GATE Topper Algorithm by Bikram Sir

1. Check topics from this post.

2. Study them from any standard textbook , if not understand go with 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.

MATHEMATICS

Syllabus

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 :

- Kenneth H Rosen 7th Ed. - Chapter 1,2 and 6 , 8, 9 , 10 (10.4, 10.5, 10.8)
- Susanna S Epp - Discrete Mathematics with Applications : Chapter 2 , 3, 6, 7, 8 , 9
- Erwin Kryszig - 9th edition Chapter 7.1 to 7.7 , 8.1 to 8.3 , 20.2
- Narsingh Deo - Chapter 2-5, 2-6, 4-5, 8-1, 8-2, 8-4, 8-6
- Sheldon Ross - Chapter 1,2,3, 4 [exclude 4.8] ,5 [exclude 5.6]

Optional :

- 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 [https://www.youtube.com/playlist?list=PL0862D1A947252D20]

LU Decomposition : this is the first video which need to be watched then shortcut ,finally system of equations video have to watch.

Linear Algebra and Calculus by Techtud

Topics with Chapter Subparts :

- 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, FIELD 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 no 2 - 2-5, 2-6, Chapter no 4 - 4-5 [connectivity] , Chapter no 8 - 8-1, 8-2, 8-4, 8-6 , so 4 color theorem , Independent set is imp from graph coloring.
- 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]

3. Types of problems asked in previous years :

1. Simple problems on logic.

2. Sets Related Questions. Properties of relation, function. Partial and Total Ordering.

3. Hasse Diagrams, Group Theory.

4. Different types of graph and there 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 .

5. Tricky Problems on Permutations and Combinations. Pigeonhole principle.

6. LA : Eigen values and eigen vectors question. Simple questions related to matrix.

7. LA : Finding Values of variable with some properties of linear equations like infinite no of solutions or unique solution.

8. Calculus : Finding Maxima and Minima. Properties of limit, Continuity and differentiability. Finding values by Mean Value Theorem. Integration.

9. For probability questions You need to practice Bays theorem, Normal and poisson distribution, mean and variance of different distributions , standard deviaton .

DIGITAL LOGIC

Reference Book :

- Digital Design – Morris Mano 3rd Edition [Chapter 1,2,3,4,5,6,7,9]

Video Lectures -

- IITM S Srinivasan [Lectures 1-30]
- MOOC : IITM Shankar Balachandran

Syllabus

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

2. Specific topics to be covered

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

3. 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

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

3 . Types of problems :

- Practice K-Map minimization. SOP, POS , Don't care representation
- Practice Multiplexer, De-multiplexer, Encoder, Decoder questions.
- Understand concept of flip flop. They are given and modulas of counter is asked.
- Practice questions related to Floating Point representation, integer representation, IEEE format, range and precision."
- A Truth table is given , what function does it represent
- D Flip - Flop
- 4 Input multiplexer 4 to 1, determine the output 2010,2014
- J-K flip flop state sequence 2014 , 2015
- Calculate the propagation delay in flip flops
- Minimum no of gates required to implement the given boolean function 2009, 2004
- For a given sequence, find out minimum number of j-k flip flip require to implement the counter 2016 , 2015
- Counter - 2011, 2007, 2004, 2014
- Important flip flops - J-K , D, T , RS type of flip flops
- Propagation delay of adder - 2004 [62] , 2015 set 1[47] ,set 2[65]
- Design of counter using flip flop [2015, 2016]
- Determining-minimum-number-of- nand-nor-gates-required-to-realize-a-boolean expression [2009, 04]

COMPUTER ORGANIZATION AND ARCHITECTURE

Reference Books :

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

1. 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.

2. Specific topics

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 For RTL : Page 37, read 2.1, 2.2, 2.3 For Datapath : Page 414 [Mano] 4.1,4.2 , 7.4
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 and 8.8 [Mano] 9.2, 9.3, 9-4

Specific 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.

Video Lectures – IIT-M Lectures by S Raman , IIT-KGP Digital Computer Design by PK Biswas specifically for Pipeline

3 . Types of problems generally comes from that chapter.

- 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.

