UNIT–8

DATABASES

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DATABASES

INTRODUCTION TO DBMS AND RELATIONAL MODEL

8.1

LEVEL–1

Q.1 A customer's telephone number is stored in a customer file, a sales agent file, and in an invoice file. In database, this is known as

(a) Transparency

(b) Availability

(c) Redundancy

(d) Integrity

Q.2 To be considered minimally relational, the DBMS must support the following key relational functions:

(a) SELECT, UNION, INTERSECT

(b) SELECT, UNION, JOIN

(c) SELECT, PROJECT, JOIN

(d) SELECT, PROJECT, UNION

Q.3 The schema of a table is an example of

(a) Relationship

(b) Entity

(c) Metadata

(d) Atomicity

Q.4 A transaction is a collection of operations that performs a single logical function in a database application. The successful execution of a database despite the possibility of system failure is called

(a) Integrity

(b) Durability

(c) Consistency

(d) Atomicity

Q.5 In context with Relational Algebra, which of the following are unary operations.

I. SELECT

II. PROJECT

III. UNION

IV. PRODUCT

(a) All are binary operations

(b) I and II only

(c) II only

(d) I and III only

Q.6 Match the following :

Group I		Group II	
1.	SELECT	A.	Vertical subset of a table
2.	PROJECT	B.	Horizontal subset of a table
		C.	Common tuples

(a) 1 – C, 2 – B

(b) 1 – C, 2 – A

(c) 1 – B, 2 – A

(d) 1 – A, 2 – B

Q.7 Database that are designed and managed specifically to meet information needs are called

(a) Database Management Systems

(b) Data Warehouses

(c) Transaction databases

(d) Production databases

Q.8 The data retrieval time factor is most critical for

(a) Data Warehouse

(b) Decision DBMS

(c) Transactional DBMS

(d) Both (a) and (b)

Q.9 A file system is said to exhibit data dependence because

(a) When any of the file's data characteristics change, all data access programs are subject to change.

(b) Data is the most important part of a file system which also includes hardware, software people and procedures.

(c) Organization of the data, within the file is determined by the data's expected use

(d) A change in any file's structure, such as the addition or deletion of a field, requires the modification of all programs using that file.

Q.10 Suppose x is a component of some tuple, and the domain for that component is the integers. If x has the value NULL, what is the value of

I. 0 * x

II. x – x

(a) NULL, NULL

(b) 0, 0

(c) NULL, 0

(d) 0, NULL

Q.11 Which of the following is a database administrator's function?

(a) User coordination

(b) Performance monitoring

(c) Backing up the database

(d) All of these

Q.12 Which two files are used during operation of the DBMS?

(a) Data dictionary and query language

(b) Data dictionary and transaction log

(c) Data manipulation language and query language

(d) Query languages and utilities

Q.13 A schema describes

(a) record relationships

(b) records and files

(c) data elements

(d) all of these

Q.14 A transparent DBMS

(a) keeps its physical structure hidden from users

(b) keeps its logical structure hidden from users

(c) Cannot hide sensitive information from users

(d) both (a) and (b)

Q.15 A phone no in a database is an example of a

(a) File

(b) Sort

(c) Field

(d) Record

Q.16 If P and Q are predicates and e is the relational algebra expression, then which of the following equivalence are valid?

(a) $\sigma_P(\sigma_Q(e))=\sigma_Q(\sigma_P(e))$

(b) $\sigma_P(\sigma_Q(e))=\sigma_{P\wedge Q}(e))$

(c) $\sigma_Q(\sigma_P(e))=\sigma_{P\wedge Q}(e))$

(d) All of these

Q.17 A race condition occurs when

(a) two users of the DBMS are interacting with different files at the same time

(b) two concurrent activities interact to cause a processing error

(c) both (a) and (b)

(d) none of these

Q.18 The distinguishable parts of a record are called

(a) database

(b) fields

(c) data

(d) files

Q.19 The logical data structure with a one-to-many relationship is a

(a) relational

(b) chain

(c) tree

(d) network

Q.20 In a large DBMS

(a) each sub-schema contains every field in the logical schema

(b) each user can access every sub-schema

(c) each user can "see" only a small part of the entire data base

(d) all of the above

Q.21 A network schema

(a) Stores data in tables

(b) Permits many-to-many relationships

(c) Restricts the structure to a one-to-many relationship

(d) None of the above

Q.22 Goals for the design of the logical schema include

(a) Being able to access data efficiently

(b) Being able to construct queries easily

(c) Avoiding data inconsistency

(d) All of the above

Q.23 When several users access the database at the same time, it is said to be

(a) Concurrent storing

(b) Connection trap

(c) Database management

(d) Integrated data

Q.24 Which of the following is not a responsibility of a DBA:

(a) Deciding access strategy

(b) Deciding the storage structure and access strategy

(c) Marketing the software

(d) Deciding the information content of the database

Q.25 A good query system

(a) allows non-programmers to access information stored in a database

(b) can be accessed only by the data processing professionals

(c) can accepts English language commands

(d) none of the above

Q.26 When using a database management system, the first thing that we must do is to

(a) load the software into our micro-computer

(b) activate file editor

(c) create a data base file

(d) keep a floppy disk in readiness

Q.27 Which of the following is an advantage of the database approach?

(a) program/data independence

(b) elimination of the data redundancy

(c) ability to associate related data

(d) all of the above

Q.28 In an entity relationship, y is the dominant entity and x is a subordinate entity. Which of the following is/are incorrect?

