Compiler Design, Computer Network & Operating System

Workbook

Computer Science Engineering
Information Technology

GATE

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Computer Science Engineering

Information Technology

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GATE Syllabus

Compiler Design : Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation. Local optimisation, Data flow analyses: constant propagation, liveness analysis, common sub expression elimination.

Computer Network : Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet, circuit and virtual circuit-switching; Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP, DHCP, ICMP), Network Address Translation (NAT); Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

Operating System : System calls, processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU and I/O scheduling. Memory management and virtual memory. File systems.

Contents

Compiler Design :

Computer Network :

Operating System :

Compiler Design

1 Lexical & Syntax Analysis

Classroom Questions

Q.1 In a compiler the module that checks every character of the source text is called:
(A) The code generator
(B) The code optimizer
(C) The lexical analyzer
(D) The syntax analyzer
[GATE 1989 : IIT Kanpur]

Q.2 Match the following:
List - I
(a) Lexical Analysis
(b) Code Optimization
(c) Code Generation
(d) Abelian Group
List - II
(p) DAG's
(q) Syntax trees
(r) Push Down automata
(s) Finite automata
(A) a-s, b-p, c-q, d-r
(B) a-r, b-p, c-q, d-s
(C) a-s, b-q, c-p, d-r
(D) a-s, b-p, c-r, d-q
[GATE 1991 : IIT Madras]

Q.3 In some programming languages, an identifier is permitted to be a letter followed by any number of letters or digits. If L and D denotes the set of letters and digits respectively, which of the following expressions defines an identifier?
(A) $(L \cup D)^+$ (B) $L(L \cup D)^*$
(C) $(L.D)^*$ (D) $L(L.D)^*$
[GATE 1995 : IIT Kanpur]

Q.4 Type checking is normally done during
(A) Lexical analysis
(B) Syntax analysis
(C) Syntax directed translation
(D) Code optimization
[GATE 1998 : IIT Delhi]

Q.5 The number of tokens in the FORTRAN statement **DO 10 I = 1.25** is
(A) 3
(B) 4
(C) 5
(D) None of the above
[GATE 1999 : IIT Bombay]

Q.6 The number of tokens in the following C statement is
$\text{printf}("i = \%d, \& i = \%x", i, \& i);$
(A) 33 (B) 26
(C) 10 (D) 21
[GATE 2000 : IIT Kharagpur]

Q.7 Consider line number 3 of the following C - program

```
int main ( ) {          /*Line 1 * /
int I, N;               /*Line 2 * /
for (I = 0; I < N; I++); /*Line 3 * /
}
```

Identify the compiler's response about this line while creating the object module **[GATE 2005 : IIT Bombay]**
(A) No compilation error
(B) Only a lexical error
(C) Only syntactic errors
(D) Both lexical and syntactic errors.

Q.8 Match all items in Group 1 with correct option from those given in Group 2
Group 1
P. Regular expression
Q. Pushdown automata
R. Dataflow analysis
S. Register allocation
Group 2
1. Syntax analysis
2. Code generation
3. Lexical analysis
4. Code optimization

Codes :
(A) $P-4, Q-1, R-2, S-3$
(B) $P-3, Q-1, R-4, S-2$
(C) $P-3, Q-4, R-1, S-2$
(D) $P-2, Q-1, R-4, S-3$
[GATE 2009 : IIT Roorkee]

Q.9 In a compiler, keywords of a language are recognized during
(A) parsing of the program
(B) the code generation
(C) the lexical analysis of the program
(D) dataflow analysis

[GATE 2011 : IIT Madras]

Q.10 Match the following :

List-I

(P) Lexical analysis
(Q) Top down parsing
(R) Semantic analysis
(S) Runtime environment

List-II

(i) Leftmost derivation
(ii) Type checking
(iii) Regular expressions
(iv) Activation records

(A) $P \leftrightarrow i, Q \leftrightarrow ii, R \leftrightarrow iv, S \leftrightarrow iii$
(B) $P \leftrightarrow iii, Q \leftrightarrow i, R \leftrightarrow ii, S \leftrightarrow iv$
(C) $P \leftrightarrow ii, Q \leftrightarrow iii, R \leftrightarrow i, S \leftrightarrow iv$
(D) $P \leftrightarrow iv, Q \leftrightarrow i, R \leftrightarrow ii, S \leftrightarrow iii$

[GATE 2016 : IISc Bangalore]

Q.11 Match the following according to input (from the left column) to the compiler phase (in the right column) that process is :

List-I

(P) Syntax tree
(Q) Character stream
(R) Intermediate representation
(S) Token stream

List-II

(i) Code generator
(ii) Syntax analyzer
(iii) Semantic analyzer
(iv) Lexical analyzer

(A) $P \rightarrow (ii), Q \rightarrow (iii), R \rightarrow (iv), S \rightarrow (i)$
(B) $P \rightarrow (ii), Q \rightarrow (i), R \rightarrow (iii), S \rightarrow (iv)$
(C) $P \rightarrow (iii), Q \rightarrow (iv), R \rightarrow (i), S \rightarrow (ii)$
(D) $P \rightarrow (i), Q \rightarrow (iv), R \rightarrow (ii), S \rightarrow (iii)$

[GATE 2017 : IIT Roorkee]

Q.12 A lexical analyzer uses the following patterns to recognize three tokens T1, T2, and T3 over the alphabet {a,b,c}.

T1: a?(b|c)*a
T2: b?(a|c)*b
T3: c?(b|a)*c

Note that 'x?' means 0 or 1 occurrence of the symbol x. Note also that the analyzer outputs the token that matches the longest possible prefix.

If the string bbaacabc is processes by the analyzer, which one of the following is the sequence of tokens it outputs?

(A) T1T2T3 (B) T1T1T3
(C) T2T1T3 (D) T3T3

[GATE 2018 : IIT Guwahati]

Q.13 Which one of the following statements is FALSE?

(A) Context-free grammar can be used to specify both lexical and syntax rules.
(B) Type checking is done before parsing.
(C) High-level language programs can be translated to different Intermediate Representations.
(D) Arguments to a function can be passed using the program stack.

[GATE 2018 : IIT Guwahati]

Q.14 The grammar $A \rightarrow AA \mid (A) \mid \varepsilon$ is not suitable for predictive parsing because the grammar is

(A) Ambiguous
(B) Left recursive
(C) Right recursive
(D) An operator grammar

Common Data for Questions 15 & 16

Consider the context-free grammar

$E \rightarrow E + E$
$E \rightarrow (E * E)$
$E \rightarrow id$

where E is the starting symbol, the set of terminals is {id, (,+,),*}, and the set of non-terminals is {E}.

Q.15 Which of the following terminal strings has more than one parse tree when parsed according to the above grammar?

(A) id + id + id + id
(B) id + (id* (id * id))
(C) (id* (id * id)) + id
(D) ((id * id + id) * id)

[GATE 2005 : IIT Bombay]

Q.16 For the terminal string with more than one parse tree obtained as solution to in above question, how many parse trees are possible?

(A) 5 (B) 4
(C) 3 (D) 2

[GATE 2005 : IIT Bombay]

Q.17 Which one of the following grammars generates the languages $L = (a^i b^j | i \neq j)$?

(A) $S \to AC|CB$
$C \to aCb|a|b$
$A \to aA|\varepsilon$
$B \to Bb|\varepsilon$

(B) $S \to aS|Sb|a|b$

(C) $S \to AC|CB$
$C \to aCb|\varepsilon$
$A \to aA|\varepsilon$
$B \to Bb|\varepsilon$

(D) $S \to AC|CB$
$C \to aCb|\varepsilon$
$A \to aA|a$
$B \to Bb|b$

[GATE 2006 : IIT Kharagpur]

Q.18 In the correct grammar above, what is the length of the derivation (number of steps starting from S) to generates the strings $a^l b^m$ with $l \neq m$

(A) $\max(l,m)+2$ (B) $l+m+2$
(C) $l+m+3$ (D) $\max((l,m)+3$

[GATE 2006 : IIT Kharagpur]

Common Data for Questions 19 & 20

Consider the CFG with {S, A, B} as the non-terminal alphabet, {a, b} as the terminal alphabet, S as the start symbol and the following set of production rules.

$S \to bA$ $S \to aB$
$A \to a$ $B \to b$
$A \to aS$ $B \to bS$
$A \to bAA$ $B \to aBB$

Q.19 Which of the following strings is generated by the grammar?

(A) aaaabb (B) aabbbb
(C) aabbab (D) abbbba

[GATE 2007 : IIT Kanpur]

Q.20 How many derivation trees are there?

(A)1 (B)2
(C)3 (D) 4

[GATE 2007 : IIT Kanpur]

Q.21 What is the maximum number of reduce moves that can be taken by a bottom up parser for a grammar with no epsilon and unit production (i.e. of type $A \to \varepsilon$ and $A \to a$) to parse a string with n tokens?

(A) $n/2$ (B) $n-1$
(C) $2n-1$ (D) 2^n

[GATE 2013 : IIT Bombay]

Q.22 Consider the grammar defined by the following production rules, with two operators* and +

$S \to T*P$
$T \to U|T*U$
$P \to Q+P|Q$
$Q \to id$
$U \to id$

Which one of the following is TRUE?

(A) + is left associative, while * is right associative
(B) + is right associative, while * is left associative
(C) Both + and * are right associative
(D) Both + and * are left associative

[GATE 2014 : IIT Kharagpur]

Common Data for Questions 23 & 24

For the grammar below, a partial LL(1) parsing table is also presented along with the grammar. Entries that need to be filled are indicated as E1, E2 and E3. ε is the empty string, $ indicates end if input, and, | separates alternate right hand sides of productions.

$S \to aAbB|bAaB|\varepsilon$
$A \to S$
$B \to S$

	a	b	$
S	F1	F2	$S \to \varepsilon$

(A){R} (B){w} (C){w, y}
(D) {w, ∉}

A	$A \to S$	$A \to S$	Error
B	$B \to S$	$B \to S$	E3

Q.23 The FIRST and FOLLOW sets for the non-terminals A and B are

(A) FIRST $(A) = \{a, b, \varepsilon\} = \text{FIRST(B)}$

FOLLOW(A) $= \{a, b\}$

FOLLOW(B) = $\{a, b, \$\}$

(B) FIRST (A) $= \{a, b, \$\}$

FIRST (B) $= \{a, b, \varepsilon\}$

FOLLOW(A) $= \{a, b\}$

$\text{FOLLOW(B)} = \{\$\}$

(C) FIRST (A) = $\{a, b, \varepsilon\} = \text{FIRST(B)}$

$\text{FOLLOW(A)} = \{a, b\}$

$\text{FOLLOW(B)} = \phi$

(D) FIRST (A) = $\{a, b\} = \text{FIRST(B)}$

FOLLOW(A) = {a, b}

FOLLOW(B) = {a, b}

[GATE 2012 : IIT Delhi]

Q.24 The appropriate entries for E1, E2 and E3 are

(A) $E1 : S \to aAbB, A \to S$

$E2 : S \to bAaB, B \to S$

$E3 : B \to S$

(B) $E1 : S \to aAbB, S \to \varepsilon$

$E2 : S \to bAaB, S \to \varepsilon$

$E3 : S \to \varepsilon$

(C) $E1 : S \to aAbB, S \to \varepsilon$

$E2 : S \to bAaB, S \to \varepsilon$

$E3 : B \to S$

(D) $E1 : A \to S, S \to \varepsilon$

$E2 : B \to S, S \to \varepsilon$

[GATE 2012 : IIT Delhi]

Q.25 Consider the following grammar :

$P \to xQRS$

$Q \to yz \mid z$

$R \to w \mid \varepsilon$

$S \to y$

What is FOLLOW(Q)?

[GATE 2017 : IIT Roorkee]

Q.26 Consider the grammar given below:

$S \to Aa$

$A \to BD$

$B \to b \mid \varepsilon$

$D \to d \mid \varepsilon$

Let a,b,d, and $ be indexed as follows:

a	b	d	$
3	2	1	0

Compute the FOLLOW set of the non-terminal B and write the index values for the symbols in the FOLLOW set in the descending order. (For example, if the FOLLOW set is {a, b, d,$}, then the answer should be 3210)

[GATE 2019 : IIT Madras]

Q.27 Consider the SLR (1) and LALR (1) parsing tables for a context free grammar. Which of the following statements is/ are true?

(A) The goto part of both tables may be different

(B) The shift entries are identical in both the tables

(C) The reduce entries in the tables may be different

(D) The error entries in the table may be different.

[GATE 1992 : IIT Delhi]

Q.28 Which of the following statements is true?

(A) SLR parser is more powerful than LALR.

(B) LALR parser is more powerful than Canonical LR parser.

(C) Canonical LR parser is more powerful than LALR parser.

(D) The parsers SLR, Canonical LR, and LALR have the same power.

[GATE 1998 : IIT Delhi]

Q.29 Which of the following statements is false?

(A) An unambiguous grammar has the same leftmost and rightmost derivation

(B) An LL(1) parser is a top-down parser

(C) LALR is more powerful than SLR (Simple LR)

(C) LALR (1) but not SLR (1)

(D) LR (1) but not LALR (1)

[GATE 2003 : IIT Madras]

(D) An ambiguous grammar can never be LR(k) for any k.

[GATE 2001 : IIT Kanpur]

Q.30 Which of the following suffices to convert an arbitrary CFG to an LL (1) grammar?

(A) Removing left recursion alone

(B) Factoring the grammar alone

(C) Removing left recursion and factoring the grammar

(D) None of the above

[GATE 2003 : IIT Madras]

Q.31 Assume that the SLR parser for a grammar G has n_1 states and the LALR parser for G has n_2 states. The relationship between n_1 and n_2 is

(A) n_1 is necessarily less than n_2

(B) n_1 is necessarily equal to n_2

(C) n_1 is necessarily greater than n_2

(D) None of the above

[GATE 2003 : IIT Madras]

Q.32 Consider the grammar shown below

$$S \rightarrow iEtSS' \mid a$$

$$S' \rightarrow eS \mid \varepsilon$$

$$E \rightarrow b$$

In the predictive parse table M, of this grammar, the entries $M[S', e]$ and $M[S', \$]$ respectively are

(A) $\{S' \rightarrow eS\}$ and $\{S' \rightarrow \varepsilon\}$

(B) $\{S' \rightarrow eS\}$ and $\{\}$

(C) $\{S' \rightarrow \varepsilon\}$ and $\{S' \rightarrow \varepsilon\}$

(D) $\{S' \rightarrow eS, S' \rightarrow \varepsilon\}$ and $\{S' \rightarrow \varepsilon\}$

[GATE 2003 : IIT Madras]

Q.33 Consider the grammar shown below :

$$S \rightarrow CC$$

$$C \rightarrow cC \mid d$$

The grammar is

(A) LL (1)

(B) SLR (1) but not LL (1)

Q.34 Which of the following grammar rules violate the requirement of an operator grammar? P, Q, R are non-terminals and r, s, t are terminals.

(i) $P \rightarrow QR$ (ii) $P \rightarrow QsR$

(iii) $P \rightarrow \varepsilon$ (iv) $P \rightarrow QtRr$

(A) (i) only

(B) (i) and (iii) only

(C) (ii) and (iii) only

(D) (iii) and (iv) only

[GATE 2004 : IIT Delhi]

Q.35 Consider the grammar

$$S \rightarrow (S) \mid a$$

Let the number of states in SLR (1), LR (1) and LALR (1) parsers for the grammar be n_1, n_2 and n_3 respectively. The following relationship holds good

(A) $n_1 < n_2 < n_3$ (B) $n_1 = n_3 < n_2$

(C) $n_1 = n_2 = n_3$ (D) $n_1 \geq n_3 \geq n_2$

[GATE 2005 : IIT Bombay]

Q.36 Consider the following grammar.

$$S \rightarrow S*E$$

$$S \rightarrow E$$

$$E \rightarrow F+E$$

$$E \rightarrow F$$

$$F \rightarrow id$$

Consider the following LR(0) items corresponding to the grammar above.

(i) $S \rightarrow S*\cdot E$

(ii) $E \rightarrow F.+E$

(iii) $E \rightarrow F.+E$

Given the items above, which two of them will appear in the same set in the canonical sets of items for the grammar?

(A) (i) and (ii)

(B) (ii) and (iii)

(C) (i) and (iii)

(D) None of these

[GATE 2006 : IIT Kharagpur]

Q.37 Consider the following grammar

$$S \rightarrow FR$$

$$R \rightarrow *S \mid \varepsilon$$

$$F \rightarrow id$$

[GATE 2007 : IIT Kanpur]

Q.41 Which of the following describes a handle (as applicable to LR parsing) appropriately?

(A) It is the position in a sentential form

In the predictive parser table, M, of the grammar the entries M[S, id] and M [R, $] respectively.

(A) $\{S \to FR\}$ and $\{R \to \varepsilon\}$

(B) $\{S \to FR\}$ and $\{\}$

(C) $\{S \to FR\}$ and $\{R \to *S\}$

(D) $\{F \to id\}$ *and* $\{R \to \varepsilon\}$

[GATE 2006 : IIT Kharagpur]

Q.38 Which one of the following is a top down parser?

(A) Recursive descent parser

(B) Operator precedence parser

(C) An LR (k) parser

(D) An LALR (k) parser

[GATE 2007 : IIT Kanpur]

Q.39 Consider the following two statements :

P : Every regular grammar is LL (1)

Q : Every regular set has LR(1) grammar.

Which of the following is TRUE?

(A) Both P and Q are true

(B) P is true and Q is false

(C) P is false and Q is true

(D) Both P and Q are false

[GATE 2007 : IIT Kanpur]

Q.40 Consider the grammar with non-terminals $N = \{S, C, S_1\}$, terminals $T = \{a, b, i, t, e\}$, with S as the start symbol, and the following set of rules

$$S \to iCtS\,S_1 \mid a$$

$$S_1 \to eS \mid \varepsilon$$

$$C \to b$$

The grammar is not LL(1) because :

(A) It is left recursive

(B) It is right recursive

(C) It is ambiguous

(D) It is not context free

(A) It is the position in a sentential form where the next shift or reduce operation will occur

(B) It is a non-terminal whose production will be used for reduction in the next step.

(C) It is production that may be used for reduction in a future step along with a position in the sentential form where the next shift or reduce operation will occur.

(D) It is the production p that will be used for reduction in the sentential form where the right hand side of the production may be found.

[GATE 2008 : IISc Bangalore]

Q.42 An LALR(1) parser for a grammar G can have shift reduce (S-R) conflicts if and only if

(A)The SLR (1) parser for G has S-R conflicts

(B)The LR (1) parser for G has S-R conflicts

(C)The LR (0) parser for G has S-R conflicts

(D)The LALR (1) parser for G has reduce-reduce conflicts

[GATE 2008 : IISc Bangalore]

Q.43 The grammar $S \to aSa \mid bS \mid c$ is

(A)LL(1) but not LR (1) (B)LR (1) but not LL(1)

(C)Both LL (1) and LR (1)

(D)Neither LL(1) nor LR(1)

[GATE 2010 : IIT Guwahati]

Q.44 Consider the following two sets of LR(1) items of an LR (1) grammar

$X \to c.X, c/d$ $\quad$ $X \to c.X, \$$

$X \to .cX, c/d$ $\quad$ $X \to .cX, \$$

$X \to .d, c/d$ $\quad$ $X \to .d, \$$

Which of the following statements related to merging of the two sets in the corresponding LALR parser is/are FALSE?

1. Cannot be merged since look aheads are different.
2. Can be merged but will result in S-R conflict.
3. Can be merged but will result in R-R conflict.

(C) $P-2, Q-4, R-1, S-3$

(D) $P-2, Q-3, R-4, S-1$

[GATE 2015 : IIT Kanpur]

Q.48 Among simple LR (SLR), canonical LR, and look – ahead LR (LALR), which of the following pairs identify the method

4. Cannot be merged since goto on c will lead to two different sets.

(A) 1 only (B) 2 only
(C) 1 and 4 only (D) 1, 2, 3 and 4

[GATE 2013 : IIT Bombay]

Q.45 A canonical set of items is given below

$S \rightarrow L. > R$

$Q \rightarrow R.$

On input symbol <the set has

(A) A shift reduce conflict and a reduce-reduce conflict.
(B) A shift-reduce conflict but not a reduce-reduce conflict.
(C) A reduce –reduce conflict but not a shift-reduce conflict.
(D) Neither a shift-reduce nor a reduce conflict.