1. Reference Books :

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

2. Video Lectures :

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

3. Topics to be read [marked parts are important for problems]**

**Regular Expressions	Linz - 3.1, 3.2, 3.3 Cohen - Chapter : 3 , 4 Martin - 3.1 to 3.5
**Finite Automata	Linz 2.1, 2.2, 2.3,2.4 Cohen - Chapter : 5, 6, 7, 8, 9 Martin - 2.1 to 2.6
**Context-free Grammars	Linz Chapter - 5 : 5.1 , 5.2, 5.3 , Chapter 6 - 6.1, 6.2 Cohen - Chapter : 13 ,14,15,16 Martin : 4.2
**Pushdown Automata	Linz Chapter - 7 : 7.1, 7.2, 7.3 Cohen - Chapter : 17 and Chapter : 18 Martin : 5.1 to 5.5
**Regular Language	Linz Chapter - 4 : 4.1, 4.2, 4.3 Cohen - Chapter : 10 , 11, 12 Martin : 3.1, 4.3
Context-Free languages	Linz Chapter – 8.2 Cohen - Chapter : 19, 21 , 22, 23 Martin 4.1, 4.2, 4.4, 4.5
Pumping Lemma	Linz Chapter - 8.1 Cohen - Chapter : 20 Martin - 6.1 to 6.3
**Turing machines	Linz Chapter - 9 : 9.1 , 9.2, 9.3 , Chapter 10, 11 Cohen - Chapter : 24, 25, 26 , 27 Martin 7.1 to 7.8 , 8.1 to 8.5
Undecidability	Linz Chapter - 12 : 12.1 to 12.4 Cohen - Chapter : 28, 29, 30, 31 Martin 9.1 to 9.5

3. Types of problems asked in Previous years :

Finite Automata covers approximately 50% questions from TOC. So give it more time then others

- 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 : In Context free grammer practice more on simplification of CFG, pushdown automata, closure properties etc.

Regular and Context Free Languages :

- Closure properties of regular language
- Decidability of regular Language
- 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 Recursive Enumerable Languages.
- Turing Machine making and expressive power of different type 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** [Chapter 1 to 8, 9.3]
  Chapters 1 and 2 FULL
  [Recursion] Chapter 3 - 3.1, 3.2, 3.3
  [Queue and Stack] Chapter 4 - 4.1 to 4.5
  [Tree DS] Chapter 5- 5.1 to 5.5
  [Sorting] Chapter 6 FULL 6.1 to 6.5
  [Searching] Chapter 7 completely - 7.1 to 7.4
  [Graphs] Chapter 8 completely - 8.1 to 8.4
  [DMM] Chapter 9 - 9.3

- [**MAW**] **Data Structures and Algorithm Analysis in C by Mark Allen Weiss** [Chapter - 2, 3 , 4, 5, 6, 7, 9, 10]

- [**HOR**] **Fundamentals of Data Structures by Horowitz and Sahni** [Chapter - 1 , 2, 3 , 4, 5, 6, 7, 9]

- [**CLRS**] (covers DSA completely) : Chapter 1,2,3,4[excluding 4.4],6,7[excluding 7.3],8,10,11[excluding 11.5],12[excluding 12.4], 15.1, 15.2,15.4 , 16.1, 16.2, 16.3 , 18, 22,23, 24[excluding 24.4 and 24.5] ,25

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

2. Specific Topics

I. 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

II. Algorithms

Searching : Binary Search , Selection	CLRS - Linear Search, binary search. Chapter 12 of 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 Sort	CLRS - Chapter 1, 2, 6.4 , 7 [excluding 7.3] ,8 [TAN]6.1 to 6.5
Hashing : Hashing Techniques Direct Addressing , Properties of hash function, Universal hashing Types of hashing -- a) Chaining b) Open addressing , Collision resolution schemes - a)Linear Probing b) Quadratic Probing c) Double Hashing	[MAW] Chapter 5 CLRS 11.1 to 11.4

Demerits associated with linear and quadratic probing(Primary and Secondary Clustering Problem)	
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

3 . Types of problems from where questions came previous years :

- Understand Different Problems on Stack, Queue, Link List. Generally they come in a C program, but you can solve them only if you know the logic.