(a) Operationally, x is deleted, y remains the same

(b) Operationally, x is deleted, so is y

(c) Operationally, if y is deleted, so is x

(d) x is existence dependent on y

LEVEL–2

Q.29 Consider the relation r_1 (P, Q, R) and r_2(R, S, T) with primary keys P and R respectively. The relation r_1 contains 2000 tuples and r_2 contains 2500 tuples. The maximum size of the join $r_1 \bowtie r_2$ is

(a) 2000

(b) 2500

(c) 4500

(d) 5000

Q.30 Consider a relation geq which represents "greater than or equal to", that is, (x, y) ∈ geq only if y ≥ x.

Create table geq

(lb integer not null

ub integer not null ,

primary key lb

foreign key (ub) references geq on delete cascade)

Which of the following is possible if a tuple (x, y) is deleted?

(a) A tuple (z, w) with z > y is deleted

(b) A tuple (z, w) with z > x is deleted

(c) A tuple (z, w) with w < x is deleted

(d) The deletion of (x, y) is prohibited

Common Data For Questions 31 to 34:

Consider the given schemes:

Branch_scheme = (Branch_name, assets, Branch_city)

Customer_scheme = (customer_name, street, customer_city)

Deposit_scheme = (Branch_name, account_number, Customer_name, balance)

Borrow_scheme = (Branch_name, loan_number, Customer_name, amount)

Client_scheme = (Customer_name, banker_name)

Q.31 Using relational algebra, the query that finds customers, who have a balance of over 1000 is

(a) $\sigma_{\text{customer\_name}}$ ($\pi_{\text{balance}>1000}$ (Borrow))

(b) $\pi_{\text{customer\_name}}$ ($\sigma_{\text{balance}>1000}$ (Borrow))

(c) $\sigma_{\text{customer\_name}}$ ($\sigma_{\text{balance}>1000}$ (Deposit))

(d) $\pi_{\text{customer\_name}}$ ($\sigma_{\text{balance}>1000}$ (Deposit))

Q.32 Which of the following queries finds the clients of banker Agassi and the city they live in?

(a) $\pi_{\text{customer\_name, customer\_city}}$ ($\sigma_{\text{Banker\_name = "Agassi"}}$ (Client × customer))

(b) $\pi_{\text{client.customer\_name, customer\_city}}$ ($\sigma_{\text{Banker\_name = "Agassi"}}$ ($\sigma_{\text{client.customer\_name = customer.customer\_name}}$ (client × customer))

(c) $\pi_{\text{client.customer\_name, customer\_city}}$ ($\sigma_{\text{Banker\_name = "Agassi"}}$ (client × customer))

(d) $\pi_{\text{client.customer\_name, customer\_city}}$ ($\sigma_{\text{client.customer\_name}}$) = customer.customer_name ($\sigma_{\text{Banker\_name = "Agassi"}}$ (client × customer))

Q.33 Which of the following tuple relational calculus finds all the customers who have a loan amount more than 1200?

(a) {t | ∃ s ∈ borrow (t[Customer_name] = s[Customer_name]) ∨ s[amount] > 1200)}

(b) {t | ∃ s ∈ borrow (t[Customer_name] = s[Customer_name]) ∧ s[amount] > 1200)}

(c) {t | t(Customer_name) ∈ borrow ∧ t[amount] > 1200)}

(d) {t(Customer_name) / t ∈ borrow ∧ t[amount] > 1200)}

Q.34 Which of the following Domain relational calculus finds all customers who have a loan amount of over 1200?

(a) {<c> | <b, |, c, a > ∈ borrow ∧ a > 1200)}

(b) {<c> | ∃<b, |, a > ∈ borrow ∧ a > 1200)}

(c) {<c> | ∃ b, |, a (<b, |, c, a > ∈ borrow ∧ a > 1200)}

(d) {<c> | ∃ b, |, a (<b, |, c a > ∈ borrow ∨ a > 1200)}

Q.35 A natural JOIN is the result of a three-stage process. Choose the option that gives the correct order of it.

(a) PRODUCT, SELECT and PROJECT

(b) PRODUCT, PROJECT and SELECT

(c) PRODUCT, JOIN and SELECT

(d) PRODUCT, JOIN and PROJECT

Q.36 Consider the relational algebra

DOCTORS(Id, Last_Name, Department, Supervisor)

NURSES(Id, Last_Name, Department, Supervisor)

Write a query to find the last names and supervisors of the medical personnel that work in the Cardiology department.

(a) $\Pi_{\text{Last\_Name, Supervisor}}(\sigma_{\text{Department = Cardiology}}(\text{NURSES}))$

$-$

$\Pi_{\text{Last\_Name, Supervisor}}(\sigma_{\text{Department = Cardiology}}(\text{DOCTORS}))$

(b) $\Pi_{\text{Last\_Name, Supervisor}}(\sigma_{\text{Department = Cardiology}}(\text{NURSES}))$

$\cap$

$\Pi_{\text{Last\_Name, Supervisor}}(\sigma_{\text{Department = Cardiology}}(\text{DOCTORS}))$

(c) $\Pi_{\text{Last\_Name, Supervisor}}(\sigma_{\text{Department = Cardiology}}(\text{NURSES}))$

$\cup$

$\Pi_{\text{Last\_Name, Supervisor}}(\sigma_{\text{Department = Cardiology}}(\text{DOCTORS}))$

(d) None of these

Common Data For Questions 37 to 39:

Consider the relations shown below:

r

A	B	C
a	1	a
b	1	b
a	1	c
c	2	d

s

A	B	C
a	1	a
a	3	d

Q.37 The result of $\sigma_{A=a}(r)$ is

(a) No Output

(b)

A	B	C
a	1	a
a	1	b

(c)

A	B	C
a	1	a
a	1	c

(d)

A
a

Q.38 The result of $\Pi_{A, B}(r)$ is

(a)

A	B
a	1
b	1
c	2

(b)

A	B
a	1
b	1
a	2
c	1

(c)

A	B
a	1
b	1
a	1
c	2

(d)

A	B
a	1
a	3

Q.39 The result of r–s is,

(a) Empty relations

(b) Illegal Operation

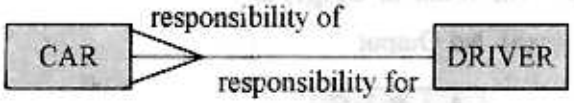
(c)

A	B	C
b	1	b
a	1	c
c	2	d

(d)

A	B	C
a	1	b
b	1	c

Q.40 Identify the type of relationship.