[GATE 2014 : IIT Kharagpur]

Q.46 Which one of the following is TRUE at any valid state in shift-reduce parsing?

(A) Viable prefixes appear only at the bottom of the stack and not inside
(B) Viable prefixes appear only at the top of the stack and not inside
(C) The stack contains only a set of viable prefixes
(D) The stack never contains viable prefixes

[GATE 2015 : IIT Kanpur]

Q.47 Match the following :

List-I

P. Lexical analysis
Q. Parsing
R. Register allocation
S. Expression evaluation

List-II

1. Graph coloring
2. DFA minimization
3. Post-order traversal
4. Production tree

Codes :

(A) $P-2, Q-3, R-1, S-4$

(B) $P-2, Q-1, R-4, S-3$

that is very easy to implement and the method that is the most powerful, in that order

(A) SLR, LALR
(B) Canonical LR, LALR
(C) SLR, canonical LR
(D) LALR, canonical LR

[GATE 2015 : IIT Kanpur]

Q.49 Consider the following grammar G

$S \rightarrow F|H$

$F \rightarrow p|c$

$H \rightarrow d|c$

Where S, F, and H are non-terminal symbol, p, d, and c are terminal symbol. Which of the following statements (s) is/are correct?

S1 : LL(1) can parse all string that are generated using grammar G

S2 : LR(1) can parse all strings that are generated using grammar G

(A) Only S1
(B) Only S2
(C) Both S1 and S2
(D) Neither S1 nor S2

[GATE 2015 : IIT Kanpur]

Q.50 Which of the following statements about parser is/are CORRECT?

(i) Canonical LR is more powerful than SLR.
(ii) SLR is more powerful than LALR.
(iii) SLR is more powerful than Canonical LR.

(A) (i) only
(B) (ii) only
(C) (iii) only
(D) (ii) and (iii) only

[GATE 2017 : IIT Roorkee]

Q.51 Consider the augmented grammar given below:

S′ → S
S → ⟨L⟩ | id
L → L,S | S

Let I0 = CLOSURE ({[S′ → S]}). The number of items in the set GOTO (I0, <) is _____ **[GATE 2017 : IIT Roorkee]**

Q.52 Which one of following kinds of derivation is used by LR parsers?

(A) Leftmost
(B) Leftmost in reverse
(C) Rightmost

Q.53 Consider the following grammar.

S → aSB | d

B → b

The number of reduction steps taken by a bottom-up parser while accepting the string aaadbbb is _____

[GATE 2020 : IIT Delhi]

(D) Rightmost in reverse

[GATE 2019 : IIT Madras]

Practice Questions

Q.1 The number of tokens in the following C code is:

Print f ("i= %d, j= % d, & i= %x, i, j & i);

(A) 3 (B) 28

(C) 12 (D) 23

Q.2 A non left recursive and left factored grammar in which all non- empty rules defining the same non terminal have disjoint first sets, such grammar is called is___

(A) LL (1) (B) LR (0)

(C) SLR (1) (D) None of these

Q.3 Consider the grammar

$Z \rightarrow Z \uparrow Y$

$Y \rightarrow T \hat{} Y / id$

Which of the following is false

(A) $\uparrow$ is left associative

(B) $\hat{}$ is right associative

(C) $\hat{}$ has higher precedence than $\uparrow$

(D) Both $\uparrow$ and $\hat{}$ are left associative

Q.4 The # define..... Direction in C is handled on a C compiler

(A) By the lexical analysis

(B) By the syntax analysis

(C) By the semantic analysis

(D) By the code optimizer

Q.5 The grammar $S \rightarrow T \mid \varepsilon \mid a,\ T \rightarrow S \mid a$

(A) is ambiguous and hence not SLR (1)

(B) is unambiguous & LR (0)

(C) is not LALR (1) but is SLR (1)

(D) is Unambiguous and hence not SLR (0)

Q.6 Which one of the following is TRUE at any valid state in shift reduce parsing?

(A) Viable prefixes appear only at the bottom of the stack and not inside

(B) Viable prefixes appear only at the top of the stack and not inside

(C) The stack contains only a set of viable prefixes.

(D) The stack never contains viable prefixes.

Q.7 Compute the FOLLOW set of S for the following CFG:

$S \rightarrow SPQR$

$P \rightarrow pPt \mid \varepsilon$

$Q \rightarrow qQ \mid \varepsilon$

$R \rightarrow Rr \mid Qm \mid \varepsilon$

(A) $\{p,q,r,m,\$\}$ (B) $\{p,q,r,t,\$\}$

(C) $\{q,r,m,\$\}$ (D) $\{p,q,r,m,t,\$\}$

Q.8 Consider the following CFG:

$E \rightarrow A$

$A \rightarrow BC \mid DBC$

$B \rightarrow Bb \mid \in$

$C \rightarrow c \mid \in$

$D \rightarrow a \mid d$

What is the FIRST and FOLLOW set of nonterminal B?

(A) FIRST $= \{b, \in\}$, FOLLOW $= \{b, c\}$

(B) FIRST $= \{b\}$, FOLLOW $= \{b, c, \$\}$

(C) FIRST $= \{b\}$, FOLLOW $= \{b, \$\}$

(D) FIRST $= \{b, \in\}$, FOLLOW $= \{b, c, \$\}$

Q.9 Consider the following grammar:

$E \rightarrow E * F \mid F$

$F \rightarrow E + G \mid G$

$G \rightarrow id \mid \in$

In the above grammar:

(A) * is left associative, + is right associative

(B) + is left associative, + is right associative

(C) Both are left associative

(D) Both are right associative

Q.10 Consider the following statements about parsers:

S1: Top- down parser cant parse left

Q.14 In the grammar $E \rightarrow E = E \mid E \mid E \mid i$ when we construct a SLR (1) machine

(A) No inadequate states parse

(B) Inadequate states can be resolved using the associativity and precedence of $= \& +$.

(C) Inadequate states cannot be resolved

(D) None of the above

recursive grammar.

S2: Keywords of a language are recognized during parsing of the program.

Choose the suitable option about above statements.

(A) S_1 is false, S_2 is true

(B) S_1 is true, S_2 is false

(C) Both statements are true

(D) Both statement are false

Q.11 Choose the False statement.

(A) No left recursive / ambiguous grammar can be LL (1)

(B) The class of grammars that can be parsed using LR methods is proper subset of the class of grammar that can be parsed by LL method

(C) LR parsing is non- backtracking method

(D) LR parsing can describe more languages than LL parsing

Q.12 Which of the following is True?

(A) Handle of a string is a sub string that matches left hand side of production

(B) RR conflicts never occur in LALR (1)

(C) SR conflicts occur in LALR (1)

(D) None of these

Q.13 The grammar

$S \to FA$

$S \to \varepsilon \mid \phi TA$

$F \to i$

Reflects that

(A) ϕ is left associative.

(B) ϕ is right associative

(C) Cannot deduce associative from the grammar

(D) None of the above.

Q.15 Consider the following statements:

(A) LL (k) grammars have one to one correspondence with DCFLs.

(B) LE (k) grammars have one to one correspondence with CFLs.

(A) A is true but B is False.

(B) A is false but B is True.

(C) Both are False

(D) Both are True.

Q.16 Consider grammar with start symbol 'E"

$E \to TE'$

$E' \to +TE' \mid \in$

$T \to FT'$

$T' \to *FT' \mid \in$

$F \to (E) \mid id$

Which of the following statement is correct?

(i) '+'has more precedence than '*'

(ii) '*' has more precedence than '+'

(iii) Both have same precedence

(iv)' id' has less precedence than '('

(A) i (B) ii

(C) iii (D) iv

Q.17 Construct the LALR (1) set of items for the grammar:

$S' \to S$

$S \to +SS \mid a$

Then, identify, in the list below, one of the LALR (1) sets of items for

(A) $[S \to a., \$]$

(B) $[S \to a., +a]$

(C) $[S \to +SS., \$ + a]$

(D) $[S \to +SS., \$]$

Q.18 Consider the following CFG, with S as start symbol:

$S \to aA \mid CB$

$A \to BaA \mid \in$

$B \to bB \mid Abc \mid \in$

$C \to B$

Which of the following is correct/

First $(S) = \{a, b, \in\}$ $(S) = \{a, \in\}$

(A) First $(B) = \{b, \in\}$

Follow $(C) = \{b, a, \$\}$

First $(S) = \{a, b, \$\}$

(B) First $(B) = \{b, \in\}$

(C) Both G_1 and G_2 is LR (k)

(D) None is LR (k)

Q.23 Consider the following grammar.

$S \to aB \mid aAb$

$A \to aAb \mid a$

$B \to aB \mid \varepsilon$

How many back tracks are required to generate the string aab from the above grammar?

(A) 1(B) 2

Follow $(C) = \{a, b, \in\}$

(C) First $(B) = \{b, \in\}$

Follow $(C) = \{b, a, \$\}$

(D) First $(B) = \{a, \in\}$

Follow $(C) = \{b, a, \$\}$

Q.19 Consider an SLR (1) and LALR (1) tables, which of the following is true?

(A) Shift entries are different

(B) Reduce entries are same

(C) Goto entries are different

(D) Error entries are different

Q.20 Among simple LR (SLR), canonical LR, and Look- ahead LR (LALR), which of the following pairs identify the method that is very easy to implement and the method that is the most powerful, in that order?

(A) SLR, LALR

(B) Canonical LR, LALR

(C) SLR, canonical LR

(D) LALR, canonical LR

Q.21 $S \to aSAb \mid bSBc \Rightarrow \text{First}(S) = \{a, b\}$

$A \to +AB \mid \varepsilon \Rightarrow \text{First}(A) = \{+, \varepsilon\}$

$B \to *BC \mid \varepsilon \Rightarrow \text{First}(B) = \{*, \varepsilon\}$

$C \to aC + d \Rightarrow \text{First}(C) = \{a, d\}$

What is in the follow (S)?

(A) $\{a, b, c, +, \$\}$ (B) $\{a, c, +, *, \$\}$

(C) $\{b, c, +, *, \$\}$ (D) $\{a, b, d, *, \$\}$

Q.22 Consider the following two grammars.

$G_1 : A \to A1 \mid 0A \mid 01$

$G_2 : A \to 0A \mid 1$

Which of the following is True regarding above grammars?

(A) G_1 is LR (k)

(B) G_2 is LR (k)

(C) 3 (D) 4

Q.24 $S \to aA * S$

$A \to +S \mid (S \mid \varepsilon$

Set {+,(} will be in the

(A) First (A) (B) First (E)

(C) Follow (E) (D) Follow (A)

Q.25 The grammar $S \to aSa \mid bS \mid \in$ is

(A) LL (1) but not LR (1)

(B) LR (1) but not LL (1)

(C) Both LL (1) and LR (1)

(D) Neither LL (1) nor LR (1)

Q.26 Consider the SDTS below

$E \to E + T \mid T$

$T \to id$

Choose the correct statement?

(A) + is left associative

(B) + is right associative

(C) The grammar is ambiguous

(D) Associativity cannot be associated with +.

Q.27 $S \to Sa \mid b$

Which of the following is True?

(A) There will be SR conflict during parsing

(B) There will be RR conflict during parsing

(C) There will be both conflict

(D) There will be no conflict

Q.28 $P \to P\alpha Q \mid Q$

$Q \to Q\beta R \mid R$

$R \to \text{num}$

If $2\alpha 3\alpha 4\beta 1\alpha 2\beta 1$ is evaluated to 18, then which of the following is the correct value for α and β

(A) +, * (B) +, $-$

(C) *, $-$ (D) $-$,+

Q.29 Which of the following is operator grammar?

(A) $S \to AA$

$A \to a \mid \in$

(B) $S \to SAS$

$A \to a$

(C) $S \to AB$

$A \to aA \mid + \mid a$

$B \to aB \mid + \mid b$

(D) $S \to A + B$

$A \to aA \mid a$

Q.32 Consider the following grammar:

$E \to TE'$

$E' \to +TE' \mid \in$

$T \to FT'$

$T' \to *FT' \mid \in$

$E \to (E) \mid id$

Which of the following is correct regarding the entry in the predictive parsing table (LL (1) parsing table) M for above grammar?

(A) $M[T, (] = T \to FT', M[T', +] = T' \to \in$

$B \to bB \mid b$

Q.30 Consider the following statements:

S_1 : A regular grammar is always linear but not all linear grammar is regular.

S_2 : In LL grammar, the usage of production rule can be predicted exactly, by looking at a limited part of input.

Which of the above statements are true?

(A) S_1 is true and S_2 is false

(B) S_2 is true and S_1 is false

(C) Both are true

(D) Both are false

Q.31 The grammar which is equivalent to

$S \to SAa \mid Sa \mid a$

$A \to Ab \mid b$

After eliminating of left recursion is

(A) $S \to aS'$
$S' \to AaS' \mid aS'$
$A \to bA'$
$A' \to bA' \mid \in$

(B) $S \to AaS' \mid aS'$
$S' \to aS' \mid \in$
$A \to bA'$
$A' \to bA' \mid \in$

(C) $S \to aS'$
$S' \to AaS' \mid aS'$
$A \to bA'$
$A' \to bA' \mid \in$

(D) $S \to aS'$
$S' \to AaS' \mid aS'$
$A \to bA'$
$A' \to \in$

(B) $M[E,(] = E' \to \in, M[E',*] - E' \to \in$

(C) $M[E,(] = E \to TE', M[E,*] \to E \to \in$

(D) $M[T,id] = T \to FT', M[T,)] = T \to FT'$

Q.33 Consider the following augmented grammar with labels a and b

$S' \to S$

$a : S \to (S)S$

$b : S \to \varepsilon$

LR (0) sets are given as following for the above grammar.

(1)	(2)	(3)	(4)	(5)	(6)
$S' \to S$	$S' \to S$	$S \to (S.)S$	$S \to (S.)S$	$S \to (S.)S$	$S \to (S)S.$
$S \to S(S)$		$S \to .(S)S$		$S \to .(S)S$	
$S \to$		$S \to .$		$S \to .$	

If the following SLR (1) table is constructed as below then find the missing entries at E_1, E_2 and E_3 respectively

	(	)	$	S
1	S_3	r_b	r_b	2
2	.		Accept	
3	S_3	E_1	E_2	4
4		S_5		
5	S_3	r_b	r_b	E_3
6		r_a	r_a	

(A) $r_a, r_b, 5$ (B) $r_a, r_a, 6$

(C) $r_b, r_a, 5$ (D) $r_b, r_b, 6$

Q.34 Assume $\times, -, +$ and / are operators. Precedence and associativity given for those operators as following:

1. $\times$ has highest precedence among all operators and it is left associative
2. $-, +$ and / are having equal precedence and they are right associative.

Using $\times$ as Multiplication, $-$ as subtraction, $+$ as Addition and / is Division.

The output of the following expression:

$10 \times 10 - 5 + 15 - 5 \times 10 / 5$ is _____,

Q.35 Consider the following grammar

$S \to ABA$

$A \to Bc \mid dA \mid \in$

$S \to .aAbB \mid bAaB \mid \in$

$A \to S$

$B \to S$

The number of entries have multiple production in LL (1) table are_____.

Q.41 Let G to a grammar with the following productions:

$E \to E + T \mid T$

$T \to T * F \mid F$

$T \to (E) + T - F$

$F \to id$

If LR (1) parser is used to construct the

$B \to eA$

How many entries have multiple productions in LL (1) table?

Q.36 Find the number of tokens in the following C code using lexical analyzer of compiler Main ( )

{

Int * a, b;

$B = 10;$

$A = \&b;$

Print (" % d % d", b, *a);

$B =$ */* pointer */ b;

}

Q.37 Consider the grammar given below

$S \to E\#$

$E \to .T \mid E;T$

$T \to Ta \mid \varepsilon$

Number of inadequate states in DFA with LR (0) items is

Q.38 Consider the following augmented grammar.

$S \to aAb \mid eb$

$A \to e \mid f$

The number of states in LR (0) construction are_____.

Q.39 Consider the following grammar:

$S \to Aa \mid B$

$B \to a \mid bC$

$C \to a \mid \in$

The number of productions in simplified CFG is_____.

Q.40 Consider the following grammar which is not LL (1) because LL (1) table contain multiple entry for same production.

DFA using the above production, then how many look a-heads are present for an item $T \to .T*F$ in the initial state_____.

Q.42 Find the number of tokens in the following C code using lexical analyzer of compiler.

Main ( )

{

/* int a = 10; */

Int * u, * v, s;

u = & s;

v = & s;

printf (" %d %d", s, *u);

//code ended

}

Q.43 Consider the following program:

Main ( )

{ int x = 10 ;

It (x < 20;

Else

y = 20 ;

}

When lexical analyzer scanning the above program, how many lexical errors can be produced?

Q.44 How many DFA states are constructed for the following augmented grammar using LR (0) parser?

$S' \to \cdot S\$$

$S' \to x \mid (A)$

$A \to A, S \mid S$

Where S is the start symbol and $S' \to S\$$ is augmented production.

Q.45 Let G be the following grammar:

$S \to aABbCD$

$A \to ASd \mid \in$

$B \to SAc \mid hC \mid \in$

$C \to Sf \mid Cg$

$C \to \cdot BD \mid \in$

How many number of productions will be in G after elimination of all null productions only?

{Consider $S \to a \mid b$ as 2 productions (i) $S \to a$, (ii) $S \to b$}.

❑❑❑

2 Semantic Analyzer

Classroom Questions

Q.1 Which data structure in a compiler is used for maintaining information about variables and their attributes?
(A) Abstract syntax tree
(B) Symbol table
(C) Semantic stack
(D) Parse table

[GATE 2010 : IIT Guwahati]

Q.2 A shift reduce parser carries out the actions specified within braces

Which of the following is true? a. '⊕' is left associative while '*' is right associative b. Both '⊕' and '*' are left associative c. '⊕' is right associative while '*' is left associative d. None of the above
(A) a (B) b
(C) c (D) d

[GATE 1997 : IIT Madras]

Q.5 In a bottom-up evaluation of a syntax

immediately after reducing with the corresponding rule of grammar.

$S \rightarrow xxW\{\text{print}"1"\}$

$S \rightarrow y\{\text{print}"2"\}$

$W \rightarrow Sz\{\text{print}"3"\}$

What is the translation of "xxxxyzz" using the syntax directed translation scheme described by the above rules?

(A) 23131 (B)11233

(C) 11231 (D) 33211

[GATE 1995 : IIT Kanpur]

Q.3 Consider the productions A → PQ and A → XY. Each of the five non-terminals A, P,Q,X, and Y has two attributes: s is a synthesized attribute, and i is an inherited attribute. Consider the following rules.

Rule 1 : P.i=A.i+2, Q.i=P.i+A.i, and A.s=P.s+Q.s

Rule 2 : X.i=A.i+Y.s and Y.i=X.s+A.i

Which one of the following is TRUE?

(A) Both Rule 1 and Rule 2 are L-attributed

(B) Only Rule 1 is L-attributed

(C) only Rule 2 is L-attributed

(D) Neither Rule 1 nor Rule 2 is L-attributed

[GATE 2020 : IIT Delhi]

Q.4 In the following grammar

X :: = X ⊕ Y / Y

Y :: = Z * Y / Z

Z :: = id

directed definition, inherited attributes can

(A) Always be evaluated.

(B) Be evaluated only if the definition is L-attributed.

(C) Be evaluated only if the definition has synthesized attributes.

(D) Never be evaluated.

[GATE 2003 : IIT Madras]

Q.6 Consider the translation scheme shown below

S → T R

R → + T {print ('+');} R | ε

T → num {print (num.val);}

Here num is a token that represents an integer and num.val represents the corresponding integer value. For an input string '9 + 5 + 2', this translation scheme will print

(A) 9 + 5 + 2 (B) 9 5 + 2 +

(C) 9 5 2 + + (D) + + 9 5 2

[GATE 2003 : IIT Madras]

Q.7 Consider the syntax directed definition shown below.

