5.5
Binary Search Trees	[MAW] 4.3 [CLRS] 12.1 to 12.3
Binary Heaps	[MAW] Chapter 6 [CLRS] 6.1, 6.2, 6.3, 6.5
Graphs	[MAW] 9.1.1 [CLRS] Chapter 22 [TAN] 8.1 to 8.4 [HOR] Chapter 6

Algorithms

Searching : Binary Search , Selection	[CLRS] : 12.1, 12.2, 12.3 [TAN] : 7.1 to 7.4
Sorting : Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Heap Sort, Quick Sort, Radix Sort, Bucket Sor	[CLRS] - Chapter 1, 2, 6.4 , 7 [excluding 7.3] ,8 [TAN]6.1 to 6.5
Hashing	[MAW] Chapter 5 [CLRS] 11.1 to 11.4
Asymptotic worst case time and space complexity	CLRS - Chapters 3,4. [excluding 4.4]
Algorithm design techniques	Greedy - CLRS 16.1, 16.2, 16.3 . Dynamic programming - CLRS 15.1, 15.2, 15.3, 15.4 Divide-and-conquer - CLRS Chapter 2
Graph search	BFS, DFS - CLRS 22.1 to 22.5
Minimum spanning trees	CLRS : Prim’s and Kruskal’s algorithms 23.1, 23.2
Shortest paths	Single Source Shortest Path - CLRS 24 [excluding 24.4 and 24.5] All Pairs Shortest Path - CLRS 25.1, 25.2

Types of Problems

- Understand Different Problems on Stack, Queue, Link List. Generally they come in a C program.
- Properties of Heap. Deletion and insertion of items in the heap.
- Practice Tree problems like no of leaf nodes, non leaf nodes, total nodes, height of the tree, no of full nodes, mirror image, etc. AVL tree and balancing them on insertion and Deletion. Binary tree, Binary Search Tree, Inorder, Preorder, Postorder traversal.
- Spanning Trees, Minimum Spanning Tree problems.
- Finding Complexity : Sometimes direct questions are asked say find complexity of Heap sort, but mostly you are given a code or question. You need to find best / average case complexity of that problem. So try to find complexity of every algorithm or program which you practice. Understand properties of complexity. Sometimes relation between them is asked.
- Searching and Sorting Problems. Difference between Different Techniques and how to apply them on different real life problems.
- Questions on approach of dynamic programming, Divide and Conquer [Merge Sort] ,Greedy [Huffman code has been asked many times for GATE] and Brute Force.
- Practice basic problems like quick sort, merge sort, knapsack problem, matrix chain multiplication, LCS, Job sequencing, Compressing Mechanism.
- Questions come from filling of hash tables with : Linear probing, Quadratic probing,
- Expected no. of empty slots after x insertions (application of probability), Load factor.
- Closed hashing, Property of a hash function and Universal Hashing

COMPILER DESIGN

Syllabus

Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.

Reference Book

- Compiler Design by Aho, Ullman and Sethi (Dragon Book)
  - Chapter 1 - FULL
  - Chapter 2 - FULL
  - Chapter 3 - 3.1, 3.2, 3.3, 3.4 , 3.5
  - Chapter 4 - 4.1, 4.2, 4.3, 4.4 to 4.9
  - Chapter 5 - 5.1, 5.2, 5.3 , 5.4, 5.5
  - Chapter 6 - 6.1, 6.2, 6.6 , 6.7
  - Chapter 7 - 7.2 ,7.3, 7.4

Video Lectures

NPTEL Lectures by Prof. SK Agarwal: Only watch Lectures 2, 4 to 27

Previous year problems

- 3-address code : [minimum number of temporary variables] constructing 3 address code for an expression (See Topic 6.2)
- Abstract Syntax tree - from syntax directed translation (Topic 5.3)
- Control flow graph no of nodes and edges from Intermediate code generation (Topic
- 6.6) [CFG not in syllabus]
- Finding First and Follow (Topic 4.4)
- Parsing : There is always a question related to parsing. You need to practice all parsing technique because there is also chances for linked questions. (Topics 4.4-4.9)
- Finding internal node in syntax-directed translation 5.4, 5.5
- Number of token generated 3.3 ,3.4
- Questions from Topics 4.4 – 4.7 LL(1)-LR(1)-SLR-LALR-CLR.
- Precedence and Associativity of operators. (Topics 4.8, 4.9)
- Finding value from expression tree. (Topics 2.8 , 6.1)
- Ambiguous grammar (Topic 4.3)