(a) 1 : 1

(b) N : M

(c) M : 1

(d) 1 : M

Q.41 We have the following relation schemas:

Patient(patient_name, patient_addr, Treating_doctor),

Hospitalcharges(patient_name, hospitalchargeid, typeofcharge, amount);

Doctorcharges(patient_name, doctorchargeid, typeofchargeid, amount)

Suppose we have query as,

(SELECT patient_name

FROM Doctorcharges)

EXCEPTALL

(SELECT patient_name

FROM Hospitalcharges)

If Jones has 3 doctorcharge bill and one hospitalcharge bill, then how many tuples with the name Jones are there in the result?

(a) 1 tuple

(b) 2 tuples

(c) 3 tuples

(d) 4 tuples

Q.42 Consider a relation with a single-attribute key and n (n > 0) tuples. If we do a Projection on the key attribute on this relation, what can we say about the cardinality of the Projection relation?

(a) Cardinality = n + 1

(b) Cardinality = n

(c) Cardinality = 1

(d) None of these

Q.43 Consider the join of a relation R with a relation S. If R has m tuples and S has n tuples Then the maximum and minimum sizes of the join respectively are

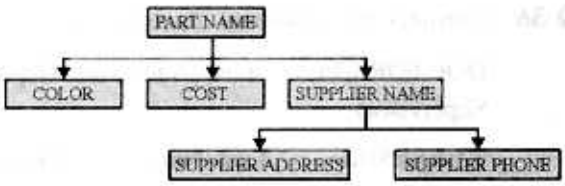
(a) mn and m + n

(b) m + n and |m – n|

(c) mn and 0

(d) m + n and 0

Q.44 Consider the model given below:



What type of model is it?

(a) Relational

(b) Network

(c) Hierarchical

(d) None of these

LEVEL–3

Common Data For Questions 45 to 48:

Answer the questions with reference to entities EMPLOYEE and PROJECT and the relationship ASSIGNED_TO between them.

Emp#	Name
101	Manish
103	Smita
104	Rock
106	Anita
107	Dipti
110	Deepak
112	Priya

Fig. : EMPLOYEE Table

Project#	Emp#
NET453	101
NET354	103
NET343	104
NET354	104
NET231	106
NET278	106
NET353	106
NET354	106
NET453	106
NET231	107
NET353	107
NET278	110
NET353	112
NET354	112

Figure : ASSIGNED_TO Table

Project#	Project_Name	Project_Leader
NET231	Pascal	107
NET278	Pascal/Object	110
NET353	Database	107
NET354	Operating Sys	104
NET453	Database	101

Figure : PROJECT Table

Q.45 Write a relational algebra expression to satisfy the following query.

"Get Emp# of employees working on project NET353"

(a) $\pi_{Emp\#}$ ($\sigma_{Project\#}$ = 'NET353'(EMPLOYEE ⋈ PROJECT))

(b) $\sigma_{Emp\#}$ ($\pi_{Project}$ = 'NET353'(ASSIGNED_TO))

(c) $\pi_{Emp\#}$ ($\sigma_{Project\#}$ = 'NET353'(ASSIGNED_TO))

(d) None of these

Q.46 Choose the correct response relation from the given option for the following query (Relational Algebra Expression).

EMPLOYEE ⋈ $\pi_{Emp\#}$ ($\sigma_{Project\#}$ = 'NET353' (ASSIGNED_TO))

(a)

Emp#	Project#	Name
106	NET353	Anita
107	NET353	Dipti
112	NET353	Priya

(b)

Emp#	Name
106	Anita
107	Dipti
112	Priya

(c)

Emp#
106
107
112

(d)

Emp#	Project#
106	NET353
107	NET353
112	NET353

Q.47 Choose the most appropriate relational algebra expression to satisfy the following query. "Obtain details of employees working on the database project"

(a) EMPLOYEE ⋈ $\pi_{Emp\#}$ (ASSIGNED_TO ⋈ ($\sigma_{Project\#}$ ($\pi_{Project\_Name}$ = 'Database' (PROJECT))))

(b) EMPLOYEE ⋈ $\pi_{Emp\#}$ (ASSIGNED_TO ⋈ ($\pi_{Project\#}$ ($\sigma_{Project\_Name}$ = 'Database' (PROJECT))))

(c) EMPLOYEE ⋈ $\pi_{Emp\#}$ (PROJECT ⋈ ($\sigma_{Project\#}$ ($\pi_{Project\_Name}$ = 'Database' (ASSIGNED_TO))))

(d) EMPLOYEE ⋈ $\pi_{Emp\#}$ (PROJECT⋈ ($\sigma_{Project\#}$ ($\pi_{Project\_Name}$ 'Database' (ASSIGNED_TO))))

Q.48 Choose the correct response relation from the given option for the following query.