S → id : = E {gen (id.place = E.place;);}

E → E1 + E2 {t = newtemp ( ); gen (t = El.place + E2.place;); E.place = t}

E → id {E.place = id.place;}

Here, gen is a function that generates the output code, and newtemp is a function that returns the name of a new temporary variable on every call. Assume that ti's are the temporary variable names generated by newtemp.

For the statement 'X: = Y + Z', the 3-address code sequence generated by this definition is

(A) X = Y + Z

(B) t1 = Y + Z; X = t1

(C) t1 =Y; t2 = t1 + Z; X = t2

(D) t1 = Y; t2 = Z; t3 = t1 + t2; X = t3

[GATE 2003 : IIT Madras]

Q.8 Consider the grammar with the following translation rules and E as the start symbol.

E → E1 # T	{ E.value = E1.value * T.value }
| T	{ E.value = T.value }
T → T1 & F	{ T.value = T1.value + F.value }
| F	{ T.value = F.value }
F → num	{ F.value = num.value }

(B) It detects reduce-reduce conflict, and resolves

(C) It detects shift-reduce conflict, and resolves the conflict in favor of a shift over a reduce action

(D) It detects shift-reduce conflict, and resolves the conflict in favor of a reduce over a shift action

[GATE 2005 : IIT Bombay]

Q.11 Consider the following expression grammar. The semantic rules for expression calculation are stated next to each grammar production.

E → number E.val = number. val

| E '+' E E(1).val = E(2).val + E(3).val

| E '×' E E(1).val = E(2).val × E(3).val

Assume the conflicts in Part (a) of this question are resolved and an LALR(1) parser is generated for parsing

Compute E.value for the root of the parse tree for the expression: 2 # 3 & 5 # 6 & 4.

(A) 200 (B) 180
(C) 160 (D) 40

[GATE 2004 : IIT Delhi]

Q.9 Consider the grammar $E \rightarrow E+n|E \times n|n$ for a sentence $n+n \times n$, then handles in the right sentential form of the reduction are

(A) $n, E+n$ and $E+n \times n$
(B) $n, E+n$ and $E+E \times n$
(C) $n, n+n$ and $n+n \times n$
(D) $n, E+n$ and $E \times n$

[GATE 2005 : IIT Bombay]

Q.10 Consider the following expression grammar. The semantic rules for expression calculation are stated next to each grammar production.

E → number E.val = number. val
| E '+' E E(1).val = E(2).val + E(3).val
| E '×' E E(1).val = E(2).val × E(3).val

The above grammar and the semantic rules are fed to a yacc tool (which is an LALR (1) parser generator) for parsing and evaluating arithmetic expressions. Which one of the following is true about the action of yacc for the given grammar?

(A) It detects recursion and eliminates recursion

parser is generated for parsing arithmetic expressions as per the given grammar. Consider an expression 3 × 2 + 1. What precedence and associativity properties does the generated parser realize?

(A) Equal precedence and left associativity; expression is evaluated to 7
(B) Equal precedence and right associativity; expression is evaluated to 9
(C) Precedence of '×' is higher than that of '+', and both operators are left associative; expression is evaluated to 7
(D) Precedence of '+' is higher than that of '×', and both operators are left associative; expression is evaluated to 9

[GATE 2005 : IIT Bombay]

Q.12 Consider the following translation scheme.

$S \rightarrow ER$
$R \rightarrow E\{\text{print}('*');\}R|\varepsilon$
$E \rightarrow F+E\{\text{print}('+');\}|F$
$F \rightarrow (S)|id\{\text{print}(id.value);\}$

Here id is a token that represents an integer and id.value represents the corresponding integer value. For an input '2*3+4' this translation scheme prints

(A) 2*3+4 (B) 2*+3 4
(C) 2 3*4+ (D) 2 3 4+*

[GATE 2006 : IIT Kharagpur]

Q.13 One of the purpose of using intermediate code in compilers is to

(A) Make parsing and semantic analysis simpler.
(B) Improve error recovery and error reporting.
(C) Increase the chances of reusing the machine-independent code optimizer in other compilers.
(D) Improve the register allocation.

[GATE 2014 : IIT Kharagpur]

Q.14 Consider the expression tree shown. Each leaf represents a numerical value, which can either be 0 or 1. Over all possible choices of the values at the leaves, the maximum possible value of the expression represented by the tree

The value of the expression 2 – 5 + 1 – 7 * 3 in this language is _____ ?

[GATE 2016 : IISc Bangalore]

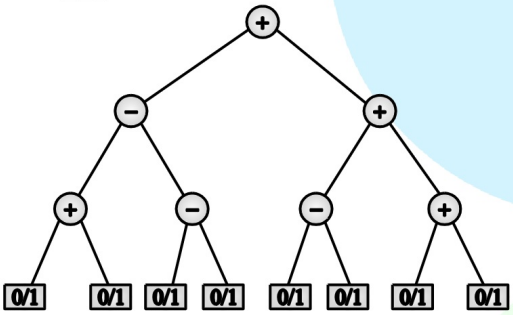
Q.17 Which one of the following statements is FALSE?

(A) Context-free grammar can be used to specify both lexical and syntax rules.
(B) Type checking is done before parsing.
(C) High-level language programs can be translated to different Intermediate Representations.
(D) Arguments to a function can be passed using the program stack.

[GATE 2018 : IIT Guwahati]

Q.18 Consider the following parse tree for the expression a # b $ c $ d # e # f, involving two binary operators $ and #.

is ___.



[GATE 2014 : IIT Kharagpur]

Q.15 Consider the following Syntax Directed Translation Scheme (SDTS), with non-terminals {S,A} and terminals {a,b}.

$S \rightarrow aA$ {print 1}

$S \rightarrow a$ {print 2}

$A \rightarrow Sb$ {print 3}

Using the above SDTS, the output printed by a bottom up parser, for the input aab is :

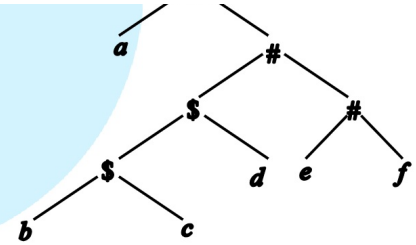
(A) 1 3 2 (B) 2 2 3

(C) 2 3 1 (D) Syntax error

[GATE 2016 : IISc Bangalore]

Q.16 The attributes of three arithmetic operators in some programming language are given below.

Operator	Precedence	Associativity	Arity
+	High	Left	Binary
−	Medium	Right	Binary
*	Low	Left	Binary



Which one of the following is correct for the given parse tree?

(A) $ has higher precedence and is left associative; # is right associative

(B) # has higher precedence and is left associative; $ is right associative

(C) $ has higher precedence and is left associative; # is left associative

(D) # has higher precedence and is right associative; $ is left associative

[GATE 2018 : IIT Guwahati]

Q.19 Consider the following grammar and the semantic actions to support the inherited type declaration attributes. Let X_1, X_2, X_3, X_4, X_5, and X_6 be the placeholders for the non-terminals D, T, L or L_1 in the following table :

Production rule	Semantic action
$D \rightarrow T\ L$	$X_1 \cdot type = X_2 \cdot type$
$T \rightarrow int$	$T \cdot type = int$
$T \rightarrow float$	$T \cdot type = float$

$L \rightarrow L_1, id$	$X_3 \cdot type = X_4 \cdot type$ $addType(id.entry, X_5 \cdot type)$
$L \rightarrow id$	$addType(id.entry, X_6 \cdot type)$

Which one of the following are the appropriate choices for X_1, X_2, X_3 and X_4?

(A) $X_1 = L,\ X_2 = T,\ X_3 = L_1,\ X_4 = L$

(B) $X_1 = T,\ X_2 = L,\ X_3 = L_1,\ X_4 = T$

(C) $X_1 = L,\ X_2 = L,\ X_3 = L_1,\ X_4 = T$

(D) $X_1 = T,\ X_2 = L,\ X_3 = T,\ X_4 = L_1$

[GATE 2019 : IIT Madras]

Practice Questions

Q.1 Consider the following SDT.

$A \rightarrow BC*$

(I) $B.i = f(A,i)$

(II) $B.i = f(A,S)$

(III) $A.S = f(B.s)$

Which of the above is violating L-attribute definition?

(A) I only (B) II only

(C) I, II (D) I, II, III

Q.2 If attribute can be evaluated in depth-

What is the output produced for the input "*pqsqsr*" using the bottom up parsing with above translations?

(A) *TAAAG* (B) *TAAAAG*

(C) *GAAA* (D) *AAAGAT*

Q.5 Consider the syntax directed translation scheme below for the grammar :

$N \rightarrow L$

$L \rightarrow L + B \mid B$

first order then definition is
(A) S-attributed
(B) L-attributed
(C) Both (A) and (B)
(D) None of these

Q.3 Let *G* be the grammar with following transition

$S \to a\{\text{print"0"}\}A$
$A \to b\{\text{print"1"}\}B$
$A \to c\{\text{print"2"}\}$
$A \to \varepsilon\{\text{print"}-\text{"}\}$
$B \to d\{\text{print"1"}\}A$
$B \to \varepsilon\{\text{print"0"}\}$

What is the output produced for the input "*abdbdc*" using the bottom up parsing with above translations?
(A) 211-10 (B) 211110
(C) 111-20 (D) 111012

Q.4 Let "*G*" be a grammar with the following translations :

$S \to p\{\text{print"}G\text{"}\}P$
$P \to q\{\text{print"}A\text{"}\}Q$
$P \to r\{\text{print"}T\text{"}\}$
$P \to \varepsilon\{\text{print"}E\text{"}\}$
$Q \to S\{\text{print"}A\text{"}\}P$
$Q \to \varepsilon\{\text{print"}O\text{"}\}$
$B \to 0 \mid 1$

The Schema is

$N \to L$ $\{N.\text{val} = L.\text{val}\}$
$N \to L + B$ $\{L.\text{val} = L.\text{val} * 2 + B.\text{val}\}$
$L \to B$ $\{L.\text{val} = B.\text{val}\}$
$B \to 0$ $\{B.\text{val} = 0\}$
$B \to 1$ $\{B.\text{val} = 1\}$

The value of *N*.val is
(A) The number of bits in the input string
(B) The value of the non decimal input in binary form.
(C) The value of the binary input in decimal form
(D) None of the above.

Q.6 $X \to YZ$
$Y \to Y + Z\{\text{print}('+');\}$
$T\{Y.\text{val} = T.\text{val}\}$
$Z \to *Y\{\text{print}('*');\}Z$
$T\{Z.\text{val} = T.\text{val}\}\ \varepsilon$
$T \to \text{num}\{\text{print}(\text{num.val});\}$

For $2+3*2$, the above translation scheme prints
(A) $2+3*2$ (B) $23+2*$
(C) $232*2+$ (D) $23*2+$

Q.7 A shift reduce parser carries out the actions specified within braces immediately after reducing with the corresponding rule of grammar.

$S \to xx$ $W\{\text{print "1"}\}$
$S \to y$ $W\{\text{print "2"}\}$
$W \to Sz\{\text{print "3"}\}$

What is the translation of *xxxxyzz* using the syntax-directed translation scheme describe by the above rules?
(A) 23131 (B) 11233
(C) 11231 (D) 33211

Q.8 Match the following errors corresponding to their phase :

Group A
1. Unbalanced parenthesis
2. Appearance of illegal characters
3. Unbalanced parenthesis

Group B
A. Syntactic error
B. Semantic error
C. Lexical error

Q.12 Consider following SDT

$S \to A$ sign // $S.\text{val} = A.\text{val}$;
Sign $\to +$ // sign.sign $= 1$
Sign $\to -$ // sign.sign $= 0$
$A \to n$ // *A*.val = value (*n*)
$A \to A1, n$ // *A*1.sign = *A*.sign;
if $(A.\text{sign} = 1)$ then
A.val $= \min(A1.\text{val}, \text{value}(n))$;
else
A.val $= \max(A1.\text{val}, \text{value}(n))$;

A partial modified grammar and actions exclusively using synthesized attributes is given below :

$S \to B+$ // $S.\text{val} = B.\text{val}$; print (*B*.val)
$S \to C-$ // $S.\text{val} = C.\text{val}$; print (*C*.val)
$B \to n$ // $B.\text{val} = \text{value}(n)$
$B \to B1.n$ // $B.\text{val} = B1$
$C \to n$ // $C.\text{val} = \text{value}(n)$
$C \to C1.n$ // $C.\text{val} = B2$

What is the value of *B*1 and *B*2 to complete the grammar respectively?
(A) Max (*B*1.val, value (*n*)), Min (*C*1.val

(A) 1→A, 2→C, 3→B
(B) 1→B, 2→C, 3→A
(C) 1→A, 2→B, 3→C
(D) 1→B, 2→C, 3→A

Q.9 In a bottom-up evaluation of a syntax directed definition, inherited attribute can
(A) Always be evaluated
(B) Be evaluated only if definition in L-attribute
(C) Never be evaluated
(D) Be evaluated only if the definition has synthesized attributes

Q.10 Type checking is normally done using
(A) Lexical analysis
(B) Syntax analysis
(C) Syntax directed translation
(D) Code optimization

Q.11 Consider the translation scheme given below :

$S \to T - R \{\text{print}('-')\} \mid R$

$R \to +T \{\text{print}('+')\} \mid R \mid F$

$F \to \text{id} \{\text{print}(\text{id.value})\} \mid \in$

For an input scheme $10-5+4$, this scheme will print
(A) $10\ 5+4-$ (B) $10\ 54-+$
(C) $105-4+$ (D) $1054+-$

(A) Max (*B*1.val, value (*n*)), Min (*C*1.val, value (*n*))
(B) Min (*B*1.val, value (*n*)), Max (*C*1.val, value (*n*))
(C) Max (*B*1.val, value (*n*)), Max (*C*1.val, value (*n*))
(D) Min (*B*1.val, value (*n*)), Min (*C*1.val, value (*n*))

Q.13 Consider the following SDT :

$E \to E + E \quad \{E.\text{val} = E_1.\text{val} + E_2.\text{val}\}$

$E \to E \times E \ \{E.\text{val} = E_1.\text{val} - E_2.\text{val}\}$

$E \to (E) \ \{E.\text{val} = E_1.\text{val}\}$

$E \to \text{id} \ \ \{E.\text{val} = \text{id.lex}\}$

The value of the attribute computed at root when the expression $[(3\times3)+(3\times5)-6]+7$ is evaluated using the above SDT are _____.

Q.14 A shift reduce parser carries out the action specified within braces immediately after reducing with the corresponding rule of grammar :

$S \to xxW$ {print "1"}
$S \to y$ {print "2"}
$W \to Sz$ {print "3"}

What is the translation of *xxxxyzz* using the syntax directed translation scheme described by the above rules?

Q.15 Consider the following SDT

$S \to S * S_1 \mid S_2 \quad (S.\text{val} = S_1.\text{val} + S.\text{val})$

$S \to S_2 \quad (S_1.\text{val} = S_2.\text{val})$

$S_2 \to S_2 \# S_3 \quad (S_2.\text{val} = S_2.\text{val} - S_3.\text{val})$

$S_2 \to S_3 \quad (S_2.\text{val} = S_3.\text{val})$

$S_3 \to \text{id} \quad (S_3.\text{val} = \text{id})$

Evaluate the expression

$15 \# 12 * 5 \# 25 \# 30 * 60$

❑❑❑

3 Intermediate Code Generation & Optimization

Classroom Questions

Q.1 The pass number for each of the following activities

(i) Object code generation

(ii) Literals added to literal table

(iii) Listing printed

(iv) Address resolution of local symbols that occur in a two assembler respectively are

(A) 1, 2, 1, 2 (B) 2, 1, 2, 1

(C) 2, 1, 1, 2 (D) 1, 2, 2, 2

[GATE 1996 : IISc Bangalore]

Q.2 The process of assigning load addresses to the various parts of the program and adjusting the code and data in the program to reflect the assigned addresses is called

(A) Assembly

(B) Parsing

(C) Relocation

(B) Syntax directed translations can be written for intermediate code generation.

(C) It enhances the portability of the front end of the compiler.

(D) It is not possible to generate code for real machines directly from high level language programs.

[GATE 1994 : IIT Kharagpur]

Q.5 A linker is given object modules for a set of programs that were compiled separately. What information need not be included in an object module?

(A) Object code.

(B) Relocation bits.

(C) Names and locations of all external symbol defined in the object module.

(C) Relocation
(D) Symbol resolution

[GATE 2001 : IIT Kanpur]

Q.3 Match the following :

Group – I

(A) Pointer data type
(B) Activation record
(C) Repeat-until
(D) Coercion

Group – II

(P) Type conversion
(Q) Dynamic data structure
(R) Recursion
(S) Non-deterministic loop

(A) a - p, b - r, c - s, d - q
(B) a - q, b - r, c - s, d - p
(C) a - q, b - s, c - r, d - p
(D) a - r, b - q, c - s, d – p

[GATE 1990 : IISc Bangalore]

Q.4 Generation of intermediate code based on an abstract machine model is useful in compilers because

(A) It makes implementation of lexical analysis and syntax analysis easier.
(D) Absolute addresses of internal symbols.

[GATE 1995 : IIT Kanpur]

Q.6 Consider the grammar rule $E \rightarrow E_1 - E_2$ for arithmetic expressions. The code generated is targeted to a CPU having a single user register. The subtraction operation requires the first operand to be in the register. If E_1 and E_2 do not have any common sub-expression, in order to get the shortest possible code.

(A) E_1 should be evaluated first
(B) E_2 should be evaluated first
(C) Evaluation of E_1 and E_2 should necessary be interleaved
(D) Order of evaluation of E_1 and E_2 is of no consequence.

[GATE 2004 : IIT Delhi]

Q.7 Consider the following C code segment.

```
for (i = 0; i < n; i++)
{
    for (j = 0; j < n; j++)
    {
        if (i%2)
        {
            X += (4*j + 5*i);
            Y += (7 + 4*j);
        }
    }
}
```

Which one of the following is false?

(A) The code contains loop-invariant computation
(B) There is scope of common sub expression elimination is this code
(C) There is scope of strength reduction in this code.
(D) There is scope of dead code elimination in this code.

[GATE 2006 : IIT Kharagpur]

Q.8 In a simplified computer the instructions are:

OP $R_j R_i$ – Performs R_j OP R_i and stores the result in register R_i

OP m, R_i – Performs val OP R_i and

Q.9 Some code optimization are carried out on the intermediate code because

(A) They enhance the portability of the complier to other target processors.
(B) Program analysis is more accurate on intermediate code than on machine code.
(C) The information from dataflow analysis cannot otherwise be used for optimization.
(D) The information from the front end cannot otherwise be used for optimization.

[GATE 2008 : IISc Bangalore]

Q.10 Which languages necessarily need heap allocation in the runtime environment?

(A) Those that support recursion.
(B) Those that use dynamic scoping
(C) Those that allow dynamic data structures
(D) Those that use global variables.

[GATE 2010 : IIT Guwahati]

Q.11 Consider two binary operators '$\uparrow$' and '$\downarrow$' with the precedence of operator $\downarrow$ being lower than that of the operator $\uparrow$. Operator $\uparrow$ is right associative while operator $\downarrow$, is left associative. Which

stores the result in R_i. Val denotes the content of memory location m.

MOV m, R_i – Moves the content of memory location m to register R_i.

MOV R_i, m – Moves the content of registers, and to memory location m

The computer has only two registers, and OP is either ADD or SUB. Consider the following basic block:

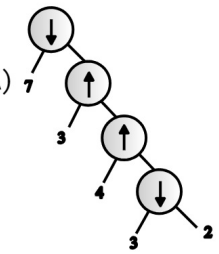
t1 = a + b
t2 = c + d
t3 = e – t2
t4 = t1 – t3

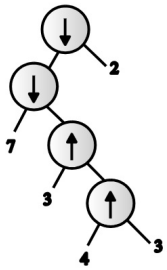
Assume that all operands are initially in memory. The final value of the computation should be in memory. What is the minimum number of MOV instruction in the code generated for this basic block?