OPERATING SYSTEMS

Syllabus

Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Reference Books

[GAL] Operating System Concepts By Galvin 7th Edition	Chapter - 1 , 2, 3, 4, 5, 6, 7, 8 , 9, 10 , 11, 12
[STA] Operating Systems Internals and Design Principles By William Stalling , 5 Ed	Chapter 3 , 4, 5 , 6, 9, 7 , 8 , 12
Modern Operating System By Andrew S Tanenbaum- 3 rd Edition	Chapter 2 , 3 , 4, 6

Video Lectures

IIT-KGP Lectures by PK Biswas (esp. For Scheduling, Deadlock)	Lectures 1 - 29
IISc - T Mathew Jacob (best for process, IPC, Concurrency, memory & VM, Files and storage)	Lectures 12 - 20 , 34 , 35

Topics and Chapters

Processes	[GAL] 3.1, 3.2, 3.3 [STA] 3.1, 3.2, 3.3, 3.4
Threads	[GAL] 4.1, 4.2, 4.4, 4.5 [STA] 4.1, 4.2
Inter-process Communication	[GAL] 3.4 , 3.5 , 3.6
** Concurrency and synchronization	[GAL] 6.1, 6.2, 6.3, 6.5, 6.6, 6.7, 6.8, 6.9 (Better than STA) [STA] 5.1, 5.2, 5.3, 5.4, 5.5, 5.6
** Deadlock	[GAL] 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7 [STA] 6.1, 6.2, 6.3, 6.4, 6.6
** CPU scheduling	[GAL] 5.1, 5.2, 5.3, 5.4, 5.5, 5.7 [STA] 9.1, 9.2
** Memory Management	[GAL] 8.1, 8.2, 8.3, 8.4, 8.5, 8.6) [STA] 7.1, 7.2, 7.3, 7.4
Virtual memory	[GAL] 9.1, 9.2, 9.4, 9.5, 9.6, 9.7, 9.8 [STA] 8.1, 8.2 (Better than GAL)

** File systems:	[GAL]10.1 - 10.3, 10.5 ; 11.1 -11.6; ** 12.2, 12.3, 12.4, 12.5, 12.7 [STA] 12.1, 12.2, 12.4, 12.6

Types of Problems

- Scheduling : Numerical Questions have more chances. Practice more in finding turn around time and waiting time of different scheduling policies.
- Deadlock : Bankers Algo, Given Sequence is safe or not. Chances of common data or linked questions.
- Concurrency and Synchronization : High Probability Of Questions in exam.
- Practice some question related to semaphores and classical problems of synchronization (this will help you to solve other questions), Mutual Exclusion case using P and V , Critical section problem.
- Memory Management : Questions generally comes from page table size, number of pages, logical address, physical address, page size, inverted page table, virtual memory, TLB etc.
- File systems: Algorithms for disk scheduling

COMPUTER NETWORKS

Reference Books

- [K&R] Computer Networking: A Top-Down Approach (6th Edition) Kurose and Ross
- [TAN] Andrew S Tanenbaum - Computer networks, 4th edition

Video Lectures

- NPTEL CN Lectures by Prof. Ghosh, IIT-KGP
- Stanford Lectures

Topics with Chapters

Concept of layering	[K&R] 1.5 [TAN] 1.4
LAN technologies (Ethernet)	[K&R] 5.4.2 [TAN]4.3
** Flow and error control techniques	[K&R] 3.4.2,3.4.3, 3.4.4, 3.5.5, 5.2 [TAN] 3.1, 3.2 [Error Ctrl], 3.3.2, 3.4
Switching	[K&R] 1.3.1, 1.3. [TAN] 2.5.5
** IPv4/IPv6	[K&R] 4.4.2, 4.4.4 [TAN] 5.6.1, 5.6.2, (IPv4) 5.6.8 (IPv6)
Routers	[K&R] 4.3 [TAN] 5.1.3, 5.1.4
** Routing algorithms (distance vector, link state)	[K&R] 4.5.1 , 4.5.2 [TAN] 5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.2.5
TCP/UDP and sockets	[K&R] 3.3, 3.5 (sockets - 2.7) [TAN] 6.1.3(sockets) , 6.4.1(udp), 6.5.1,6.5.2,6.5.3,6.5.4,6.5.5, 6.5.6, 6.5.8
** Congestion control	[K&R] 3.6, 3.7 [TAN] 5.4.2 [leaky & token]
Application layer protocols (DNS, SMTP, POP, FTP, HTTP)	[K&R] 2.1, 2.2, 2.3, 2.4,2.5 (overview) [TAN] 7.1,7.2,7.3
Basics of Wi-Fi	[K&R] 6.1,6.2,6.3 (5.7 in old version) [TAN] 4.4
Network security	[K&R] 8.4 (authentication) [TAN] 8.7
** Basics of public and private key cryptography	[K&R] (Asymetric key cryptography) 8.2.2 [TAN] 8.3
Digital signatures and Certificates	[K&R] 8.3.3 [TAN] 8.4.2 , 8.5.1
Firewalls	[K&R] 8.9.1 [TAN] 8.6.2