"Get the number of employees who work on all projects".

(a)

Emp#
101
106

(b)

Emp#
112

(c)

Emp#
106

(d)

Emp#
107

Q.49 Consider the following:

Process	Time
P	4
Q	5
Q	3
P	3
R	4

Fig. r_1

Time
3
4

Fig. r_2

$r_1 \div r_2$ gives

(a)

Process
P
Q
R

(b)

Process	Time
P	4
Q	3
P	3
R	4

(c)

Process	Time
P	3
P	4

(d) None of these

Common Data For Questions 50 to 52:

Refer table 1, table 2 and table 3 of a banking system.

Table 1

Client_name	Client_City	Client_pin
Amit	Mumbai	400086
Bhavna	Bangalore	613432
Kiran	Pune	523512
Manish	Vashi	423721
Prakash	Ratnagiri	414564
Sagar	Mumbai	400086
Vishal	Chennai	724036
Yaresh	Bangalore	614012

Fig. The client relation

Table 2

Acc_no	Balance
S_101	1000
S_102	1500
S_251	1900
S_256	900
S_305	1350

Fig. The Account relation

Table 3

Client_name	Acc_no
Bhavna	S_101
Bhavna	S_251
Manish	S_256
Prakash	S_102
Vishal	S_305

Fig. The Depositor relation

Q.50 How many tuples will be present in response to the following query

$\pi_{(Client\_name,Client\_pin)}(Client) \times \pi_{(Client\_name)}(Depositor)$

(a) 40

(b) 35

(c) 32

(d) 28

Q.51 How many tuples and attributes will be the result of the following query

$\sigma_{Client\_city = "Bangalore"}$ (Client ⋈ Account ⋈ Depositor) where '⋈' is natural join.

(a) 8, 6

(b) 8, 5

(c) 8, 4

(d) 2, 5

Q.52 Which of the following is a query to find the name of all client who have an account in the bank and balance more than 1000

(a) $\pi_{(Client\_name)}$ ($\sigma_{(Balance > "1000")}$ (Client ⋈ Account ⋈ Depositor))

(b) $\sigma_{(Client\_name)}$ ($\pi_{(Balance > "1000")}$ (Client ⋈ Account ⋈ Depositor))

(c) $\pi_{(Client\_name)}$ ($\sigma_{(Balance > "1000")}$ (Client ⋈ Account))

(d) $\sigma_{(Client\_name)}$ ($\pi_{(Balance > "1000")}$ (Client ⋈ Account))

GATE QUESTIONS

Q.53 Let R (a, b, c) and S (d, e, f) be two relations in which d is the foreign key of S that refers to the primary key of R

Consider the following four operations R and S

A. Insert into R

B. Insert into S

C. Delete from R

D. Delete from S

Which of the following is true about the referential integrity constraint above?

[GATE 1997]

[2–Marks]

(a) None of these can cause its violation

(b) All of these can cause its violation

(c) Both A and D can cause its violation

(d) Both B and C can cause its violation

Q.54 Which of the following query transformations (i.e., replacing the L.H.S. expression by the R.H.S expression) is incorrect? R_1 and R_2 are relations, C_1 C_2 are selection conditions and A_1 and A_2 are attributes of R_1 **[GATE 1998]**

[2–Marks]

(a) $\sigma_{C_1}(\sigma_{C_1}(R_1)) \rightarrow \sigma_{C_2}(\sigma_{C_2}(R_1))$

(b) $\sigma_{C_1}(\pi_{A_1}(R_1)) \rightarrow \pi_{A_1}(\sigma_{C_1}(R_1))$

(c) $\sigma_{C_1}(R_1 \cup R_2) \rightarrow \sigma_{C_1}(R_1) \cup \sigma_{C_2}(R_2)$

(d) $\pi_{A_1}(\sigma_{C_1}(R_1)) \rightarrow \sigma_{C_1}(\pi_{A_1}(R_1))$

Q.55 Let R = (a, b, c, d, e, f) be a relation schema with the following dependencies c → f, e → a, cc → d, a → b. Which of the following is a key of R? **[GATE 1999]**

[1–Mark]

(a) ac

(b) ae

(c) ec

(d) cd

Q.56 The relational algebra expression equivalent to the following tuple calculus expression

$\{t \mid t \in r \wedge (t[A] = 10 \wedge t[B] = 20)\}$ is

[GATE 1999]

[1–Mark]

(a) $\sigma_{(A=10 \vee B=20)}(r)$

(b) $\sigma_{(A=10)}(r) \cup \sigma_{(B=20)}(r)$

(c) $\sigma_{(A=10)}(r) \cap \sigma_{(B=20)}(r)$

(d) $\sigma_{(A=10)}(r) - \sigma_{(B=20)}(r)$

Q.57 Given the relations

employee(name, salary, deptno), and

department(deptno, deptname, address)

which of the following queries cannot be expressed using the basic relational algebra operations (σ, π, x, |x|, $\cap$, $\cup$, –)?