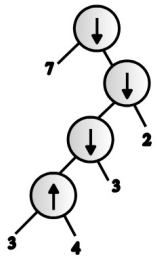
(A) 2 (B) 3
(C) 5 (D) 6

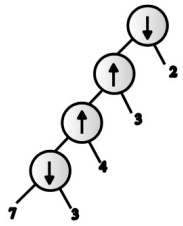
[GATE 2007 : IIT Kanpur]

one of the following represents the parse tree for expression $(7 \downarrow 3 \uparrow 4 \uparrow 3 \downarrow 2)$?

(A) 

(B) 

(C) 

(D) 

[GATE 2011 : IIT Madras]

Q.12 Which one of the following is FALSE?

(A) A basic block is a sequence of instructions where control enters the sequence at the beginning and exists at the end.

(B) Available expression analysis can be used for common sub-expression elimination.

(C) Live variable analysis can be used for dead code elimination.

(D) $x = 4*5 \Rightarrow x = 20$ is an example of common sub-expression elimination.

[GATE 2014 : IIT Kharagpur]

Q.13 Which one of the following is NOT performed during compilation?

(A) Dynamic memory allocation
(B) Type checking
(C) Symbol table management
(D) Inline expansion

[GATE 2014 : IIT Kharagpur]

Q.14 For a C program accessing $X[i][j][k]$, the following intermediate code is generated by a complier. Assume that the size of an integer is 32 bits and the size of character is bits.

$t0 = i*1024$
$t1 = j*32$
$t2 = k*4$
$t3 = t1 + t0$
$t4 = t3 + t2$
$t5 = X[t4]$

Which one of the following statements

(A) 1 and 2 only (B) 2 and 3 only
(C) 3 and 4 only (D) 1 and 3 only

[GATE 2014 : IIT Kharagpur]

Q.16 Consider the basic block given below.

$a = b + c$
$c = a + d$
$d = b + c$
$e = d - b$
$a = e + b$

The minimum number of nodes and edges present in the DAG representation of the above basic block respectively are

(A) 6 and 6 (B) 8 and 10
(C) 9 and 12 (D) 4 and 4

[GATE 2014 : IIT Kharagpur]

Q.17 A variable x is said to be live at a statement S_i in a program if the following three conditions hold simultaneously:

1. There exists a statement S_j that uses x
2. There is a path from S_i to S_j in the flow graph corresponding to the program
3. The path has no intervening assignment to x including at S_i and

about the source code for the C program is CORRECT?

(A) X is declared as "int $X[32][32][8]$"

(B) X is declared as "int $X[4][1024][32]$"

(C) X is declared as "$char\ X[4][32][8]$"

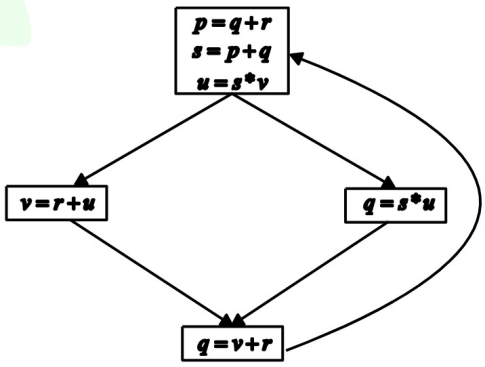
(D) X is declared as "$char\ X[32][16][2]$"

[GATE 2014 : IIT Kharagpur]

Q.15 Which of the following statements are CORRECT?

1. Static allocation of all data areas by a compiler makes it impossible to implement recursion.
2. Automatic garbage collection is essential to implement recursion.
3. Dynamic allocation of activation records is essential to implement recursion.
4. Both heap and stack are essential to implement recursion.

S_j



The variables which are live both at the statement in basic block 2 and at the statement in basic block 3 of the above control flow graph are

(A) p, s, u (B) r, s, u

(C) r, u (D) q, v

[GATE 2015 : IIT Kanpur]

Q.18 The least number of temporary variables required to create a three-address code in static single

assignment form for the expression q + r/3 + s – t * 5 + u * v/w is _____.

[GATE 2015 : IIT Kanpur]

Q.19 In the context of abstract-syntax-tree (AST) and control-flow-graph (CFG), which one of the following is TRUE?

(A) In both AST and CFG, let node N_2 be the successor of node N_1. In the input program, the code corresponding to N_2 is present after the code corresponding to N_1

(B) For any input program, neither AST nor CFG will contain a cycle

(C) The maximum number of successors of a node in an AST and a CFG depends on the input program

(D) Each node in AST and CFG corresponds to at most one statement in the input program

[GATE 2015 : IIT Kanpur]

Q.20 Consider the intermediate code given below.

(1) $i = 1$

(2) $j = 1$

(3) $t_1 = 5 * i$

(4) $t_2 = t_1 + j$

(5) $t_3 = 4 * t_2$

The grammars use D as the start symbol, and use six terminal symbols int; id[ ] num.

Grammar G1	**Grammar G2**
$D \rightarrow \text{int}\ L;$	$D \rightarrow \text{int}\ L;$
$L \rightarrow id[E$	$L \rightarrow id\ E$
$E \rightarrow num]$	$E \rightarrow E[num]$
$E \rightarrow num][E$	$E \rightarrow [num]$

Which of the grammar correctly generate the declaration mentioned above?

(A) Both G1 and G2

(B) Only G1

(C) Only G2

(D) Neither G1 nor G2

[GATE 2016 : IISc Bangalore]

Q.22 Consider the following intermediate program in three address code

$$p = a - b$$
$$q = p * c$$
$$p = u * v$$
$$q = p + q$$

Which one of the following corresponds to a static single assignment form of the above code?

(A) $p_1 = a - b$ (B) $p_3 = a - b$

$q_1 = p_1 * c$ $q_4 = p_3 * c$

(6) $t_4 = t_3$

(7) $a[t_4] = -1$

(8) $j = j + 1$

(9) if $j <= 5\, goto(3)$

(10) $i = i + 1$

(11) If $i < 5\, goto(2)$

The number of nodes and edges in the control-flow-graph constructed for the above code, respectively, are

(A) 5 and 7 (B) 6 and 7

(C) 5 and 5 (D) 7 and 8

[GATE 2015 : IIT Kanpur]

Q.21 A student wrote two context-free grammars G1 and G2 for generating a single C-Like array declaration. The dimension of the array is at least one. For example,

$\text{int}\, a[10][3];$

above grammar containing then if terminals. The number of control flow paths in P is _____.

For example the program

If e_1 then e_2 else e_3 has 2 control flow paths, $e_1 \to e_2$ and $e_1 \to e_3$

[GATE 2017 : IIT Roorkee]

$p_1 = u \cdot v$ $p_4 = u \cdot v$

$q_1 = p_1 + q_1$ $q_5 = p_4 + q_4$

(C) $p_1 = a - b$ (D) $p_1 = a - b$

$q_1 = p_2 * c$ $q_1 = p * c$

$p_3 = u * v$ $p_2 = u * v$

$q_2 = p_4 + q_3$ $q_2 = p + q$

[GATE 2017 : IIT Roorkee]

Q.23 Consider the following grammar :

$stmt \to if$ expr then expr else expr; stmt| 0

expr $\to$ term relop term |term

term $\to$ id |number

id $\to a|b|c$

Number $\to$ [0-9]

Where relop is relational operator (e.g., <,>,..), 0 refers to the empty statement, and if, then, else are terminals. Consider a program P following the

Practice Questions

Q.1 Consider the following statements regarding run-time environment

Which of the above statement is true?

(A) The storage used for heap section can grow at run time but not stack section.

(B) Only control links and access links are saved or restored when a function call or return happen at runtime.

(C) Control links are used in the activation record to access the non-local data.

(D) Temporary variables are one of the contents of an activation record.

Q.2 Which of the following is the postfix form of the following expression?

$-b + c * d / e$

(A) $-b\ cde * / +$ (B) $b - cd * e / +$

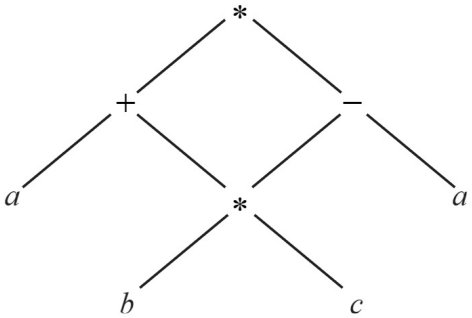
(C) $b\ cd * e / + -$ (D) $b\ cde * / + -$

Q.3 Number of internal nodes in the *DAG* representation of the following expression are :

$\big((a * a) * (a * a) * \big((a * a) * (a * a)\big)\big)$

(A) 2 (B) 3

Q.6 The equivalent expression for the DAG is



(A) $\big((a+b) * c) * (b * (c-a)\big)$

(B) $a + (b * c - a)$

(C) $(a + (b * c)) * ((b * c) - a)$

(D) $a * (a + b * c) - a$

Q.7 Consider the C program given below :

```
main ( )
{
    a = a + b;
    c = a × c;
    d = c − d;
    a = c/d;
    printf ("%d", a);
}
```

(C) 4 (D) 5

Q.4 Post fix conversion for the given expression is

$(x+y)*(p-q)/(m+n)$

(A) $xy+pq-*mn+/$

(B) $xypq+-*mn+/$

(C) $xy+pq*-mn+/$

(D) $xy+-*mn/+$

Q.5 Arrays with dynamic bounds are unpopular in HLLs as

(A) The checking of bounds is prohibitively expensive.

(B) Dynamic storage allocation is more expensive than static storage allocation.

(C) More efficient code can be generated.

(D) All of the above

What will be the minimum number of nodes and edges present in the DAG representation of the output of above C program?

(A) 6 and 6 (B) 7 and 6

(C) 6 and 7 (D) 8 and 8

Q.8 What will be the output of the following program for call by name and copy restore parameter passing mechanism respectively?

```
void func (int a, int b)
{
    a = a + b;
    b = a + b;
    a = b - a;
    b = a - b
}
```



```
main ( )
{
    int j, i = 4;
    int array [10] = {1,2,3,4,5,6,7,8,9,0}
    func (i, array [i]);
    for (j = 0; j < 10; j++)
    printf ("%d", array [j]);
}
```

(A) call by name : $-1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 9$
copy restore : $1\ 2\ 3\ 4\ -9\ 6\ 7\ 8\ 9\ 0$

(B) call by name : $-1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 9$
copy restore : $1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 0$

(C) call by name : $-1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 9$
copy restore : $1\ 2\ 3\ 4\ -8\ 6\ 7\ 8\ 9\ 0$

(D) call by name : $-1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 9$
copy restore : $1\ 2\ 3\ 4\ -8\ 6\ 7\ 8\ 9\ 0$

Q.9 Which of the following parameter is not included in the activation record of recursive function call?

(A) Local variables (B) Return value

(C) Global variable (D) Access links

Q.10 Consider the following three address code table :

Location	Operator	Operand 1	Operand 2
(1)	*	*a*	*b*
(2)	Uminus	(1)	
(3)	+	c	*d*
(4)	+	(2)	(3)
(5)	+	*a*	*b*
(6)	+	(5)	(3)

S_3 : Heap allocation can support pointers and it can allocate or deallocate storage at run-time.

Which of the above statements are true?

(A) S_1 and S_2 (B) S_2 and S_3

(C) S_3 and S_1 (D) S_1, S_2 and S_3

Q.12 What is the minimum number of extra registers required to swap two numbers where two numbers are stored in two different registers?

Q.13 A directed acyclic graph represents one form of intermediate representation. The number of non-terminal nodes in DAG of $a=(b+c)*(b+c)$ expression is

Q.14 Consider the following expression :
The number

$$((x+y)-((x+y)*(x+y)))$$
$$+((x+y)*(x+y))$$
$$+((x+y)\div(x+y))$$

r of nodes to represent the DAG for the above expression is _____

Q.15 Consider the following expression

$x=a*b-c*d+e$

For generating target code how many register will be required apart from accumulator *A*?

Q.16 Consider two binary operators * and ^ with precedence of operator * being lower than of ^. Operator * is left

(7)	–	(4)	(6)

Which of the following expression represents the above three address code (triple representation)?

(A) $-(a*b)-(c+d)+(a+b+c+d)$

(B) $+(a*b)-(c+d)-(a+b+c+d)$

(C) $-(a*b)+(c+d)-(a+b+c+d)$

(D) $-(a*b)+(c+d)+(a+b-(c+d))$

Q.11 Consider the following statements :

S_1 : Static allocation can not support recursive function.

S_2 : Stack allocation can support pointers but cannot deallocate storage at run-time.

associative while operator ^ is right associative. The value of $3*2\hat{}3*4$ is _____

Q.17 Given the 3-address code for a basic block

Num	Instruction	Meaning
1.	$Ld\,a,T_1$	$T_1 \leftarrow a$
2.	$Ld\,b,T_2$	$T_2 \leftarrow b$
3.	$L\,dc,T_3$	$T_3 \leftarrow c$
4.	$Ld\,d,T_4$	$T_4 \leftarrow d$
5.	Add T_1,T_2,T_5	$T_5 \leftarrow T_1+T_2$
6.	Add T_5,T_3,T_6	$T_6 \leftarrow T_3+T_5$
7.	Add T_6,T_4,T_7	$T_7 \leftarrow T_6+T_4$
8.	$ST\ T_7,a$	$a \leftarrow T_7$

How many registers are needed to allocate this basic block with no spills?

Q.18 Find the minimum number of temporary variables created in a 3-address code for the following expression

$a+b*c+d-e-a+b*c$

Consider following grammar for precedence and associativity.

Q.19 Given the 3-address code for a basic block:

Number	Instruction	Meaning
1	$Ld\,a,T_1$	$T_1 \leftarrow a$
2	$Ld\,b,T_2$	$T_2 \leftarrow b$
3	$Ld\,c,T_3$	$T_3 \leftarrow c$
4	$Ld\,d,T_4$	$T_4 \leftarrow d$
5	Add T_1,T_2,T_5	$T_5 \leftarrow T_1+T_2$
6	Add T_1,T_2,T_5	$T_5 \leftarrow T_1+T_2$
7	Add T_1,T_2,T_5	$T_5 \leftarrow T_1+T_2$
8	$ST\ T_7,a$	$a \leftarrow T_7$

How many registers are needed to allocate this basic block with no spills?

$S \rightarrow ES$

$E \rightarrow E-F \mid F$

$F \rightarrow F+G \mid T$

$G \rightarrow G*H \mid H$

$H \rightarrow id \mid \varepsilon$

Q.20 Consider the intermediate code given below :

1. $a=10$
2. $b=15$
3. $a=a+b$
4. $b=a-b$
5. $a=a-b$
6. if $(a==b)$ go to (3)

The number of nodes and edges in the control-flow graph constructed for the above code, respectively are X and Y. The value of $X+Y$ is _____.

❑❑❑

Computer Network

1 Basics Concept of Network

Classroom Questions

Q.1 Consider that 15 machines need to be connected in a LAN using 8-port Ethernet switches. Assume that these switches do not have any separate uplink ports. The minimum number of switches needed is _____.

(A) 3 (B) 7

(C) 1 (D) 5

[GATE 2019, IIT Madras]

Q.2 In the following pairs of OSI protocol layer/sub-layer and its functionality, the INCORRECT pair is

(A) Network layer and Routing

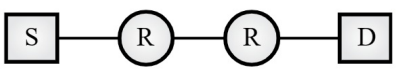
(B) Data Link Layer and Bit synchronization

(C) Transport layer and End-to-end process communication

(D) Medium Access Control sub-layer and Channel sharing

[GATE 2014, IIT Kharagpur]

Q.3 Assume that source S and destination D are connected through two intermediate routers labeled R. Determine how many times each packet has to visit the network layer and the data link layer during a transmission from S to D.



(A) Segment (B) Datagram

(C) Message (D) Frame

[GATE 2012, IIT Delhi]

Q.5 In Ethernet when Manchester encoding is used, the bit rate is :

(A) Half the baud rate

(B) Twice the baud rate

(C) Same as the baud rate

(D) None of the above

[GATE 2007, IIT Kanpur]

Q.6 Which of the following statements is FALSE regarding a bridge?

(A) Bridge is a layer 2 device

(B) Bridge reduces collision domain

(C) Bridge is used to connect two or more LAN segments

(D) Bridge reduces broadcast domain

[GATE 2005, IIT Bombay]

Q.7 Choose the best matching between Group-1 and Group-2 :

Group-1	Group-2
P. Data link layer	1. Ensures reliable transport of data over a physical point-to-point link
Q. Network layer	2. Encodes/decodes data for physical transmission
R.Transport layer	3. Allows end-to-end communication between two processes

(A) Network layer – 4 times and Data link layer – 4 times

(B) Network layer – 4 times and Data link layer – 3 times

(C) Network layer – 4 times and Data link layer – 6 times

(D) Network layer – 2 times and Data link layer – 6 times

[GATE 2013, IIT Bombay]

Q.4 The protocol data unit (PDU) for the application layer in the Internet stack is:

	4. Routes data from one network node to the next

(A) P-1, Q-4, R-3 (B) P-2, Q-4, R-1

(C) P-2, Q-3, R-1 (D) P-1, Q-3, R-2

[GATE 2004, IIT Delhi]

Q.8 Which of the following is NOT true with respect to a transparent bridge and a router?

(A) Both bridge and router selectively forward data packets

(B) A bridge uses IP addresses while a router uses MAC addresses

(C) A bridge builds up its routing table by inspecting incoming packets

(D) A router can connect between a LAN and a WAN

[GATE 2004, IIT Delhi]

Q.9 Which of the following functionality must be implemented by a transport protocol over and above the network protocol?

(A) Recovery from packet losses

(B) Detection of duplicate packets

(C) Packet delivery in the correct order

(D) End to end connectivity

[GATE 2003, IIT Madras]

Q.10 In a network of LANs connected by bridges, packets are sent from one LAN to another through intermediate bridges. Since more than one path may exist between two LANs, packets may have to be routed through multiple bridges. Why is the spanning tree algorithm used for bridge-routing?

(A) For shortest path routing between LANs

(B) For avoiding loops in the routing paths

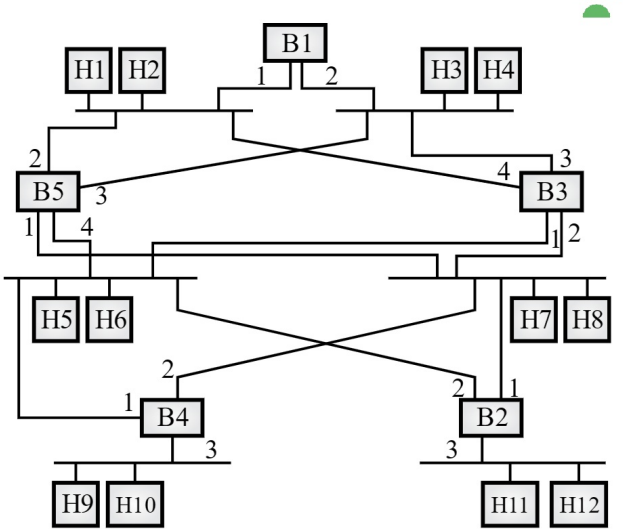
(C) For fault tolerance

(D) For minimizing collisions

[GATE 2003, IIT Madras]

Common Data Question 11 & 12

Consider the diagram shown below where a number of LANs are connected by (transparent) bridges. In order to avoid packets looping through circuits in the graph, the bridges organize themselves in a spanning tree. First, the root bridge is identified as the bridge with the least serial number. Next, the root sends out (one or more) data units to enable the setting up of the spanning tree of



Q.11 For the given connection of LANs by bridges, which one of the following choices represents the depth first traversal of the spanning tree of bridges?

(A) B1, B5, B3, B4, B2

(B) B1, B3, B5, B2, B4

(C) B1, B5, B2, B3, B4

(D) B1, B3, B4, B5, B2

[GATE 2006, IIT Kharagpur]

Q.12 Consider the spanning tree B1, B5, B3, B4, B2 for the given connection of LANs by bridges that represents the depth first traversal of the spanning tree of bridges. Let host H1 send out a broadcast ping packet. Which of the following options represents the correct forwarding table on B3?

(A)

Hosts	Port
H1, H2, H3, H4	3
H5, H6, H9, H10	1
H7, H8, H11, H12	2

(B)

Hosts	Port
H1, H2	4
H3, H4	3
H5, H6	1

shortest paths from the root bridge to each bridge.