Types of Problems

- Addressing related questions : Subnet address, supernet address, brodcast address, range of network, no of host, classless addressing, non continuous addresses, first host and last host finding etc.
- Properties Of Circuit Switching and packet switching, Routing Protocols and Numerical Problems on them.
- Flow Control and Error Control Policies.
- Numerical Problems on Window Size [sliding window protocols] , No Of Sequence bits, frame size, bandwidth, round trip time, utilization, Hamming Distance, CRC.
- Congestion Control policies like slow start, congestion avoidence and Congestion Detection.
- IP Header , TCP and UDP header format, theory related to Ethernet and token ring.
- Basics Of Diferent Type of protocols like : FTP, HTTP, DHCP, ARP, RARP, SMTP, ICMP, POP.
- Basic Concepts of Cryptography and firewalls.

DATABASE MANAGEMENT SYSTEMS

Syllabus

ER-model. Relational model: relational algebra **, tuple calculus **, SQL. Integrity constraints, normal forms**. File organization, indexing (e.g., B and B+ trees**). Transactions and concurrency control.

Reference Books

[RAG] Database Management Systems by Raghu Ramakrishnan and Gehrke ~ 2nd edition	Chapters 1, 2, 3 [3.1- 3.5], 4 [4.1,4.2,4.3] , 5 [5.1 - 5.5, 5.6.2, 5.6.3, 5.6.4] ,8,9, 15, 18, 19
[KOR] Database System Concepts by Silberschatz, Korth and Sudarshan ~ 4th edition	Chapters 2, 3, 4, 6, 7, 11, 12, 15,16
[NAV] Fundamentals of Database Systems – Elmasri and Navathe ~ 4th edition	Chapters 2,3, 5,6, 7.1,8,10,11,14,17,18

Video Lectures

- NPTEL Lectures – IIT Madras
- NPTEL Lectures – IIT KGP

Topics and Chapters

E/R Model	[RAG] 2.1 to 2.5 , [KOR] 2.1 to 2.9
Relational Data Model	RAG 3.1 – 3.5, 4.1, 4.2,4.3 [KOR] - 3.1 to 3.6
SQL	[RAG] 5.1 - 5.5, 5.6.2, 5.6.3, 5.6.4 [KOR] - 4.1 to 4.7, 4.9
Dependencies and Normal forms	[NAV] 10.1 to 10.5; 11.1, 11.2, 11.3, 11.4, [RAG] - 15.1 to 15.8
Data Storage and Indexes	[RAG] 8.1 to 8.4 , 9.1 to 9.7, 10.1 to 10.3 [KOR] - 12.1,12.2[imp, Multilevel -12.2.1.2] , 12.3,12.4[imp] , 12.5
Transaction processing and Error recovery	[KOR] - 15.1- 15.5[imp] ,15.6 – 15.9 [imp] , Concurrency – 16.1,16.2 [imp],16.3, 16.6, 16.7, 16.8 [RAG] - 18.1 to 18.4 , 19.1, 19.2, 19.3.1

Types of problems

ER-model and Relational model : relational algebra, tuple calculus

- Minimum number of tables required [2005, 2008]
- Properties of ER model [2012]
- Meaning of given Tuple Relational Calculus query [2008, 2007]
- Normal form [2016]
- Meaning of relational algebra statement [2007, 2014]
- Functional dependencies [2005]
- Relation algebra optimized version [2014] , problems on Join [2004, 2014] , optimized form [2014], no.of tuples [2012 , 2013]
- Meaning of query [2008]

SQL : Practice select clause properly with additional properties of having, group by, any, all, exit. Question may come with relational algebra in common data section.

Integrity constraints, normal forms.

- Normalization : find normal form [2016 - 09, 08, 03], finding candidate keys [2005, 2011, 2013, 2014] , decomposition of relation [2002] , loss less join and dependency preservation [2001] minimal cover [2014]

Transactions and concurrency control

- Finding View and Conflict serializability [2003, 2008, 2010, 2014, 2012]
- Finding Recoverable [2014, 2006 ,2015 ,2016] and Cascade schedule.
- Lock based[2004], Two phase, time stamp and graph based protocal with their properties like deadlock freedom [2016], starvation freedom.
- Acid properties in real life situation in transaction [2015 , 2016]

File organization and indexing.

- Formation and structure of B and B+ trees
- Primary and clustering index[2008 , 2002, 2013, 2015]
- Numerical Questions from no of block required in indexing of different type,[IT 2005] collision resolution minimum and maximum no of nodes in B,B+ trees [2010]. ordered indexing & hashing 2011