[GATE 2000]

[1–Mark]

(a) Department address of every employee

(b) Employees whose name is the same as their department name

(c) The sum of all employees salaries

(d) All employees of a given department

Q.58 Suppose the adjacency relation of vertices in a graph is represented in a table Adj(X, Y). Which of the following queries cannot be expressed by a relational algebra expression of constant length? **[GATE 2001]**

[1–Mark]

(a) List of all vertices adjacent to a given vertex

(b) List of all vertices which have self loops

(c) List of all vertices which belong to cycles of less than three vertices

(d) List of all vertices reachable from a given vertex

Q.59 Which of the following relational calculus expressions is not safe? **[GATE 2001]**

[2–Marks]

(a) $\{t \mid \forall u \in R_1(u[A] = \text{"x"} \Rightarrow \exists s \in R_2(t[A] = s[A] \wedge s[A] = u[A]))\}$

(b) $\{t \mid \exists u \in R_1(t[A] = u[A]) \wedge \exists s \in R_2(t[A] = s[A])]\}$

(c) $\{t \mid \neg(t \in R_1)\}$

(d) $\{t \mid \exists u \in R_1(t[A] = u[A]) \wedge \neg \exists s \in R_2(t[A] = s[A])]\}$

Q.60 Let r and s be two relations over the relation schemes R and S respectively, and let A be an attribute in R. Then the relational algebra expression $\sigma_{A=a}(r \bowtie s)$ is always equal to

[GATE 2001]

[1–Mark]

(a) $\sigma_{A=a}(r)$

(b) r

(c) $\sigma_{A=a}(r) \bowtie s$

(d) none of the above

Q.61 With regard to the expressive power of the formal relational query languages, which of the following statements is true? **[GATE 2002]**

[1–Mark]

(a) Relational algebra is more powerful than relational calculus

(b) Relational algebra has the same power as relational calculus

(c) Relational algebra has the same power as safe relational calculus

(d) None of the above

Q.62 Let R_1 (A, B, C) and R_2 (D, E) be two relation schema, where the primary keys are shown underlined, and let C be a foreign key in R_1 referring to R_2. Suppose there is no violation of the above referential integrity constraint in the corresponding relation instances r_1 and r_2. Which one of the following relational algebra expressions would necessarily produce an empty relation? **[GATE 2004]**

[1–Mark]

(a) $\Pi_D(r_2) - \Pi_C(r_1)$

(b) $\Pi_C(r_1) - \Pi_D(r_2)$

(c) $\Pi_D(r_1 \bowtie_{C \neq D} R_2)$

(d) $\Pi_C(r_1 \bowtie_{C=D} r_2)$

Q.63 Consider the following relation schema pertaining to a students database:

Student (rollno, name, address)

Enroll (rollno, courseno, coursename)

where the primary keys are shown underlined. The number of tuples in the student and Enroll tables are 120 and 8 respectively. What are the maximum and minimum number of tuples that can be present in (Student * Enroll), where '*' denotes natural join? **[GATE 2004]**

[1–Mark]

(a) 8, 8

(b) 120, 8

(c) 960, 8

(d) 960, 120

Q.64 It is desired to design an object–oriented employee record system for a company. Each employee has a name, unique id and salary. Employees belong to different categories and their salary is determined by their category. The functions getName, getId and computeSalary are required. Given the class hierarchy below, possible locations for these functions are:

I. getId is implemented in the superclass

II. getId is implemented in the subclass

III. getName is an abstract function in the superclass

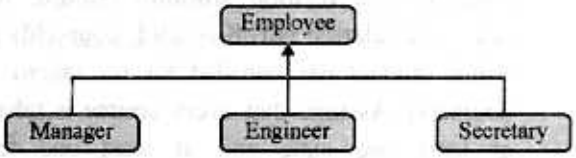
IV. getName is implemented in the superclass

V. getName is implemented in the subclass

VI. getSalary is an abstract function in the superclass

VII. getSalary is implemented in the superclass

VIII. getSalary is implemented in the subclass



Choose the best design **[GATE 2004]**

[2–Marks]

(a) I, IV, VI, VIII

(b) I, IV, VII

(c) I, III, V, VI, VIII

(d) II, V, VIII

Q.65 Consider the relation Student (name, sex, marks), where the primary key is shown underlined, pertaining to students in a class that has at least one boy and one girl. What does the following relational algebra expression produce?

$$\Pi_{name}(\sigma_{sex=female}(Student)) - \Pi_{name}\left(Student \bowtie_{(sex=female \wedge x=male \wedge marks<m)} \rho_{n,x,m}(Student)\right)$$

[GATE 2004]

[2–Marks]

(a) names of girl students with the highest marks

(b) names of girl students with more marks than some boy student

(c) names of girl students with marks not less than some boy student

(d) names of girl students with more marks than all the boy student

Q.66 Which level of locking provides the highest degree of concurrency in a relational database?

[IT-GATE 2004]

[1 Mark]

(a) Page

(b) Table

(c) Row

(d) Page, table and row level locking allow the same degree of concurrency

Q.67 Let r be a relation instance with schema R = (A, B, C, D). We define $r_1 = \Pi_{A, B, C}(r)$ and $r_2 = \Pi_{A,D}(r)$. Let $s = r_1 * r_2$ where * denotes natural join. Given that the decomposition of r into r_1 and r_2 is lossy, which one of the following is TRUE?

[GATE 2005]

(a) $s \subset r$ **[1–Mark]**

(b) $r \cup s = r$

(c) $r \subset s$

(d) $r * s = s$

Q.68 Consider a relation scheme R = (A, B, C, D, E, H) on which the following functional dependencies hold : {A → B, BC → D, E → C, D → A}. What are the candidate keys of R?

[GATE 2005]

(a) AE, BE **[2–Marks]**

(b) AE, BE, DE

(c) AEH, BEH, BCH

(d) AEH, BEH, DEH

Q.69 Let E_1 and E_2 be two entities in an E/R diagram with simple single-valued attributes. R_1 and R_2 are two relationships between E_1 and E_2, where R_1 is one-to-many and R_2 is many-to-many. R_1 and R_2 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model?

[GATE 2005]

[2–Marks]

(a) 2

(b) 3

(c) 4

(d) 5

Q.70 The following table has two attributes A and C where A is the primary key and C is the foreign key referencing A with on-delete cascade.