Each bridge identifies a port (the root port) through which it will forward frames to the root bridge. Port conflicts are always resolved in favour of the port with the lower index value. When there is a possibility of multiple bridges forwarding to the same LAN (but not through the root port), ties are broken as follows: bridges closest to the root get preference and between such bridges, the one with the lowest serial number is preferred.

	H7, H8, H9, H10, H11, H12	2

(C)

Hosts	Port
H3, H4	3
H5, H6, H9, H10	1
H1, H2	4
H7, H8, H11, H12	2

(D)

Hosts	Port
H1, H2, H3, H4	3
H5, H7, H9, H10	1
H7, H8, H11, H12	4

[GATE 2006, IIT Kharagpur]

Practice Questions

Q.1 Which of the following option is NOT TRUE about protocol?

(A) It is a set of rules followed by each node in network.

(B) It is implemented inside header of data packet.

(C) It is a program written at different layers to do specific task.

(D) It is used to design OSI model.

Q.2 Which one of the following addressing scheme is implemented at Application Layer?

(A) MAC-address

(B) IP-address

(C) Port-address

(D) Specific address

Q.3 Which of the following options is/are TRUE about header?

(A) All the protocols are implemented inside header.

(B) Header size can not be greater than size of data.

(C) Some of the layer may not include header.

(D) No packet can travel into the network without header.

Q.4 Which one of the protocol is NOT associated with physical Layer?

(A) Data rate

(B) Bit synchronization

(C) Circuit switching

(D) Network topology

(E) Access control

Q.5 Suppose a connecting device has four ports. What is the minimum number of devices required to connect 10 computers.

Q.7 Which of the following options is/are TRUE?

(A) The packet is known by Frame in Data Link Layer.

(B) The packet is known by Datagram at application Layer.

(C) The packet is known by segment at Transport Layer.

(D) The name of packet is different at different Layer due to different header size.

Q.8 Which one of the following is NOT TRUE?

(A) Circuit switching takes place at physical Layer and uses physical address.

(B) Datagram switching takes place at network Layer and resources are allocated on demand.

(C) In circuit switching all the packets follow same path.

(D) In datagram switching, packets might not follow same path.

Q.9 Which of the following address is NOT contained by header?

(A) MAC-address (B) IP-address

(C) Port-address (D) Specific address

Q.10 Which layers of the OSI reference model are host-to-host layers?

(A) Transport, session, presentation, application

(B) Session, presentation, application

(C) Datalink, transport, presentation, application

(D) Physical, datalink, network, transport

Q.11 The following are names of data units

Q.6 Which of the following options is/are TRUE?

(A) MAC-address is used to identify a particular host inside network.

(B) IP-address is used to identify a host.

(C) Port-address is used to identify a process inside host.

(D) Specific-address is used to find an application inside host.

in each layer. Mark the correct choice

(A) Packet: Data Link Layer

(B) Message: Transport Layer

(C) Bits: Physical Layer

(D) None of these

Q.12 Which of the following protocols is NOT part of Networks Layer?

(A) DHCP (B) ARP

(C) Go-back-N (D) BGP

Q.13 Which of the following is NOT TRUE about protocols?

(A) It is used for flow control.

(B) It is used to forward data packet.

(C) It is used to design OSI model.

(D) It is used inside header of data packet.

Q.14 Which of the following address scheme is NOT represented by bits?

(A) MAC-Address

(B) IP-Address

(C) Port-Address

(D) Specific Address

Q.15 The Header part of packet in different layer does NOT contains

(A) MAC-Address

(B) IP-Address

(C) Port Address

(D) Specific Address

❑❑❑

2 Data Link Layer

Classroom Questions

Q.1 Consider the sliding window flow-control protocol operating between a sender and a receiver over a full-duplex error-free link. Assume the following:

- The time taken for processing the data frame by the receiver is negligible.
- The time taken for processing the acknowledgement frame by the sender is negligible.
- The sender has infinite number of frames available for transmission.
- The size of the data frame is 2000 bits and the size of the acknowledgement frame is 10 bits.
- The link data rate in each direction is 1 Mbps (= 10^6 bits per second).
- One way propagation delay of the link is 100 milliseconds.

The minimum value of the sender's window size in terms of the number of frames, (rounded to the nearest integer) needed to achieve a link utilization of 50% is _____.

[GATE 2021, IIT Bombay]

Q.2 Consider the cyclic redundancy check (CRC) based error detecting scheme having the generator polynomial X^3+X+1. Suppose the message $m_4m_3m_2m_1m_0 = 11000$ is to be transmitted. Check bits $c_2c_1c_0$ are appended at end of the message by the transmitter using the above CRC scheme. The transmitted bit string is denoted by $m_4m_3m_2m_1m_0c_2c_1c_0$. The value of the check bit sequence $c_2c_1c_0$

length 1,000 bits. The channel transmission rate is 1 Mbps (=10^6 bits per second). The aggregate number of transmissions across all the nodes (including new frame transmissions and retransmitted frames due to collisions) is modelled as a Poisson process with a rate of 1,000 frames per second. Throughput is defined as the average number of frames successfully transmitted per second. The throughput of the network (rounded to the nearest integer) is _____.

[GATE 2021, IIT Bombay]

Q.4 Consider a simple communication system where multiple nodes are connected by a shared broadcast medium (like Ethernet or wireless). The nodes in the system use the following carrier-sense based medium access protocol. A node that receives a packet to transmit will carrier-sense the medium for 5 units of time. If the node does not detect any other transmission, it starts transmitting its packet in the next time unit. If the node detects another transmission, it waits until this other transmission finishes, and then begins to carrier-sense for 5 time units again. Once they start to transmit, nodes do not perform any collision detection and continue transmission even if a collision occurs. All transmissions last for 20 units of time. Assume that the transmission signal travels at the speed of 10 meters per unit time in the medium.

Assume that the system has two nodes

is

(A) 101 (B) 110

(C) 100 (D) 111

[GATE 2021, IIT Bombay]

Q.3 Consider a network using the pure ALOHA medium access control protocol, where each frame is of

P and Q, located at a distance d meters from each other. P start transmitting a packet at time t = 0 after successfully completing its carrier-sense phase. Node Q has a packet to transmit at time t = 0 and begins to carrier-sense the medium.

The maximum distance d (in meters, rounded to the closest integer) that allows Q to successfully avoid a collision between its proposed transmission and P's ongoing transmission is _____.

[GATE 2018, IIT Guwahati]

Q.5 A computer network uses polynomials over GF(2) for error checking with 8 bits as information bits and uses x^3+x+1 as the generator polynomial to generate the check bits. In this network, the message 01011011 is transmitted as :

(A) 01011011010 (B) 01011011011

(C) 01011011101 (D) 01011011100

[GATE 2017, IIT Roorkee]

Q.6 The values of parameters for the Stop-and-Wait ARQ protocol are as given below :

- Bit rate of the transmission channel = 1 Mbps.
- Propagation delay from sender to receiver = 0.75 ms.
- Time to process a frame = 0.25 ms.
- Number of bytes in the information frame = 1980.
- Number of bytes in the acknowledge frame = 20.
- Number of overhead bytes in the information frame = 20.

Assume there are no transmission errors. Then, the transmission efficiency (expressed in percentage) of the Stop-and-Wait ARQ protocol for the above parameters is _____ (correct to 2 decimal places).

(A) 89.33% (B) 89.34%

(C) 89.35% (D) 89.36%

[GATE 2017, IIT Roorkee]

Q.7 Consider two hosts X and Y, connected by a single direct link of rate 10^6 bits/sec. The distance between the two hosts is 10,000 km and the propagation speed along the link is 2×10^8 m/sec. Host X sends a file of 50,000 bytes as one large message to host Y

(B) p = 50 and q = 400

(C) p = 100 and q = 50

(D) p = 400 and q = 50

[GATE 2017, IIT Roorkee]

Q.8 A sender uses the Stop-and-Wait ARQ protocol for reliable transmission of frames. Frames are of size 1000 bytes and the transmission rate at the sender is 80 Kbps (1 Kbps = 1000 bits/second). Size of an acknowledgment is 100 bytes and the transmission rate at the receiver is 8 Kbps. The one-way propagation delay is 100 milliseconds. Assuming no frame is lost, the sender throughput is _____ bytes/second.

(A) 2500 (B) 2501

(C) 2502 (D) 2503

[GATE 2016, IISc Bangalore]

Q.9 A network has a data transmission bandwidth of 20×10^6 bits per second. It uses CSMA/CD in the MAC layer. The maximum signal propagation time from one node to another node is 40 microseconds. The minimum size of a frame in the network is _____ bytes.

(A) 200 (B) 201

(C) 202 (D) 203

[GATE 2016, IISc Bangalore]

Q.10 Consider a 128×10^3 bits/second satellite communication link with one way propagation delay of 150 milliseconds. Selective retransmission (repeat) protocol is used on this link to send data with a frame size of 1 kilobyte. Neglect the transmission time of acknowledgement. The minimum number of bits required for the sequence number field to achieve 100% utilization is _____.

(A) 4 (B) 5

(C) 6 (D) 7

[GATE 2016, IISc Bangalore]

Q.11 Consider a LAN with four nodes S_1, S_2, S_3 and S_4. Time is divided into fixed-size slots, and a node can being its transmission only at the beginning

one large message to host Y continuously. Let the transmission and propagation delays be p milliseconds and q milliseconds respectively. Then the value of p and q are

(A) p = 50 and q = 100

of a slot. A collision is said to have occurred if more than one node transmit in the same slot. The probability of generation of a frame in a time slot by S_1, S_2, S_3 and S_4 are

$0.1, 0.2, 0.3$ and 0.4 respectively. The probability of sending a frame in the first slot without any collision by any of these four stations is _____.

(A) 0.4404 (B) 0.463
(C) 0.464 (D) 0.465

[GATE 2015, IIT Kanpur]

Q.12 Suppose that the stop-and-wait protocol is used on a link with a bit rate of 64 kilobits per second and 20 milliseconds propagation delay. Assume that the transmission time for the acknowledgment and the processing time at nodes are negligible. Then the minimum frame size in bytes to achieve a link utilization of atleast 50 % is _____.

(A) 320 (B) 321
(C) 322 (D) 323

[GATE 2015, IIT Kanpur]

Q.13 A link has transmission speed of 10^6 bits/sec. It uses data packets of size 1000 bytes each. Assume that the acknowledgment has negligible transmission delay and that its propagation delay is the same as the data propagation delay. Also, assume that the processing delays at nodes are negligible. The efficiency of the stop-and-wait protocol in this setup is exactly 25%. The value of the one way propagation delay (in milliseconds) is _____.

(A) 12 (B) 13
(C) 14 (D) 15

[GATE 2015, IIT Kanpur]

Q.14 Consider a CSMA/CD network that transmits data at a rate of 100 Mbps $(10^8$ bits per second) over a 1 km (kilometer) cable with no repeaters. If the minimum frame size required for this network is 1250 bytes, what is the signal speed (km/sec) in the cable?

(A) 8000 (B) 10000
(C) 16000 (D) 20000

[GATE 2015, IIT Kanpur]

Q.15 Consider a network connecting two systems located 8000 Km apart. The

second. It needs to design a Go-Back-N sliding window protocol for this network. The average packet size is 10^7 bits. The network is to be used to its full capacity. Assume that processing delays at nodes are negligible. Then, the minimum size in bits of the sequence number field has to be _____.

(A) 8 (B) 7
(C) 6 (D) 5

[GATE 2015, IIT Kanpur]

Q.16 Consider a selective repeat sliding window protocol that uses a frame size of 1 KB to send data on a 1.5 Mbps link with a one-way latency of 50 msec. To achieve a link utilization of 60%, the minimum number of bits required to represent the sequence number field is _____.

(A) 5 (B) 6
(C) 7 (D) 8

[GATE 2014, IIT Kharagpur]

Q.17 A bit-stuffing based framing protocol uses an 8-bit delimiter pattern of 01111110. If the output bit-string after stuffing is 01111100101, then the input bit-string is :

(A) 0111110100 (B) 0111110101
(C) 0111111101 (D) 0111111111

[GATE 2014, IIT Kharagpur]

Q.18 Determine the maximum length of the cable (in km) for transmitting data at a rate of 500 Mbps in an Ethernet LAN with frames of size 10,000 bits. Assume the signal speed in the cable to be 2,00,000 km/s.

(A) 1 (B) 2
(C) 2.5 (D) 5

[GATE 2013, IIT Bombay]

Q.19 Let G(x) be the generator polynomial used for CRC checking. What is the condition that should be satisfied by G(x) to detect odd number of bits in error?

(A) G(x) contains more than two terms
(B) G(x) does not divide $1+x^k$, for any k

bandwidth of the network is 500×10^6 bits per second. The propagation speed of the media is 4×10^6 meters per

not exceeding the frame length

(C) 1+x is a factor of G(x)

(D) G(x) has an odd number of terms.

[GATE 2009, IIT Roorkee]

Common Data Question 20 & 21

Frames of 1000 bits are sent over a 10^6 bps duplex link between two hosts. The propagation time is 25 ms. Frames are to be transmitted into this link to maximally pack them in transit (within the link).

Q.20 What is the minimum number of bits (I) that will be required to represent the sequence numbers distinctly? Assume that no time gap needs to be given between transmission of two frames.

(A) I = 2 (B) I = 3

(C) I = 4 (D) I = 5

[GATE 2009, IIT Roorkee]

Q.21 Let I be the minimum number of bits (I) that will be required to represent the sequence numbers distinctly assuming that no time gap needs to be given between transmission of two frames.

Suppose that the sliding window protocol is used with the sender window size of 2^I, where I is the numbers of bits as mentioned earlier and acknowledgements are always piggy backed. After sending 2^I frames, what is the minimum time the sender will have to wait before starting transmission of the next frame? (Identify the closest choice ignoring the frame processing time)

(A) 16 ms (B) 18 ms

(C) 20 ms (D) 22 ms

[GATE 2009, IIT Roorkee]

Q.22 A 1 Mbps satellite link connects two ground stations. The altitude of the satellite is 36,504 km and speed of the signal is 3×10^8 m/s. What should be the packet size for a channel utilization of 25% for a satellite link using go-back-127 sliding window proto-col? Assume that the acknowledgment packets are negligible in size and that there are no errors during communication.

(A) 120 bytes (B) 60 bytes

(C) 240 bytes (D) 90 bytes

[GATE 2008, IISc Bangalore]

Q.23 The minimum frame size required for a CSMA/CD based computer network

(A) 125 bytes

(B) 250 bytes

(C) 500 bytes

(D) None of the above

[GATE 2008, IISc Bangalore]

Q.24 There are n stations in slotted LAN. Each station attempts to transmit with a probability p in each time slot. What is the probability that ONLY one station transmits in a given time slot?

(A) $np(1-p)^{n-1}$ (B) $(1-p)^{n-1}$

(C) $p(1-p)^{n-1}$ (D) $1-(1-p)^{n-1}$

[GATE 2007, IIT Kanpur]

Q.25 In a token ring network the transmission speed is 10^7 bps and the propagation speed is 200 meters/μs. The 1-bit delay in this network is equivalent to:

(A) 500 meters of cable.

(B) 200 meters of cable.

(C) 20 meters of cable.

(D) 50 meters of cable.

[GATE 2007, IIT Kanpur]

Q.26 The message 11001001 is to be transmitted using the CRC polynomial x^3+1 to protect it from errors. The message that should be transmitted is:

(A) 11001001000 (B) 11001001011

(C) 11001010 (D) 110010010011

[GATE 2007, IIT Kanpur]

Q.27 The distance between two stations M and N is L kilometres. All frames are K bits long. The propagation delay per kilometre is t seconds. Let R bits/second be the channel capacity. Assuming that the processing delay is negligible, the minimum number of bits for the sequence number field in a frame for maximum utilization, when the sliding window protocol is used, is :

(A) $\left\lceil \log_2 \frac{2LtR+2K}{K} \right\rceil$

(B) $\left\lceil \log_2 \frac{2LtR}{K} \right\rceil$

running at 1Gbps on a 200m cable with a link speed of 2×10^8 m/sec is :

(C) $\left\lceil \log_2 \frac{2LtR+K}{K} \right\rceil$

(D) $\left\lceil \log_2 \frac{2LtR+2K}{2K} \right\rceil$

[GATE 2007, IIT Kanpur]

Q.28 An error correcting code has the following code words: 00000000, 00001111, 01010101, 10101010, 11110000. What is the maximum number of bit errors that can be corrected?

(A) 0 (B) 1
(C) 2 (D) 3

[GATE 2007, IIT Kanpur]

Q.29 A broadcast channel has 10 nodes and total capacity of 10 Mbps. It uses polling for medium access. Once a node finishes transmission, there is a polling delay of 80 µs to poll the next node. Whenever a node is polled, it is allowed to transmit a maximum of 1000 bytes. The maximum throughput of the broadcast channel is :

(A) 1 Mbps (B) 100/11 Mbps
(C) 10 Mbps (D) 100 Mbps

[GATE 2007, IIT Kanpur]

Q.30 Station A needs to send a message consisting of 9 packets to Station B using a sliding window (window size 3) and go-back-n error control strategy. All packets are ready and immediately available for transmission. If every 5th packet that A transmits gets lost (but no acks from B ever get lost), then what is the number of packets that A will transmit for sending the message to B?

(A) 12 (B) 14
(C) 16 (D) 18

[GATE 2006, IIT Kharagpur]

Q.31 Station A uses 32 byte packets to transmit messages to Station B using a sliding window protocol. The round trip delay between A and B is 80 milliseconds and the bottleneck bandwidth on the path between A and B is 128 kbps. What is the optimal window size that A should use?

(A) 20 (B) 40
(C) 160 (D) 320

[GATE 2006, IIT Kharagpur]

Q.32 A router has two full-duplex Ethernet interfaces each operating at 100 Mb/s. Ethernet frames are atleast 84 bytes long (including the Preamble and the Inter-Packet-Gap). The maximum packet processing time at the router for wire speed forwarding to be possible is (in micro-seconds)

(A) 0.01 (B) 3.36
(C) 6.72 (D) 8

[GATE 2006, IIT Kharagpur]

Q.33 On a wireless link, the probability of packet error is 0.2. A stop-and-wait protocol is used to transfer data across the link. The channel condition is assumed to be independent of transmission to transmission. What is the average number of transmission attempts required to transfer 100 packets?

(A) 100 (B) 125
(C) 150 (D) 200

[GATE 2006, IIT Kharagpur]

Q.34 Suppose the round trip propagation delay for a 10 Mbps Ethernet having 48-bit jamming signal is 46.4 µs. The minimum frame size is :

(A) 94 (B) 416
(C) 464 (D) 512

[GATE 2005, IIT Bombay]

Q.35 The maximum window size for data transmission using the selective reject protocol with n-bit frame sequence numbers is:

(A) 2^n (B) 2^{n-1}
(C) 2^n-1 (D) 2^{n-2}

[GATE 2005, IIT Bombay]

Q.36 Which of the following statements is TRUE about CSMA/CD :

(A) IEEE 802.11 wireless LAN runs CSMA/CD protocol
(B) Ethernet is not based on CSMA/CD protocol
(C) CSMA/CD is not suitable for a high propagation delay network like satellite network
(D) There is no contention in a CSMA/CD network

[GATE 2005, IIT Bombay]

Q.37 A network with CSMA/CD protocol in the MAC layer is running at 1Gbps over

a 1 km cable with no repeaters. The signal speed in the cable is 2×10^8 m/sec. The minimum frame size for this network should be:

(A) 10000 bits (B) 10000 bytes
(C) 5000 bits (D) 5000 bytes

[GATE 2005, IIT Bombay]

Q.38 A channel has a bit rate of 4 kbps and one-way propagation delay of 20 ms. The channel uses stop and wait protocol. The transmission time of the acknowledgment frame is negligible. To get a channel efficiency of at least 50%, the minimum frame size should be

(A) 80 bytes (B) 80 bits
(C) 160 bytes (D) 160 bits

[GATE 2005, IIT Bombay]

Q.39 In a TDM medium access control bus LAN, each station is assigned one time slot per cycle for transmission. Assume that the length of each time slot is the time to transmit 100 bits plus the end-to-end propagation delay. Assume a propagation speed of 2×10^8 m/sec. The length of the LAN is 1 km with a bandwidth of 10 Mbps. The maximum number of stations that can be allowed in the LAN so that the throughput of each station can be 2/3 Mbps is

(A) 3 (B) 5
(C) 10 (D) 20

[GATE 2005, IIT Bombay]

Q.40 Consider the following message M = 1010001101. The cyclic redundancy check (CRC) for this message using the divisor polynomial $x^5+x^4+x^2+1$ is :

(A) 01110 (B) 01011
(C) 10101 (D) 10110

[GATE 2005, IIT Bombay]

Q.41 A and B are the only two stations on an Ethernet. Each has a steady queue of frames to send. Both A and B attempt to transmit a frame, collide, and A wins the first backoff race. At the end of this successful transmission by A, both A and B attempt to transmit and collide. The probability that A wins the second backoff race is :

(A) 0.5 (B) 0.625
(C) 0.75 (D) 1.0

[GATE 2004, IIT Delhi]

Q.42 In a sliding window ARQ scheme, the transmitter's window size is N and the receiver's window size is M. The minimum number of distinct sequence numbers required to ensure correct operation of the ARQ scheme is

(A) min (M,N) (B) max (M,N)
(C) M+N (D) MN

[GATE 2004, IIT Delhi]

Q.43 Consider a 10 Mbps token ring LAN with a ring latency of 400 μs. A host that needs to transmit seizes the token. Then it sends a frame of 1000 bytes, removes the frame after it has circulated all around the ring, and finally releases the token. This process is repeated for every frame. Assuming that only a single host wishes to transmit, the effective data rate is

(A) 1Mbps (B) 2Mbps
(C) 5Mbps (D) 6Mbps

[GATE 2004, IIT Delhi]

Q.44 A 20 Kbps satellite link has a propagation delay of 400 ms. The transmitter employs the "go back n ARQ" scheme with n set to 10. Assuming that each frame is 100 byte long, what is the maximum data rate possible?