- 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 question comes related to complexity like give 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

Types of problems comes in exam:

- 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:

Operating System Concepts By Galvin 7th Edition	Chapter - 1 , 2, 3, 4, 5, 6, 7, 8 , 9, 10 , 11, 12
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 completely have to read

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

2. Topics with Chapter readings (are important for problems)**

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

3. **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 :

1. [K&R] Computer Networking: A Top-Down Approach (6th Edition) by Kurose and Ross {Chapters 1- 5, , Chapter 6 (basics of wifi) - 6.1, 6.2 , 6.3 , Chapter 8 – security in computer networks }
2. [TAN] Andrew S Tanenbaum - Computer networks, 4th edition (Chapter 1,2,3,4,5,6,7,8)

Topics with Chapter Subparts (NOTE: ** marked parts are important for problems)

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:	authentication [K&R] 8.4 [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

Video Lectures :

NPTEL CN Lectures by Prof. Ghosh, IIT-KGP

Stanford Lectures

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 :

Database Management Systems by Raghu Ramakrishnan, Johannes 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
Database System Concepts by Abraham Silberschatz, Henry F. Korth, S. Sudarshan ~ 4th edition	Chapters 2, 3, 4, 6, 7, 11, 12, 15,16
Fundamentals of Database Systems - By Ramez Elmasri, Shamkant B. Navathe ~ 4th edition	Chapters 2,3, 5,6, 7.1,8,10,11,14,17,18

Topics with Chapter Subparts :

Introduction - General introduction to database systems; Database - DBMS disctinction, approaches to building a database, data models, database management system, three-schema architecture of a database, challenges in building a DBMS, various components of a DBMS.	[RAG] 1.2,1.3, 1.5, 1.6,1.7 , 1.8,1.9 [Korth] 1.1 - 1.9
E/R Model - Conceptual data modeling - motivation, entities, entity types, various types of attributes, relationships, relationship types, E/R diagram notation, examples.	[RAG] 2.1 to 2.5 , [Korth] 2.1 to 2.9
Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators: selection, projection, cross product, various types of joins, division, example queries, tuple relation calculus, domain relational calculus, converting the database specification in E/R notation to the relational schema***	RAG 3.1 – 3.5, 4.1, 4.2,4.3 Korth - 3.1 to 3.6, {only tuple calculus}
SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL - basic select-from-where block and its semantics, nested queries - correlated and uncorrelated, notion of aggregation, aggregation functions group by and having clauses, embedded SQL.	[RAG] 5.1 - 5.5, 5.6.2, 5.6.3, 5.6.4 Korth - 4.1 to 4.7, 4.9
Dependencies and Normal forms - Importance of a good schema design, problems encountered with bad schema designs, motivation for normal forms,	Navathe 10.1 to 10.5; 11.1, 11.2, 11.3,11.4, Raghuramakrishnan - 15.1 to 15.8

dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, multi-valued dependencies and 4NF, join dependencies and definition of 5NF.	
Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.	[RAG] 8.1 to 8.4 , 9.1 to 9.7 , 10.1 to 10.3 , Korth - 12.1,12.2[imp, Multilevel -12.2.1.2] , 12.3,12.4[imp] , 12.5
Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.	Korth - 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

Video Lectures:

NPTEL Lectures – IIT Madras

NPTEL Lectures – IIT KGP

Types of problems :

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

- Minimum number of tables required 05 ,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 [2013,11,14,05] , decomposition of relation [2002] , loss less join and dependency preservation[2001] minimal cover - 2014

4. Transactions and concurrency control

- Finding View and Conflict serializability [2014 ,2012,10,2003,2008]
- Finding Recoverable [2014, 2006 ,2015 ,2016] and Cascade schedule.
- Lock based[2004], Two phase, time stamp and graph based protocal with there properties like deadlock freedom [2016], starvation freedom.
- Acid properties in real life situation in trandaction 2015 , 2016

5. File organization, indexing (e.g., B and B+ trees).

- Formation and structure of B and B+ trees
- Primary and clustering index[2013, 08 , 2002, 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