A	C
2	4
3	4
4	3
5	2
7	2
9	5
6	4

The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2, 4) is deleted is: **[GATE 2005]**

[2–Marks]

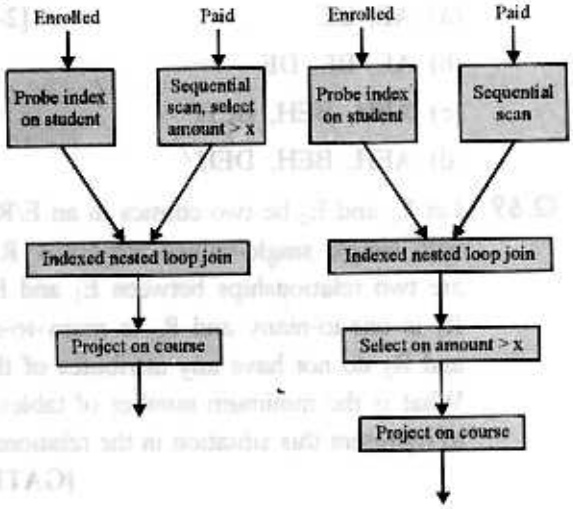
(a) (3, 4) and (6, 4)

(b) (5, 2) and (7, 2)

(c) (5, 2), (7, 2) and (9, 5)

(d) (3, 4), (4, 3) and (6, 4)

Q.71 Consider the relation enrolled (student, course) in which (student, course) is the primary key, and the relation paid (student, amount) where student is the primary key. Assume no null values and no foreign keys or integrity constraints. Assume that amounts 6000, 7000, 8000, 9000 and 10000 were each paid by 20% of the students. Consider these query plans (Plan 1 on left, Plan 2 on right) to "list all courses taken by students who have paid more than x."



A disk seek takes 4 ms. disk data transfer bandwidth is 300 MB/s and checking a tuple to see if amount is greater than x takes 10 μs. Which of the following statements is correct?

[GATE 2006]

[2–Marks]

(a) Plan 1 and Plan 2 will not output identical row sets for all databases

(b) A course may be listed more than once in the output of Plan 1 for some databases

(c) For x = 5000, Plan 1 executes faster than Plan 2 for all databases

(d) For x = 9000, Plan 1 executes slower than Plan 2 for all databases

Q.72 Information about a collection of students is given by the relation **studinfo** (studId, name, sex). The relation **enroll** (studId, courseId) gives which student has enrolled for (or taken) what course(s). Assume that every course is taken by at least one male and at least one female student. What does the following relational algebra expression represent?

$\prod_{courseId}((\prod_{studId}(\sigma_{sex = \text{"female"}}(studInfo)) \times \prod_{courseId}(enroll)) - enroll)$ **[GATE 2007]**

[2–Marks]

(a) Courses in which all the female students are enrolled

(b) Courses in which a proper subset of female students are enrolled

(c) Courses in which only male students are enrolled

(d) None of the above

Q.73 Consider the relation **employee**(name, sex, supervisorName) with name as the key.supervisor Name gives the name of the supervisor of the employee under consideration. What does the following Tuple Relational Calculus query produce? **[GATE 2007]**

[2–Marks]

{e.name | employee(e) ∧

(∀x) [¬empolyee(x) ∨ x.supervisorName

≠ e.name ∨ x.sex = "male"]}

(a) Names of employees with a male supervisor

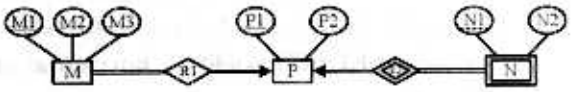
(b) Names of employees with no immediate male subordinates

(c) Names of employees with no immediate female subordinates

(d) Names of employees with a female supervisor

Common Data For Questions 74 to 75:

Consider the following ER diagram



Q.74 The minimum number of tables needed to represent M, N, P, R1, R2 is **[GATE 2008]**

[2–Marks]

(a) 2

(b) 3

(c) 4

(d) 5

Q.75 Which of the following is a correct attribute set for one of the tables for the correct answer to the above question? **[GATE 2008]**

[2–Marks]

(a) {M1, M2, M3, P1}

(b) {M1, P1, N1, N2}

(c) {M1, P1, N1}

(d) {M1, P1}

Q.76 Let R and S be two relations with the following schema

R(P, Q, R1, R2, R3)

S(P, Q, S1, S2)

where {P, Q} is the key for both schemas. Which of the following queries are equivalent?

[GATE 2008]

[2–Marks]

I. $\Pi_P(R \bowtie S)$

II. $\Pi_P(R) \bowtie \Pi_P(S)$

III. $\Pi_P(\Pi_{P,Q}(R) \cap \Pi_{P,Q}(S))$

IV. $\Pi_P(\Pi_{P,Q}(R) - (\Pi_{P,Q}(R) - \Pi_{P,Q}(S)))$

(a) Only I and II

(b) Only I and III

(c) Only I, II and III

(d) Only I, III and IV

ANSWER KEY

1	c	2	c	3	c	4	b	5	b
6	c	7	b	8	c	9	a	10	a
11	d	12	b	13	d	14	a	15	c
16	d	17	b	18	b	19	c	20	d
21	b	22	d	23	a	24	c	25	a
26	c	27	d	28	b	29	a	30	c
31	d	32	d	33	b	34	c	35	a
36	c	37	c	38	a	39	c	40	c
41	b	42	b	43	c	44	c	45	c
46	b	47	b	48	c	49	d	50	d
51	d	52	a	53	d	54	a	55	c
56	c	57	c	58	d	59	c,d	60	c
61	c	62	a	63	a	64	a	65	d
66	c	67	c	68	d	69	b	70	c
71	c	72	c	73	c	74	a	75	a
76	c								

SOLUTIONS

S.1 (c)

Redundant data is unnecessarily duplicated data. A database contains data **redundancy** when the same data about the same entity are kept in different locations. Redundant data are often the source of difficult – to – trace information errors. Reports might yield different results, depending on which version of the data was used.