(A) 5 Kbps (B) 10 Kbps
(C) 15 Kbps (D) 20 Kbps

[GATE 2004, IIT Delhi]

Q.45 Consider a simplified time slotted MAC protocol, where each host always has data to send and transmits with probability p = 0.2 in every slot. There is no backoff and one frame can be transmitted in one slot. If more than one host transmits in the same slot, then the transmissions are unsuccessful due to collision. What is the maximum number of hosts which this protocol can support if each host has to be provided a minimum throughput of 0.16 frames per time slot?

(A) 1 (B) 2
(C) 3 (D) 4

[GATE 2004, IIT Delhi]

Q.46 A 2 km long broadcast LAN has 10^7 bps bandwidth and uses CSMA/CD. The signal travels along the wire at 2×10^8 m/s. What is the minimum packet size that can be used on this network?

(A) 50 bytes

(B) 100 bytes

(C) 200 bytes

(D) None of the above

[GATE 2003, IIT Madras]

Q.47 Host A is sending data to host B over a full duplex link. A and B are using the sliding window protocol for flow control. The send and receive window sizes are 5 packets each. Data packets (sent only from A to B) are all 1000 bytes long and the transmission time for such a packet is 50 µs. Acknowledgment packets (sent only from B to A) are very small and require negligible transmission time. The propagation delay over the link is 200 µs. What is the maximum achievable throughput in this communication?

(A) 7.69×10^6 Bps (B) 11.11×10^6 Bps

(C) 12.33×10^6 Bps (D) 15.00×10^6 Bps

[GATE 2003, IIT Madras]

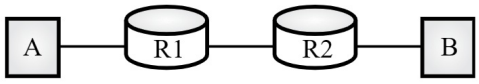
Q.48 What is the distance of the following code
000000,010101,000111,011001,111111?

(A) 2 (B) 3

(C) 4 (D) 1

[GATE 1995, IIT Kanpur]

Q.49 Consider the store and forward packet switched network given below. Assume that the bandwidth of each link is 10^6 bytes/sec. A user on host *A* sends a file of size 10^3 bytes to host *B* through routers R_1 and R_2 in three different ways. In the first case a single packet containing the complete file is transmitted from *A* to *B*. In the second case, the file is split into 10 equal parts, and these packets are transmitted from *A* to *B*. In the third case, the file is split into 20 equal parts and these packets are sent from *A* to *B*. Each packet contains 100 bytes of header information along with the user data. Consider only transmission time and ignore processing, queuing and propagation delays. Also assume that there are no errors during transmission. Let T_1, T_2 and T_3 be the times taken to transmit the file in the first, second and third case respectively. Which one of the following is CORRECT?



(A) $T_1<T_2<T_3$ (B) $T_1>T_2>T_3$

(C) $T_2=T_3, T_3<T_1$ (D) $T_1=T_3, T_3>T_2$

[GATE 2014, IIT Kharagpur]

Q.50 Consider a source computer (S) transmitting a file of size 10^6 bits to a destination computer (D) over a network of two routers (R_1 and R_2) and three links (L_1, L_2 and L_3). L_1 connects S to R_1, L_2 connects R_1 to R_2 and L_3 connects R_2 to D. Let each link be of length 100 km. Assume signals travel over each link at a speed of 10^8 meters per second. Assume that the link bandwidth on each link is 1 Mbps. Let the file be broken down into 1000 packets each of size 1000 bits. Find the total sum of transmission and propagation delays in transmitting the file from S to D?

(A) 1005 ms (B) 1010 ms

(C) 3000 ms (D) 3003 ms

[GATE 2012, IIT Delhi]

Q.51 In a packet switching network, packets are routed from source to destination along a single path having two intermediate nodes. If the message size is 24 bytes and each packet contains a header of 3 bytes, then the optimum packet size is:

(A) 4 (B) 6

(C) 7 (D) 9

[GATE 2005, IIT Bombay]

Q.52 Which one of the following statements is FALSE?

(A) Packet switching leads to better utilization of bandwidth resources than circuit switching

(B) Packet switching results in less variation in delay than circuit switching

(C) Packet switching requires more per-packet processing than circuit switching

(D) Packet switching can lead to reordering unlike in circuit switching

[GATE 2004, IIT Delhi]

Q.53 In an Ethernet local area network, which one of the following statements is TRUE?

(A) A station stops to sense the channel once it starts transmitting a frame.

(B) The purpose of the jamming signal is to pad the frames that are smaller than the minimum frame size.

(C) A station continues to transmit the packet even after the collision is detected.

(D) The exponential back off mechanism reduces the probability of collision on retransmissions.

[GATE 2016, IISc Bangalore]

Q.54 Consider a 3-bit error detection and 1-bit error correction hamming code for 4-bit data. The extra parity bits required would be _____ and the 3-bit error detection is possible because the code has a minimum distance of _____.

[GATE 1992, IIT Delhi]

Q.55 Following 7 bit single error correcting hamming coded message is received.

7	6	5	4	3	2	1	Bit No.
1	0	0	0	1	1	0	X

Determine if the message is correct (assuming that at most 1 bit could be corrupted). If the message contains an error find the bit which is erroneous and gives correct message.

[GATE 1994, IIT Kharagpur]

Q.56 In a data link protocol, the frame delimiter flag is given by 0111. Assuming that bit stuffing is employed, the transmitter sends the data sequence 01110110 as :

(A) 01101011 (B) 011010110

(C) 011101100 (D) 0110101100

[GATE 2004, IIT Delhi]

Q.57 Consider a parity check code with three data bits and four parity check bits.

Three of the Code Words are 0101011, 1001101 and 1110001.

Which of the following are also code words?

I. 0010111 II. 0110110

III. 1011010 IV. 0111010

(A) I and III (B) I, II and III

(C) II and IV (D) I, II, III and IV

[GATE 2004, IIT Delhi]

Q.58 In a communication network, a packet of length L bits takes link L_1 with a probability of p_1 or link L_2 with a probability of p_2. Link L_1 and L_2 have bit error probability of b_1 and b_2 respectively. The probability that the packet will be received without error via either L_1 or L_2 is

(A) $(1-b_1)Lp_1+(1-b_2)Lp_2$

(B) $[1-(b_1+b_2)L]p_1p_2$

(C) $(1-b_1)L(1-b_2)Lp_1p_2$

(D) $1-(b_1Lp_1+b_2Lp_2)$

[GATE 2005, IIT Bombay]

Q.59 In the 4B/5B encoding scheme, every 4 bits of data are encoded in a 5-bit code word. It is required that the code words have at most 1 leading and at most 1 trailing zero. How many are such code words possible?

(A) 14 (B) 16

(C) 18 (D) 20

[GATE 2006, IIT Kharagpur]

Q.60 Suppose that it takes 1 unit of time to transmit a packet (of fixed size) on a communication link. The link layer uses a window flow control protocol with a window size of N packets. Each packet causes an ack or a nak to be generated by the receiver, and ack/nak transmission times are negligible. Further, the round trip time on the link

is equal to N units. Consider time $i > N$. If only acks have been received till time i (no naks), then the good put evaluated at the transmitter at time i (in packets per unit time) is

(A) $1-\frac{N}{i}$ (B) $\frac{i}{(N+i)}$

(C) 1 (D) $1-e^{\frac{i}{N}}$

[GATE 2006, IIT Kharagpur]

Q.61 Data transmitted on a link uses the following 2D parity scheme for error detection :

Each sequence of 28 bits is arranged in a 4×7 matrix (rows r_0 through r_3, and columns d_7 through d_1) and is padded with a column d_0 and row r_4 of parity bits computed using the even parity scheme. Each bit of column d_0 (respectively, row r_4) gives the parity of the corresponding row (respectively, column). These 40 bits are transmitted over the data link.

	d_7	d_6	d_5	d_4	d_3	d_2	d_1	d_0
r_0	0	1	0	1	0	0	1	1
r_1	1	1	0	0	1	1	1	0
r_2	0	0	0	1	0	1	0	0
r_3	0	1	1	0	1	0	1	0
r_4	1	1	0	0	0	1	1	0

The table shows data received by a receiver and has n corrupted bits. What is the mini-mum possible value of n?

(A) 1 (B) 2

(C) 3 (D) 4

[GATE 2008, IISc Bangalore]

Q.62 Two hosts are connected via a packet switch with 107 bits per second links. Each link has a propagation delay of 20 microseconds. The switch begins forwarding a packet 35 microseconds after it receives the same. If 10000 bits of data are to be transmitted between the two hosts using a packet size of 5000 bits, the time elapsed between the transmission of the first bit of data and the reception of the last bit of the data in microseconds is _____.

[GATE 2015, IIT Kanpur]

Practice Questions

Q.1 Which of the following options is/are TRUE?

(A) Framing protocol is used to separate frames at receiving end.

(B) Bit stuffing technique is used to identify data inside frame.

(C) Framing protocols use flag/delimiter bits pattern to separate frame.

(D) Bit stuffing is used to detect error inside frame.

Q.2 The minimum Hamming distance to correct 4-bits error is _____

Q.3 On wireless link, the probability of packet error is 0.25. Stop and wait protocol is used to transfer data. What is the average number of transmission attempts required to transfer 200 packets _____?

Q.4 Which of the following pair of window size at Sender and Receiver is NOT possible in selective repeat protocol if 4-bits sequence number field is used?

(A) (6, 6) (B) (7, 7)

(C) (8, 8) (D) (10, 10)

Q.5 A channel has bit rate of 10 kbps and one way propagation delay of 20 ms . The channel uses stop and wait protocol. The transmission time of acknowledgement is negligible to get channel efficiency of 60%, the minimum frame size should be _____ bytes?

Q.6 If a file consisting of 50,000 characters takes 40 second to send, then data rate is_____ kbps?

Q.7 In full duplex channel, if the data rate of link is 20 Mbps and signal speed is 200 m/μs. The number of bytes that can be placed on the channel of 100 km is _____?

Q.8 A network with bandwidth of 10 Mbps can pass an average of 18000 frames per minute with each frame carrying 10^4 bits. What is the through put of this network?

(A) 10 Mbps (B) 5 Mbps
(C) 3 Mbps (D) 2 Mbps

Q.9 Consider a 10 Mbps link with channel utilization of 80%. Network is using sliding window protocols. The throughput of channel is _____? (Mbps)

Q.10 Find maximum utilization of channel in polling protocol if size of frame is 10000 bits and bandwidth is 1 Mbps and propagation delay is 10 ms with 5 station in LAN is _____? (%)

Q.11 In CRC if the data unit is 100111001 and the divisor is 1011 then what is dividend at the receiver?

(A) 100111001101 (B) 100111001011
(C) 100111001 (D) 100111001110

Q.12 In Ethernet CSMA/CD, the special bit sequence transmitted by media access management to handle collision is called

(A) Preamble (B) Postamble
(C) Jam (D) None of these

Q.13 Frames of 1000 bits are sent over a 10^6 bps duplex link between two hosts. The propagation time is 25 ms. Frames are to be transmitted into this link to maximally pack them in transit (within the link).

What is the minimum number of bits (I) that will be required to represent the sequence numbers distinctly? Assume that no time gap needs to be given between transmission of two frames.

(A) $I=2$ (B) $I=3$
(C) $I=4$ (D $I=5$

Q.14 A pure ALOHA network transmits 200 bits frames using a shared channel with 200 kbps bandwidth. If the system (all stations put together) produces 500 frames per second, then the throughput of the system is _____.

(A) 0.384 (B) 0.184
(C) 0.286 (D) 0.586

Q.15 In CRC checksum method, assume that given frame for transmission is 1101011011 and the generator polynomial is $G(x)=x^4+x+1$.

After implementing CRC encoder, the encoded word sent from sender side is _____.

(A) 11010110111110 (B) 11101101011011
(C) 110101111100111 (D) 110101111001111

Q.16 A slotted ALOHA network transmits 200 bits frames using a shared channel with 200 kbps bandwidth. If the system (all stations put together) produces 1000 frames per second, then the throughput of the system is _____.

(A) 0.268 (B) 0.468'
(C) 0.368 (D) 0.568

Q.17 A link of capacity 100 Mbps is carrying traffic from a number of sources. Each source generates an on-off traffic stream; when the source is on, the rate of traffic is 10 Mbps, and when the source is off, the rate of traffic is zero. The duty cycle, which is the ratio of on-time to off-time, is 1:2. When there is no buffer at the link, the minimum number of sources that can be multiplexed on the link so that link capacity is not wasted and no data loss occurs is S_1. Assuming that all sources are synchronized and that the link is provided with a large buffer, the maximum number of sources that can be multiplexed so that no data loss occurs is S_2. The values of S_1 and S_2 are, respectively,

(A) 10 and 30 (B) 12 and 25
(C) 5 and 33 (D) 15 and 22

Q.18 A CSMA/CD network is having a bandwidth of 512 Mbps and a distance of 200 meters. Determine the minimum frame size in bits, in order to detect a collision. Assume that that the signal speed is 2×10^8m/s.

Q.19 A LAN uses CSMA/CD protocol. The end-to-end propagation delay between two stations is 50μs. Then the contention time is

(A) 150μs (B) 100μs
(C) 200μs (D) None of these

Q.20 An Ethernet channel has transmission time 2ms, contention time 4ms and idle time 2ms. Then the channel utilization is _____ (in percentage)

Q.21 Which of the following are functions of Data Link layer?

(i) Flow Control (ii) Error Control
(iii) Compression (iv) File Manager
(v) Dialog Control

(A) i and ii (B) ii, iv and v
(C) i and iii (D) iii, iv, and v

Q.22 The minimum frame size in CSMA/CD network is 24 bytes. If channel bandwidth is 1Mbps then what will be the propagation delay?

(A) 112 μs (B) 192 μs
(C) 170 μs (D) None of these

Q.23 Consider a pure ALOHA network, operating at 10 Mbps and the frame length is 100 bits. The vulnerable time in this network in μs is _____.

Q.24 A sender sends a series of packets to the same destination using 4-bit sequence numbers. If the sequence number starts with 0, what is the sequence no after bending 100 packets?

(A) 2 (B) 3
(C) 4 (D) 5

Q.25 A Go-Back-N ARQ is using 7 bits to represent the sequence number. What is the size of window (receiver's)?

(A) 127 (B) 8
(C) 14 (D) None of these

Q.26 A computer is using the following sequence numbers

0, 1, 2, 3, 4, 5, 6, 7, 0, 1, 2, 3 .....

What is the size of the window (Assume selective repeat protocol is used)

(A) 16 (B) 8
(C) 4 (D) 3

Q.27 Check sum of 10101001 11000001 (8-bit segment)

(A) 00001100 (B) 11110000
(C) 10010100 (D) 10011000

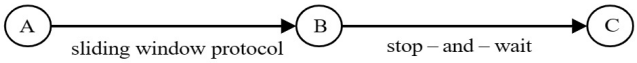
Q.28 Which of the following statements is/are FALSE?

S_1: Hamming code is used for both error detection and correction.

S_2: CRC is used for error detection.

(A) S_1 only
(B) S_2 only
(C) Both S_1 and S_2
(D) Neither S_1 nor S_2

Q.29 The distance between A to B is 2000 km. The propagation delay is $2\mu s/km$ for both links. The data rate between A and B is 200 kbps. Both the links are full duplex. All data frames are 1000 bits and ACK frames are negligible. Window size is 2. If the RTT between A and C is 10ms then what is the distance between B and C? (in km)



Q.30 Consider Sliding Window Protocol for a 10 Mbps channel with one-way latency of 150μs. If the packet size is 1 KB then what is the link utilization for window size of 127?

(A) 75% (B) 100%
(C) 43% (D) None of these

Q.31 A channel connecting source and destination has data rate of 20 kbps, propagation delay of $50\mu s$. If the transmission delay is equal to two times the propagation delay then what is the packet size for stop-and-wait protocol? Source and destination are 10 km apart.

(A) 250 bytes (B) 50 bytes
(C) 500 bytes (D) 400 bytes

Q.32 Consider the following data

$$\left.\begin{array}{l}20\text{ kbps satallite channel}\\1000\text{ bits data frames}\\RTT = 50\text{ms}\end{array}\right\} T_x = \frac{L}{B} = \frac{1000}{20\times10^3} = 50\text{ms}$$

What is the max throughput for window size of 4?

(A) 1 kbps (B) 4 kbps
(C) 5 kbps (D) 4 kbps

Q.33 Consider a network connecting 2 systems located 200 km apart. The bandwidth of the network is 50Mpbs. The propagation speed of the media is 2×10^8 m/s. It is needed to design a Go-Back-N Sliding Window Protocol for this network. The average packet size 200 bytes then find length of cable

is 10^3 bits. The network is to be used to its full capacity. Assume that processing delays at nodes are negligible. Then the minimum size in bits of the sequence number field has to be _____.

Q.34 On a workless link, the probability of packet error is 0.4. A Stop and Wait protocol is used to transfer data across the link. The channel condition is assumed to be independent from transmission to transmission. What is the average approximate number of transmission attempts required to transfer 100 packets?

Q.35 The message 1100 1001 is to be transmitted using the CRC polynomial x^3+1 to protect it from errors. The CRC for this scenario is _____.

(A) 011 (B) 100
(C) 110 (D) 101

Q.36 Station A uses 16 bytes packets to transmit messages to station B using SWP. The latency between A and B is 40ms and the bandwidth on the path between A and B is 64 kbps. What is the optimal window size that A should use?

(A) 20 (B) 40
(C) 160 (D) 320

Q.37 Consider a 64kbps satellite communications link with one-way latency of 50ms. Selective repeat protocol is used on this link to send data with a frame size of 1KB. Neglect the transmission time of ACK. The minimum number of bits required for the sequence number field to achieve 100% utilization is _____.

Q.38 A 10kbps satellite link has propagation delay of 200ms. The sender employs the Go-Back-N ARQ scheme with n set to 10. If each frame is 50 bytes long, what is the maximum data rate possible (in kbps).

Q.39 In a CSMA/CD protocol, the signal speed is $2*10^8$ m/s and bandwidth is 10^7 bps. If the minimum size of frame is _____ (km)?

Q.40 An error detecting code has the following code words :

00000000 00001111
01010101
10101010 11110000

What is the minimum number of bits errors that can be detected?

(A) 1 (B) 2
(C) 3 (D) 4

Q.41 A and B are only two stations on an Ethernet. A and B attempt to transmit a frame and collide. What is the probability that station B wins first backoff race?