S.2 (c)

Relational algebra defines the theoretical way of manipulating table contents using the eight relational functions. SELECT, PROJECT, JOIN, INTERSECT, UNION, DIFFERENCE, PROJECT and DIVIDE. To be considered minimally relational, the DBMS must support the key relational functions **SELECT, PROJECT and JOIN**. Very few DBMS are capable of supporting all eight relational operators.

S.3 (c)

A data dictionary contains metadata – that is, data about data. **The schema of tables is an example of metadata**. A database system consults the data dictionary before reading or modifying actual data.

S.4 (b)

Atomicity: Requires that all operations (parts) of a transaction be completed, if not, the transaction is aborted. In other words, a transaction is treated as a single, indivisible, logical unit or work.

Durability: Indicates the permanence of the database's consistent state. When a transaction is completed, the database reaches a consistent state, and that state cannot be lost, even in the event of the system's failure.

S.5 (b)

SELECT and PROJECT are called unary operations because they operate on one relation.

S.6 (c)

SELECT yields values for all attributes found in a table. SELECT can be used to list all of the row's values for each attribute, or it can yield selected row values for each attribute. In other words, **SELECT yields a horizontal subset of a table**.

PROJECT produces a list of all values for selected attributes. In other words, **PROJECT yields a vertical subset of a table**.

S.7 (b)

Production databases, also known as Transaction databases are the databases we encounter when we participate in online transactions such as enrolling in a class, registering for car, buying a product, or making a bank deposit or withdrawal. Although such databases yield streams of useful information, there are specialized databases, known as **data warehouses** that are designed and managed specifically to meet information needs. The data warehouses derive most of their data from production databases.

S.8 (c)

Transactions such as product or service sales, payments and supply purchases reflect critical day–to–day operations. Such transactions are time–critical and must be recorded accurately and immediately. A database management system primarily designed to support such "immediate response" transactions is classified as **transactional databases.**

S.9 (a)

A file system is said to exhibit structural dependence because a change in any file's structure, such as addition or deletion of a field, requires modifications of all programs using that file. That means, access to a file is dependent on its structure.

A file system is said to exhibit data dependence because a **change in any file's data characteristics**, such as changing the field from integer to decimal, **requires change in all data access programs**. That means, access to a file data is dependent on its data characteristics.

S.10 (a)

When we operate on a NULL and any value, including another NULL, using any attribute operator, **the result is NULL**.

S.11 (d)

Optimizing the perforamance of the queries is one of the important function of a DBMS. User co-ordination and backing-up the database is also its function.

S.13 (d)

Schema means the structure of the database, the tables, the constraints, the relation, etc. which make-up the entire database.

S.16 (d)

a, b, c are same type of equivalence expressions.

S.27 (d)

Advantages of database approach:

1. Reduce data redundancy.
2. Provides data sharing facilites.
3. Provides data integrity.
4. Provides data independance.

S.29 (a)

$r_1(P, Q, R)$ and $r_2(R, S, T)$.

The primary keys are P and R respectively. Relation r_1 contains 2000 tuples and R_2 contains 2500 tuples.

R is the foreign key in relation r_1. The maximum size of the join $r_1 \bowtie r_2$ is **2000 tuples** as the min of (tuples in r_1, tuples in r_2) is 2000.

S.30 (c)

A tuple (z, W) with w < x is deleted.

S.31 (d)

The SQL statement is

Select customer_name from Deposit where (balance>1000);

∴ Relational Algebra Query is

$$\pi_{\text{customer\_name}} (\sigma_{\text{balance}>1000} (\text{Deposit}))$$

S.32 (d)

Select client.customer_name,
client.customer_city from client, customer
where (client.customer_name = customer.
Customer_name and Banker_name = "Agassi"

∴ Relational Algebra Query is

$$\pi_{\text{client.customer\_name, customer\_city}} (\sigma_{\text{client.customer\_name}} = \text{customer.customer\_name} (\sigma_{\text{Banker\_name = "Agassi"}} (\text{Client} \times \text{customer}))$$

S.33 (b)

∴ Relational Algebra Query is

$$\{t \mid \exists\ s \in \text{borrow}\ (t[\text{Customer\_name}] = s[\text{Customer\_name}]) \wedge s[\text{amount}] > 1200)\}$$

S.34 (c)

The relational calculus statement is

$\{<c> \mid \exists\ b, |, a\ (<b, |, c, a> \in \text{borrow} \wedge a > 1200)\}$

S.35 (a)

A natural JOIN links tables by selecting only the rows with common values in their common attribute(s). A natural join is the result of a three –stage process:

Step 1: First, a **PRODUCT** of the tables is created.

Step 2: A **SELECT** is then performed on the output of step 1 to yield only the rows for which the common attribute(s) values are equal.

Step 3: A **PROJECT** is performed on the results of Step 2 to yield a single copy of each attribute, thereby eliminating duplicate columns.

S.36 (c)

Since we want the last names and supervisors of the medical personnel that work in the Cardiology department,

(i) First, we find the last names and supervisors among Nurses who work in Cardiology department.