(A) 0.5 (B) 0.75
(C) 0.625 (D) 0.25

Common Data Question 42 & 43

Q.42 Station A uses 1000 bytes packet to transmit message to station B using Sliding Window Protocol. The propagation delay between A and B is 80 ms and bandwidth on the path is 4 Mbps. What is the optimal window that station A should use?

(A) 20 (B) 40
(C) 80 (D) 160

Q.43 In above questions if both the stations are using Selective Repeat Protocol, then what is the minimum number of bits required to represent Sequence Number field is

(A) 7 (B) 6
(C) 8 (D) 5

Q.44 Suppose the propagation delay for a 10 Mbps Ethernet having 64 bits jamming signal is 54.4 micro sec. What is the minimum frame size_____ (bytes)?

Q.45 The sender is using Framing Protocol with delimiter flag size of 01110. If actual data is 101111110111011. Then find the number of stuff bits in transmitted data?

Q.46 In the polling media access control protocol bus LAN, each station is assigned one time slot for transmission. Each station wants to transmit a frame of size 100 bits. The

Q.49 Consider a 10 Mbps link with propagation delay of 20 ms. The size of

propagation speed is $2^* 10^8$ m/s and the length of LAN is 1 km. The bandwidth is 10 Mbps. If total number of stations over this network is 5, then find the throughput of channel?

(A) 10/3 Mbps (B) 10 Mbps
(C) 20/3 Mbps (D) 5 Mbps

Q.47 Frames of 1000 bytes are sent over $2*10^6$ bps full duplex link between two hosts. The propagation delay is 80 ms. Frames are to be transmitted into this link to maximally pack them in transit. If sender is using Selective repeat protocol then what is the number of bits to represent sequence number distinctly?

(A) 4 (B) 5
(C) 6 (D) 7

Q.48 A broadcast channel has total capacity of 10 Mbps and uses polling for media access. Once a node finish transmission there is polling delay of 80 micro sec to poll next node. Whenever a node is polled it is allowed to transmit a maximum 1000 bytes. The maximum number of stations that can be allowed in LAN so that throughput of each station is 10/11 Mbps.

(A) 5 (B) 10
(C) 15 (D) 20

frame is 1000 bits and network is using selective repeat protocol. If transmission time of acknowledgement and processing time is negligible then for window size 10 what is the throughput of channel _____ (Mbps)?

Q.50 A 25 kbps satellite link has a propagation delay of 400 ms. The transmitter employs Go-Back-N sliding window protocol. If size of each frame is 100 bytes and effective bandwidth of channel is 10 kbps then find maximum window size possible?

❑❑❑

3 Network Layer

Classroom Questions

Q.1 An organization requires a range of IP address to assign one to each of its 1500 computers. The organization has approached an Internet Service Provider (ISP) for this task. The ISP uses CIDR and serves the requests from the available IP address space 202.61.0.0/17. The ISP wants to assign an address space to the organization which will minimize the number of routing entries in the ISP's router using route aggregation. Which of the following address spaces are potential candidates from which the ISP can allot any one of the organization?

I. 202.61.84.0/21 II. 202.61.104.0/21
III. 202.61.64.0/21 IV. 202.61.144.0/21

(A) I and II only (B) III and IV only
(C) II and III only (D) I and IV only

[GATE 2020, IIT Delhi]

Q.2 Consider three machines M, N, and P with IP addresses 100.10.5.2, 100.10.5.5, and 100.10.5.6 respectively. The subnet mask is set to 255.255.255.252 for all the three machines. Which one of the following is true?

(A) M, N, and P all belong to the same subnet
(B) Only M and N belong to the same subnet
(C) M, N, and P belong to three different subnets
(D) Only N and P belong to the same subnet

[GATE 2019, IIT Madras]

Q.3 Consider the following routing table at an IP router :

Network No.	Net Mask	Next Hop
128.96.170.0	255.255.254.0	Interface 0
128.96.168.0	255.255.254.0	Interface 1
128.96.166.0	255.255.254.0	R2
128.96.164.0	255.255.252.0	R3
0.0.0.0	Default	R4

For each IP address in Group I Identify the correct choice of the next hop from Group II using the entries from the routing table above.

Group I	Group II
(i) 128.96.171.92	(a) Interface 0
(ii) 128.96.167.151	(b) Interface 1
(iii) 128.96.164.151	(c) R2
(iv) 128.96.165.121	(d) R3
	(e) R4

(A) i-a, ii-c, iii-e, iv-d
(B) i-a, ii-d, iii-b, iv-e
(C) i-b, ii-c, iii-d, iv-e
(D) i-b, ii-c, iii-e, iv-d

[GATE 2015, IIT Kanpur]

Q.4 In the network 200.10.11.144/27, the fourth octet (in decimal) of the last IP address of the network which can be assigned to a host is _____.

(A) 158 (B) 157
(C) 156 (D) 155

[GATE 2015, IIT Kanpur]

Q.5 An IP router implementing Classless Inter-domain Routing (CIDR) receives a packet with address 131.23.151.76. The router's routing table has the following entries :

Prefix	Outer Interface Identifier
131.16.0.0/12	3
131.28.0.0/14	5
131.19.0.0/16	2
131.22.0.0/15	1

The identifier of the output interface on which this packet will be forwarded is _____.

(A) 1 (B) 2
(C) 3 (D) 4

[GATE 2014, IIT Kharagpur]

Q.6 In the IPv4 addressing format, the number of networks allowed under Class *C* addresses is:

(A) 2^{14} (B) 2^{7}
(C) 2^{21} (D) 2^{24}

192.168.1.110. R2 has IP addresses 192.168.1.67 and 192.168.1.155. The subnet mask used in the network is 255.255.255.224.

Given the information above, how many distinct subnets are guaranteed to

[GATE 2012, IIT Delhi]

Q.7 An Internet Service Provider (ISP) has the following chunk of CIDR-based IP addresses available with it: 245.248.128.0/20. The ISP wants to give half of this chunk of addresses to Organization *A*, and a quarter to Organization *B*, while retaining the remaining with itself. Which of the following is a valid allocation of addresses to *A* and *B*?

(A)
245.248.136.0/21 and 245.248.128.0/22

(B)
245.248.128.0/21 and 245.248.128.0/22

(C)
245.248.132.0/22 and 245.248.132.0/21

(D)
245.248.136.0/24 and 245.248.132.0/21

[GATE 2012, IIT Delhi]

Q.8 Suppose computers *A* and *B* have *IP* addresses 10.105.1.113 and 10.105.1.91 respectively and they both use same subnet mask *N*. Which of the values of *N* given below should not be used if *A* and *B* should belong to the same network?

(A) 255.255.255.0

(B) 255.255.255.128

(C) 255.255.255.192

(D) 255.255.255.224

[GATE 2010, IIT Guwahati]

Q.9 If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?

(A) 1022 (B) 1023

(C) 2046 (D) 2047

[GATE 2008, IISc Bangalore]

Q.10 Host X has IP address 192.168.1.97 and is connected through two routers R1 and R2 to another host Y with IP address 192.168.1.80. Router R1 has IP addresses 192.168.1.135 and 192.168.1.110. R2 has IP addresses 192.168.1.67 and 192.168.1.155. The subnet mask used in the network is 255.255.255.224.

How many distinct subnets are guaranteed to already exist in the network?

(A) 1 (B) 2

(C) 3 (D) 6

[GATE 2008, IISc Bangalore]

Q.11 Host X has IP address 192.168.1.97 and is connected through two routers R1 and R2 to another host Y with IP address 192.168.1.80. Router R1 has IP addresses 192.168.1.135 and 192.168.1.110. R2 has IP addresses 192.168.1.67 and 192.168.1.155. The subnet mask used in the network is 255.255.255.224.

Which IP address should X configure its gateway as?

(A) 192.168.1.67 (B) 192.168.1.110

(C) 192.168.1.135 (D) 192.168.1.155

[GATE 2008, IISc Bangalore]

Q.12 The address of a class B host is to be split into subnets with a 6-bit subnet number. What is the maximum number of subnets and the maximum number of hosts in each subnet?

(A) 62 subnets and 262142 hosts.

(B) 64 subnets and 262142 hosts.

(C) 62 subnets and 1022 hosts.

(D) 64 subnets and 1024 hosts.

[GATE 2007, IIT Kanpur]

Q.13 Two computers C1 and C2 are configured as follows. C1 has IP address 203.197.2.53 and netmask 255.255.128.0. C2 has IP address 203.197.75.201 and netmask 255.255.192.0. Which one of the following statements is true?

(A) C1 and C2 both assume they are on the same network

(B) C2 assumes C1 is on same network, but C1 assumes C2 is on a different network

(C) C1 assumes C2 is on same network, but C2 assumes C1 is on a different network

(D) C1 and C2 both assume they are on different networks.

[GATE 2006, IIT Kharagpur]

Q.14 A router uses the following routing table :

Destination	Mask	Interface
144.16.0.0	255.255.0.0	eth0

Q.18 The routing table of a router is shown below :

Destination	Subnet Mask	Interface
128.75.43.0	255.255.255.0	Eth0
128.75.43.0	255.255.255.128	Eth1
192.12.17.5	255.255.255.225	Eth3
Default		Eth2

144.16.64.0	255.255.224.0	eth1
144.16.68.0	255.255.255.0	eth2
144.16.68.64	255.255.255.224	eth3

A packet bearing a destination address 144.16.68.117 arrives at the router. On which interface will it be forwarded?

(A) eth0 (B) eth1
(C) eth2 (D) eth3

[GATE 2006, IIT Kharagpur]

Q.15 A subnetted Class B network has the following broadcast address: 144.16.95.255 its subnet mask

(A) is necessarily 255.255.224.0
(B) is necessarily 255.255.240.0
(C) is necessarily 255.255.248.0
(D) could be any one of 255.255.224.0, 255.255.240.0,255.255.248.0

[GATE 2006, IIT Kharagpur]

Q.16 An organization has a class *B* network and wishes to form subnets for 64 departments. The subnet mask would be :

(A) 255.255.0.0 (B) 255.255.64.0
(C) 255.255.128.0 (D) 255.255.252.0

[GATE 2005, IIT Bombay]

Q.17 A company has a class *C* network address of 204.204.204.0. It wishes to have three subnets, one with 100 hosts and two with 50 hosts each. Which one of the following options represents a feasible set of subnet address/subnet mask pairs?

(A) 204.204.204.128/255.255.255.192
204.204.204.0/255.255.255.128
204.204.204.64/255.255.255.128
(B) 204.204.204.0/255.255.255.192
204.204.204.192/255.255.255.128
204.204.204.64/255.255.255.128
(C) 204.204.204.128/255.255.255.128
204.204.204.192/255.255.255.192
204.204.204.224/255.255.255.192
(D) 204.204.204.128/255.255.255.128
204.204.204.64/255.255.255.192
204.204.204.0/255.255.255.192

[GATE 2005, IIT Bombay]

Default		Eth2

On which interface will the router forward packets addressed to destinations 128.75.43.16 and 192.12.17.10 respectively?

(A) Eth1 and Eth2 (B) Eth0 and Eth2
(C) Eth0 and Eth3 (D) Eth1 and Eth3

[GATE 2004, IIT Delhi]

Q.19 A subnet has been assigned a subnet mask of 255.255.255.192. What is the maximum number of hosts that can belong to this subnet?

(A) 14 (B) 30
(C) 62 (D) 126

[GATE 2004, IIT Delhi]

Q.20 A host is connected to a Department network which is part of a University network. The University network, in turn, is part of the Internet. The largest network in which the Ethernet address of the host is unique is

(A) the subnet to which the host belongs
(B) the department network
(C) the university network
(D) the internet

[GATE 2004, IIT Delhi]

Q.21 The subnet mask for a particular network is 255.255.31.0. Which of the following pairs of IP addresses could belong to this network?

(A) 172.57.88.62 and 172.56.87.23
(B) 10.35.28.2 and 10.35.29.4
(C) 191.203.31.87 and 191.234.31.88
(D) 128.8.129.43 and 128.8.161.55

[GATE 2003, IIT Madras]

Q.22 Match the following :

List-I

(a) 200.10.192.100
(b) 7.10.230.1
(c) 128.1.1.254
(d) 255.255.235.255
(e) 100.255.255.255

List-II

(i) Class A
(ii) Limited broadcast address
(iii) Directed broadcast address
(iv) Class C
(v) Class B

Q.23 A device has two or more IP addresses, the device is called

be fragmented, i.e., Don't Fragment (DF) flag in the IP header is not set by P.

Which of the following statements is/are correct?

(A) Two fragments are created at R and the IP datagram size carrying the second fragment is 620 bytes.

the device is called

(A) Work station (B) Router

(C) Gateway (D) All the above

Q.24 A host with IP address 200.100.1.1 wants to send a packet to all hosts in the same network. What is SIP and DIP?

Q.25 A host with IP address 10.100.100.100 wants to use Loop testing. What is SIP and DIP?

Q.26 How many bits are allocated for NID and HID in 23.192.157.234 address

Q.27 What is not true about subnetting?

(A) It is applied for single network.

(B) It is used to improve security.

(C) Bits are borrowed from network portion.

(D) Bits are borrowed from last portion.

Q.28 What is not true about supernetting.

(A) It is used to improved security.

(B) It is applicable for two or more networks.

(C) Bits are borrowed from network portion.

(D) It is used to improve flexibility of IP address allotment.

Q.29 Which devices can use logical addressing system?

(A) Hub (B) Switch

(C) Bridge (D) Router

Q.30 Consider two hosts P and Q connected through a router R. The maximum transfer unit (MTU) value of the link between P and R is 1500 bytes, and between R and Q is 820 bytes.

A TCP segment of size 1400 bytes was transferred from P to Q through R, with IP identification value as 0x1234. Assume that the IP header size is 20 bytes. Further, the packet is allowed to

(B) If the second fragment is lost, R will resend the fragment with the IP identification value 0x1234.

(C) If the second fragment is lost, P is required to resend the whole TCP segment.

(D) TCP destination port can be determined by analysing only the second fragment.

[GATE 2021, IIT Bombay]

Q.31 Consider the following statements about the functionality of an IP based router.

I. A router does not modify the IP packets during forwarding.

II. It is not necessary for a router to implement any routing protocol.

III. A router should reassemble IP fragments if the MTU of the outgoing link is larger than the size of the incoming IP packet.

Which of the above statements is/are TRUE?

(A) I and II only (B) II only

(C) I only (D) II and III only

[GATE 2020, IIT Delhi]

Q.32 Consider an IP packet with a length of 4,500 bytes that includes a 20-byte IPv4 header and 40-byte TCP header. The packet is forwarded to an IPv4 router that supports a Maximum Transmission Unit (MTU) of 600 bytes. Assume that the length of the IP header in all the outgoing fragments of this packet is 20 bytes. Assume that the fragmentation offset value stored in the first fragment is 0.

The fragmentation offset value stored in the third fragment is _____.

(A) 144 (B) 145

(C) 146 (D) 147

[GATE 2018, IIT Guwahati]

Q.33 The maximum number of IPv4 router addresses that can be listed in the record route (RR) option field of an IPv4 header is _____.

(A) 9 (B) 10

(C) 11 (D) 12

[GATE 2017, IIT Roorkee]

Q.34 An IP datagram of size 1000 bytes arrives at a router. The router has to forward this packet on a link whose

(A) 256 (B) 257

(C) 258 (D) 259

[GATE 2014, IIT Kharagpur]

Q.38 An IP router with a Maximum Transmission Unit (MTU) of 1500 bytes has received an IP packet of size 4404 bytes with an IP header of length 20 bytes. The values of the relevant fields in the header of the third IP fragment generated by the router for this packet

MTU (maximum transmission unit) is 100 bytes. Assume that the size of the IP header is 20 bytes.

The number of fragments that the IP datagram will be divided into for transmission is _____.

(A) 13 (B) 14
(C) 15 (D) 16

[GATE 2016, IISc Bangalore]

Q.35 Which of the following fields of an IP header is NOT modified by a typical IP router?

(A) Check sum
(B) Source address
(C) Time to Live (TTL)
(D) Length

[GATE 2015, IIT Kanpur]

Q.36 Host A (on TCP/IP v4 network A) sends an IP datagram D to host B (also on TCP/IP v4 network B). Assume that no error occurred during the transmission of D. When D reaches B, which of the following IP header field(s) may be different from that of the original datagram D?

i. TTL ii. Checksum
iii. Fragment offset

(A) i only (B) i and ii only
(C) ii and iii only (D) i, ii and iii

[GATE 2014, IIT Kharagpur]

Q.37 Every host in an IPv4 network has a 1 second resolution real-time clock with battery backup. Each host needs to generate up to 1000 unique identifiers per second. Assume that each host has a globally unique IPv4 address. Design a 50–bit globally unique ID for this purpose. After what period (in seconds) will the identifiers generated by a host wrap around?

generated by the router for this packet are :

(A) MF bit : 0, Datagram Length : 1444; Offset : 370
(B) MF bit : 1, Datagram Length : 1424; Offset : 185
(C) MF bit : 1, Datagram Length : 1500; Offset : 370
(D) MF bit : 0, Datagram Length : 1424; Offset : 2960

[GATE 2014, IIT Kharagpur]

Q.39 In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset value is 300. The position of the datagram, the sequence numbers of the first and the last bytes of the payload, respectively are :

(A) Last fragment, 2400 and 2789
(B) First fragment, 2400 and 2759
(C) Last fragment, 2400 and 2759
(D) Middle fragment, 300 and 689

[GATE 2013, IIT Bombay]

Q.40 One of the header fields in an IP datagram is the Time-to-Live (TTL) field. Which of the following statements best explains the need for this field?

(A) It can be used to prioritize packets.
(B) It can be used to reduce delays.
(C) It can be used to optimize throughput.
(D) It can be used to prevent packet looping.

[GATE 2010, IIT Guwahati]

Q.41 For which one of the following reasons does internet protocol (IP) use the time-to-live (TTL) field in IP datagram header?

(A) Ensure packets reach destination within that time
(B) Discard packets that reach later than that time
(C) Prevent packets from looping indefinitely
(D) Limit the time for which a packet gets queued in intermediate routers

[GATE 2006, IIT Kharagpur]

Q.42 Which of the following statements is

Q.44 What is the rate at which application data is transferred to host H_C? Ignore errors, acknowledgements and other overheads?

(A) 325.5 Kbps (B) 354.5 Kbps
(C) 409.6 Kbps (D) 512.0 Kbps

[GATE 2004, IIT Delhi]

Q.45 In the TCP/IP protocol suite, which one of the following is NOT part of the IPv4 header?

TRUE?

(A) Both Ethernet frame and IP packet include checksum fields

(B) Ethernet frame includes a checksum field and IP packet includes a CRC field

(C) Ethernet frame includes a CRC field and IP packet includes a checksum field

(D) Both Ethernet frame and IP packet include CRC fields

Common Data Question 43 & 44

Consider three IP networks A, B and C. Host H_A in network A sends messages each containing 180 bytes of application data to a host H_C in network C. The TCP layer prefixes a 20 byte header to the message. This passes through an intermediate network B. The maximum packet size, including 20 byte IP header, in each network is :

A : 1000 bytes

B : 100 bytes

C : 1000 bytes

The networks A and B are connected through a 1 Mbps link, while B and C are connected by a 512 Kbps link (bps = bits per second).

Q.43 Assuming that the packets are correctly delivered, how many bytes, including headers, are delivered to the IP layer at the destination for one application message, in the best case? Consider only data packets.

(A) 200 (B) 220

(C) 240 (D) 260

[GATE 2004, IIT Delhi]

(A) Fragment Offset

(B) Source IP address

(C) Destination IP address

(D) Destination port number

[GATE 2004, IIT Delhi]

Q.46 A TCP message consisting of 2100 bytes is passed to IP for delivery across two networks. The first network can carry a maximum payload of 1200 bytes per frame and the second network can carry a maximum payload of 400 bytes per frame, excluding network overhead. Assume that IP overhead per packet is 20 bytes. What is the total IP overhead in the second network for this transmission?

(A) 40 bytes (B) 80 bytes

(C) 120 bytes (D) 160 bytes

[GATE 2004, IIT Delhi]

Q.47 Which of the following assertions is FALSE about the Internet Protocol (IP)?

(A) It is possible for a computer to have multiple IP addresses

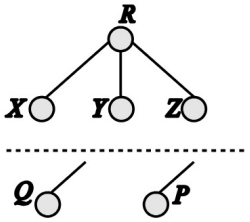
(B) IP packets from the same source to the same destination can take different routes in the network

(C) IP ensures that a packet is discarded if it is unable to reach its destination within a given number of hops

(D) The packet source cannot set the route of an outgoing packets; the route is determined only by the routing tables in the routers on the way.

[GATE 2003, IIT Madras]

Q.48 Consider a computer network using the distance vector routing algorithm in its network layer. The partial topology of the network is as shown below.



The objective is to find the shortest cost path from the router R to router P and Q. Assume that R does not initially

(C) I, II and IV only

(D) II, III and IV only

[GATE 2017, IIT Roorkee]

Q.50 Host A sends a UDP datagram containing 8880 bytes of user data to host B over an Ethernet LAN. Ethernet frames may carry data up to 1500 bytes (i.e. MTU = 1500 bytes). Size of UDP header is 8 bytes and size of IP header is 20 bytes. There is no option field in IP header. How many total number of IP fragments will be transmitted and what will be the contents of offset field

know the shortest routes to P and Q. Assume that R has three neighbouring routers denoted as X, Y and Z. During one iteration, R measures its distance to its neighbours X, Y and Z as 3, 2 and 5, respectively. Router R gets routing vectors from its neighbors that indicate that the distance to router P from routers X, Y and Z are 7, 6 and 5 respectively. The routing vector also indicates that the distance to router Q from routers X, Y and Z are 4, 6 and 8 respectively. Which of the following statement (s) is/are correct with respect to the new routing table of R, after updation during this iteration?

(A) The distance from R to P will be stored as 10.
(B) The distance form R to Q will be stored as 7.
(C) The next lop router for a packet from R to P is Y.
(D) The next lop router for a packet from R to Q is Z.

Q.49 Consider the following statements about the routing protocols. Routing Information Protocol (RIP) and Open Shortest Path First (OSPF) in an IPv4 network.

I. RIP uses distance vector routing
II. RIP packets are sent using UDP
III. OSPF packets are sent using TCP
IV. OSPF operation is based on link-state routing

Which of the above statements are CORRECT?

(A) I and IV only
(B) I, II and III only

in the last fragment?

(A) 6 and 925 (B) 6 and 7400
(C) 7 and 1110 (D) 7 and 8880

[GATE 2015, IIT Kanpur]

Q.51 Consider the following three statements about link state and distance vector routing protocols, for a large network with 500 network nodes and 4000 links.

[S_1] : The computational overhead in link state protocols is higher than in distance vector protocols.

[S_2] : A distance vector protocol (with split horizon) avoids persistent routing loops, but not a link state protocol.

[S_3] : After a topology change, a link state protocol will converge faster than a distance vector protocol.

Which one of the following is correct about S_1, S_2, and S_3?

(A) S_1, S_2, and S_3 are all true.
(B) S_1, S_2, and S_3 are all false.
(C) S_1 and S_2 are true, but S_3 is false.
(D) S_1 and S_3 are true, but S_2 is false.

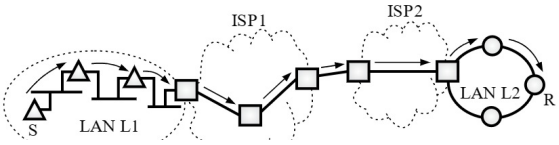
[GATE 2014, IIT Kharagpur]

Q.52 Which of the following is TRUE about the interior gateway routing protocols – Routing Information Protocol (RIP) and Open Shortest Path First (OSPF)

(A) RIP uses distance vector routing and OSPF uses link state routing
(B) OSPF uses distance vector routing and RIP uses link state routing
(C) Both RIP and OSPF use link state routing
(D) Both RIP and OSPF use distance vector routing

[GATE 2014, IIT Kharagpur]

Q.53 In the diagram shown below, L1 is an Ethernet LAN and L2 is a Token-Ring LAN. An IP packet originates from sender S and traverses to R, as shown. The links within each ISP and across the two ISPs, are all point-to-point optical links. The initial value of the TTL field is 32. The maximum possible value of the TTL field when R receives the datagram is _____.



of updates, what will be the new distance vector at node, N3?

(A) 3, 2, 0, 2, 5 (B) 3, 2, 0, 2, 6
(C) 7, 2, 0, 2, 5 (D) 7, 2, 0, 2, 6

[GATE 2011, IIT Madras]

Q.55 The cost of link N2-N3 reduces to 2 (in both directions). After the next round of updates, the link N1-N2 goes down. N2 will reflect this change immediately in its distance vector as cost, ∞. After the NEXT ROUND of update, what will be the cost to N1 in the distance vector of N3?

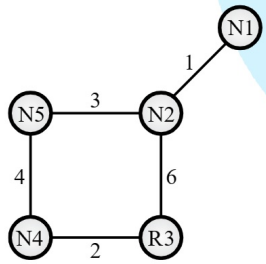
(A) 3 (B) 9
(C) 10 (D) ∞

(A) 26 (B) 27
(C) 28 (D) 29

[GATE 2015, IIT Kanpur]

Common Data Question 54 & 55

Consider a network with five nodes, N1 to N5, as shown as below.



The network uses a Distance Vector Routing protocol. Once the routes have been stabilized, the distance vectors at different nodes are as follows.

N1 : (0,1,7,8,4)
N2 : (1,0,6,7,3)
N3 : (7,6,0,2,6)
N4 : (8,7,2,0,4)
N5 : (4,3,6,4,0)

Each distance vector is the distance of the best known path at that instance to nodes, N1 to N5, where the distance to itself is 0. Also, all links are symmetric and the cost is identical in both directions. In each round, all nodes exchange their distance vectors with their respective neighbors. Then all nodes update their distance vectors. In between two rounds, any change in cost of a link will cause the two incident nodes to change only that entry in their distance vectors.

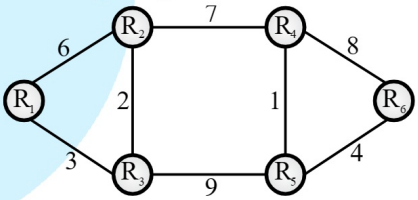
Q.54 The cost of link N2-N3 reduces to 2 (in both directions). After the next round

(C) 10 (D) ∞

[GATE 2011, IIT Madras]

Common Data Question 56 & 57

Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram.



Q.56 All the routers use the distance vector based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbour with the weight of the respective connecting link. After all the routing tables stabilize, how many links in the network will never be used for carrying any data?

(A) 4 (B) 3
(C) 2 (D) 1

[GATE 2010, IIT Guwahati]

Q.57 Suppose the weights of all unused links are changed to 2 and the distance vector algorithm is used again until all routing tables stabilize. How many links will now remain unused?

(A) 0 (B) 1
(C) 2 (D) 3

[GATE 2010, IIT Guwahati]

Q.58 Two popular routing algorithms are Distance Vector (DV) and Link State (LS) routing. Which of the following are true?

[S_1] : Count to infinity is a problem only with DV and not LS routing
[S_2] : In LS, the shortest path algorithm is run only at one node
[S_3] : In DV, the shortest path algorithm is run only at one node
[S_4] : DV requires lesser number of network messages than LS

(A) S_1, S_2 and S_4 only
(B) S_1, S_3 and S_4 only
(C) S_2 and S_3 only
(D) S_1 and S_4 only

[GATE 2008, IISc Bangalore]

Q.59 For the network given in the figure below, the routing tables of the four nodes *A*, *E*, *D* and *G* are shown.

Q.60 Count to infinity is a problem associated with

(A) link state routing protocol.
(B) distance vector routing protocol
(C) DNS while resolving host name
(D) TCP for congestion control

[GATE 2005, IIT Bombay]

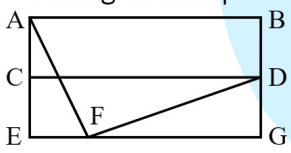
Q.61 Consider the following two statements.

S_1 : Destination MAC address of an ARP reply is a broadcast address.

S_2 : Destination MAC address of an ARP request is a broadcast address.

Which one of the following choices is correct?

Suppose that F has estimated its delay to its neighbours, A, E, D and G as 8, 10, 12 and 6 msecs respectively and updates its routing table using distance vector routing technique.



Routing table of A

A	0
B	40
C	14
D	17
E	21
F	9
G	24

Routing table of D

A	20
B	8
C	30
D	0
E	14
F	7
G	22

Routing table of E

A	24
B	27
C	7
D	20
E	0
F	11
G	22

Routing table of G

A	21
B	24
C	22
D	19
E	22
F	10
G	0

(A)

A	8
B	20
C	17
D	12
E	10
F	0
G	6

(B)

A	21
B	8
C	7
D	19
E	14
F	0
G	22

(C)

A	8
B	20
C	17
D	12
E	10
F	16
G	6

(D)

A	8
B	8
C	7
D	12
E	10
F	0
G	6

[GATE 2007, IIT Kanpur]

(A) S_1 is true and S_2 is false.

(B) Both S_1 and S_2 are true.

(C) S_1 is false and S_2 is true.

(D) Both S_1 and S_2 are false.

[GATE 2021, IIT Bombay]

Q.62 Suppose that in an IP-over-Ethernet network, a machine X wishes to find the MAC address of another machine Y in its subnet. Which one of the following techniques can be used for this?

(A) X sends an ARP request packet to the local gateway's IP address which then finds the MAC address of Y and sends to X

(B) X sends an ARP request packet to the local gateway's MAC address which then finds the MAC address of Y and sends to X

(C) X sends an ARP request packet with broadcast MAC address in its local subnet

(D) X sends an ARP request packet with broadcast IP address in its local subnet

[GATE 2019, IIT Madras]

Q.63 Which one of the following protocols is NOT used to resolve one form of address to another one?

(A) DNS (B) ARP

(C) DHCP (D) RARP

[GATE 2016, IISc Bangalore]

Q.64 The ARP is used for

(A) Finding the IP address from the DNS.

(B) Finding the IP address of the default gateway.

(C) Finding the IP address that corresponds to a MAC address.

(D) Finding the MAC address that corresponds to an IP address.

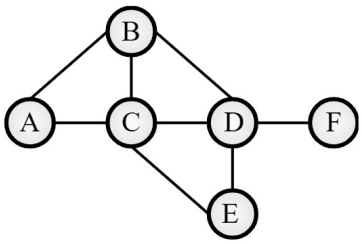
[GATE 2005, IIT Bombay]

Q.65 Trace route reports a possible route that is taken by packets moving from some host A to some other host B. Which of the following options represents the technique used by trace route to identify these hosts :

(A) By progressively querying routers

ii. From each accessible neighbour, it gets the costs to relay to other nodes via that neighbour (as the next hop).

iii. Each node updates its routing table based on the information received in the previous two steps by choosing the minimum cost.



Q.66 For the graph given above, possible routing tables for various nodes after they have stabilized, are shown in the following options. Identify the correct

(A) By progressively querying routers about the next router on the path to *B* using ICMP packets, starting with the first router

(B) By requiring each router to append the address to the ICMP packet as it is forwarded to *B*. The list of all routers en-route to *B* is returned by *B* in an ICMP reply packet

(C) By ensuring that an ICMP reply packet is returned to *A* by each router en-route to *B*, in the ascending order of their hop distance from *A*

(D) By locally computing the shortest path from *A* to *B*

[GATE 2005, IIT Bombay]

Common Data Question 66 & 67

Consider a simple graph with unit edge costs. Each node in the graph represents a router. Each node maintains a routing table indicating the next hop router to be used to relay a packet to its destination and the cost of the path to the destination through that router. Initially, the routing table is empty. The routing table is synchronously updated as follows. In each updated interval, three tasks are performed.

i. A node determines whether its neighbours in the graph are accessible. If so, it sets the tentative cost to each accessible neighbour as 1. Otherwise, the cost is set to ∞.

table.

(A)

Table for node A		
A	–	–
B	B	1
C	C	1
D	B	3
E	C	3
F	C	4

(B)

Table for node C		
A	A	1
B	B	1
C	–	–
D	D	1
E	E	1
F	E	3

(C)

Table for node B		
A	A	1
B	–	–
C	C	1
D	D	1
E	C	2
F	D	2

(D)

Table for node D		
A	B	3
B	B	1
C	C	1
D	–	–
E	E	1
F	F	1

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Q.67 Continuing from the earlier problem, suppose at some time *t*, when the costs have stabilized, node *A* goes down. The cost from node *F* to node *A* at time $(t+100)$ is :

(A) > 100 but finite

(B) ∞

(C) 3

(D) > 3 and ≤ 100

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Practice Questions

Q.1 Range of IP Address from 224.0.0.0 to 239.255.255.255 are

(A) Reserved for loopback

(B) Reserved for broadcast

(C) Used for multicast packets

(D) Reserved for future addressing

Q.2 On a LAN, where are IP datagrams transported?

(A) In the LAN header

(B) In the application field

(C) In the information field of the LAN frame

(D) After the TCP header

Q.3 Which of the following transmission media is not readily suitable to CSMA

(B) The total number of bytes in header is 16 bytes

(C) The upper layer protocol is ICMP

(D) The receiver rejects the packet

Q.8 A supernet has a first address of 205.16.32.0 and a supernet mask of 255.255.248.0. A router receives 4 packets with the following destination addresses. Which packet belongs to this supernet?

(A) 205.16.42.56 (B) 205.17.32.76

(C) 205.16.31.10 (D) 205.16.39.44

Q.9 An organization is granted the block 130.34.12.64/26. It needs to have 4 subnets. Which of the following is not an address of this organization?

media is not readily suitable to CSMA operation?

(A) Radio (B) Optical fibers
(C) Coaxial cable (D) Twisted pair

Q.4 The broadcast address for IP network 172.16.0.0 with subnet mask 255.255.0.0 is

(A) 172.16.0.255
(B) 172.16.255.255
(C) 255.255.255.255
(D) 172.255.255.255

Q.5 What is IP class and number of sub-networks if the subnet mask is 255.224.0.0?

(A) Class A, 3 (B) Class A, 8
(C) Class B, 3 (D) Class B, 32

Q.6 The process of modifying IP address information in IP packet headers while in transit across a traffic routing device is called

(A) Port address translation (PAT)
(B) Network address translation (NAT)
(C) Address mapping
(D) Port mapping

Q.7 An IP packet has arrived with the first 8 bits as 0100 0010. Which of the following is correct?

(A) The number of hops this packet can travel is 2
(A) 130.34.12.124 (B) 130.34.12.89
(C) 130.34.12.70 (D) 130.34.12.132

Q.10 Which network protocol allows hosts to dynamically get a unique IP number on each bootup

(A) DHCP (B) BOOTP
(C) RARP (D) ARP

Q.11 The address of a class B host is to be split into subnets with a 6 bit subnet number. What is the maximum number of subnets and the maximum number of hosts in each subnet?

(A) 62 subnets and 262142 hosts
(B) 64 subnets and 262142 hosts
(C) 62 subnets and 1022 hosts
(D) 64 subnets and 1024 hosts

Q.12 Which of the following statement(s) is/are false?

[S1] : ARP request is broadcast and ARP reply is unicast

[S2] : DHCP is used as resolver to map address from one form to another

(A) S1 only (B) S2 only
(C) Both (D) None of these

Q.13 Which of the following protocol uses Path Vector Routing?

(A) OSPF (B) RIP
(C) BGP (D) None of these

Q.14 A mask has created 30 subnets. What is the particular byte of the mask where the extra 1's are added?

(A) 11110000 (B) 11111000
(C) 11000000 (D) 11111100

Q.15 If we have an IP host address of 201.222.5.120 and a subnet mask of 255.255.255.240. What is the broadcast address?

(A) 201.222.5.121 (B) 201.222.5.122
(C) 201.222.5.127 (D) 201.222.5.122

Q.16 Given the address 172.16.2.120 and the subnet mask of 255.255.248.0. How many hosts are available?

Q.17 Find the mask that creates 21 subnets in class-A

(A) 255.128.0.0 (B) 255.192.0.0
(C) 255.248.0.0 (D) 255.240.0.0

Q.18 Given the mask 255.255.252.0, how forwarded to a link with MTU of 1500 bytes. What will be the offset of the second fragment?

Q.23 BGP is based on

(A) Link state routing
(B) Distance vector routing
(C) Dijkstra's Algorithm
(D) Path vector routing

Q.24 Which of the following protocol(s) is/are used for routing within an autonomous system?

(A) OSPF (B) RIP
(C) Both A & B (D) BGP

Q.25 Which one of the following hosts in any subnet of 192.168.32.0 is not valid. Assume the subnet mask used is 255.255.255.240

(A) 192.168.32.33 (B) 192.168.32.112
(C) 192.168.32.119 (D) 192.168.32.126

many hosts per subnet does this create?

(A) 252 (B) 1024

(C) 1022 (D) None of these

Q.19 Which of the following IP addresses are considered 'network' addresses with a /28 prefix?

(A) 165.203.5.192 (B) 165.203.6.255

(C) 165.203.6.240 (D) 165.203.6.255

Q.20 A class C network address has been subnetted with a /28 mask. Which of the following addresses is a broadcast address for one of the resulting subnets?

(A) 198.57.78.33 (B) 198.57.78.64

(C) 198.57.78.97 (D) 198.57.78.15

Q.21 You are a network administrator and have been assigned the IP address of 201.222.5.0. You need to have 24 subnets with 6 hosts per subnet. The subnet mark is 255.255.255.248. What is the address of 4^{th} subnet?

(A) 201.222.5.10 (B) 201.222.5.1

(C) 201.222.5.16 (D) 201.222.5.24

Q.22 A datagram of 400 bytes (3980 bytes of IP Payload plus 20 bytes of IP Header) arrives at a router and must be

Q.26 You have a network ID 131.107.0.0 with 8 subnets. You need to allow the largest possible number of hosts/subnet. Which subnet mask should you use?

(A) 255.255.240.0 (B) 255.255.248.0

(C) 255.255.252.0 (D) 255.255.224.0

Q.27 A router has the following CIDR entries in the routing table

Address/mask	Next hop
135.46.56.0/22	Interface 0
135.46.58.0/22	Interface 1
135.53.40.0/23	Router 1
Default	Router 2

What is the next hop the router routes to, if a packet with the IP address 135.46.63.10 arrives at it?

(A) Interface 0 (B) Interface 1

(C) Router 1 (D) Router 2

Q.28 IP Address : 124.133.112.66

Mask : 255.255.224.0

Which of the following is not a broadcast address of the subnet?

(A) 124.133.255.255

(B) 124.133.63.255

(C) Both (A) and (B)

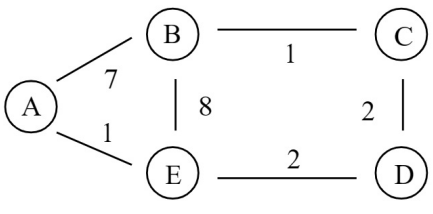
(D) None of these

Q.29 A datagram of 4000 bytes (20 bytes of IP Header + 3980 bytes of IP Payload) arrives at a router and must be forwarded the link with MTU of 1500 bytes then at what byte the 2^{nd} fragment is ended?

(A) 2960 (B) 1480

(C) 2959 (D) 1479

Q.30 Consider the following graph:



The initial state of routing table is

	A	B	C	D	E
A	0	7	∞	∞	1
B	7	0	1	∞	8
C	∞	1	0	2	∞

(A) 201.15.130.143 (B) 201.15.130.158

(C) 201.15.131.192 (D) 201.12.130 .16 3

Q.34 What will be the valid broadcast address's fourth byte for subnet 172.16.176.0/20?

(A) 255 (B) 254

(C) 252 (D) 250

Q.35 Suppose a subnet x has a subnet mask 255.255.192.0 and a system A has IP address 157.106.46.234. Which of the following belongs to same network as A?

(A) 157.106.63.3

(B) 157.106.132.71

(C) Both (A) and (B)

(D) None of these

Q.36 Find total number of networks in class B IP-Addressing?

(A) 2^{16} (B) 2^{14}

(C) 2^{24} (D) 2^{12}