(ii) Secondly, we find the last names and supervisors among Doctors who work in the Cardiology department.

(iii) Lastly, we took the **union** of both to find the required query.

S.37 (c)

Since, it is only selection and not projection, all the attributes will appear in the result having A = a.

S.38 (a)

The output relation will contain attributes of A and B.

But tuple (a, 1) is repeated.

Therefore it will appear only once.

S.39 (c)

Since both r and s are union compatible, the operation is legal. The result will be relation r after removing all the tuples that are common to both.

S.40 (c)

L to R : Each CAR must be responsibility of one and only one DRIVER,

R to L : Each DRIVER must be responsible for one or more CARs,

This is a **M : 1** relationship.

S.41 (b)

Since we retain all duplicates by using EXCEPTALL, therefore the number of duplicate copies a tuple in result is equal to number of duplicate copies of the tuples in d minus the number of duplicate copies of the tuple in b, provided that the difference is positive.

S.42 (b)

Since there are n different tuples in the relation, there must be n different key values, one per tuple. Therefore, the cardinality of the projection on the key attribute should be equal to n since there are no duplicate values and each value must appear only once.

S.43 (c)

The maximum size would be the case where every tuple of R is combined with every tuple of S to get **mn** tuples. The minimum case is when no tuple of R is able to combine with any tuple of S.

S.44 (c)

It is **hierarchical** because access to each item is only through one path beginning at the top. One could not access the cost without knowing the part name. For relational model, it would be tables as shown below. The tables would be connected by the supplier ID number. The relational model would be better because any item can be accessed quickly in a variety of ways.

PART NAME	COLOR	COST	SUPPLIER ID

SUPPLIER ID	SUPPLIER ADDRESS	SUPPLIER PHONE

S.45 (c)

To evaluate the given query, we select those tuples of relations ASSIGNED_TO such that the value of the Project# attribute is NET353. We then project the result on the attribute Emp# to get the response relation.

The response relation is as shown below

Emp#
106
107
112

S.46 (b)

The first part of the evaluation of this query is the same as in the query in the previous example. It is however, followed by a natural join of the result with EMPLOYEE relation to gather the complete details about the employees working on the project NET353.

S.47 (b)

This query requires two joins. The first step is to find the number(s) of the project(s) named Database. This involves a selection of the

relation PROJECT, followed by a projection on the attribute Project#. The result of this projection is joined with the ASSINGED_TO relation to give tuples of the ASSINGED_TO involving Database. This is projected on Emp# and subsequently joined with EMPLOYEE to get the required employee details

The response relation via as shown below.

EMPLOYEE $\bowtie$ $\pi_{Emp\#}$ (ASSINGED_TO $\bowtie$ ($\pi_{Project\#}$ ($\sigma_{Project\_Name\ =\ 'Database'}$ (PROJECT))))

Emp#	Name
101	Manish
106	Anita
107	Dipti
112	Priya

S.48 (c)

The sequence to follow in evaluating this query is first compile a list of all projects from the PROJECT relation by a simple projection on Project#, then dividing the ASSIGNED_TO relation by it to derive a unary containing the required employee numbers

The relational algebra expression for this is,

ASSIGNED_TO ÷ $\pi_{Project\#}$ (PROJECT)

S.49 (d)

DIVIDE requires the use of one single column table and one two-column table. Using the above question, we note that

(i) r1 is divided by r2. r1 and r2 both contains 'Time' but do not share 'Process'

(ii) To be included in the result (r1 ÷ r2), a value in the unshared column 'Process' must be associated (in the dividing r2) with every value in r1.

(iii) The only value associated with both 3 and 4 is P.

∴ The correct answer is

Process
P

S.50 (d)

Since a relation is a set, any duplicate rows are eliminated, The result of

$\pi_{(Client\_name,\ Client\_pin)}$(Client)

has 7 tuples since (Mumbai, 400086) is repeated.

Similarly

$\pi_{(Client\_name)}$(Depositor) has 4 rows. Therefore, the Cartesian Product operation (X) results in **7 × 4 = 28 tuples**

S.51 (d)

The result of the above q ry will be

Client _name	Client _city	Client _pin	Acc _no	Balance
Bhavna	Bangalore	613432	S_101	1000
Bhavna	Bangalore	613432	S_251	1900

S.52 (a)

(Client $\bowtie$ Account $\bowtie$ Depositor) gives the list of all client having an account in the bank.

$\pi_{(Client\_name)}$ ($\sigma_{(Balance\ >\ "1000")}$ **(Client $\bowtie$ Account $\bowtie$ Depositor))** gives the list of all clients having balance more than 1000 and option (a) satisfies the required query.

S.53 (d)

When **Insert into 'S'** operation will take place there will be inconsistency in the data base, since it has a foreign key which refers to the primary key of R. When **delete from 'R'** take place it will cause violation because since it's primary key is the foreign key for 'S' so there will be inconsistency in the database. Before deleting from R, the corresponding rows from S has to be deleted. The other options (A) and (D) will not cause such problem.

S.54 (a)

Here the values of selection conditions $C_1 \neq C_2$ (they may not be equal)

Therefore it is not equivalent. The other three query transformation are equivalent.

S.55 (c)

$c \to f$
$e \to a$
$ec \to d$
$a \to b$ } given

$e \to a$

$\therefore$ $ec \to a$ $\to$ (1)

$a \to b$

$\therefore$ $ec \to b$ $\to$ (2)

$c \to f$

$\therefore$ $ec \to f$ $\to$ (3)

also $ec \to ec$ $\to$ (4)

$ec \to d$ $\to$ (5)

$\therefore$ $ec \to abcde$

$\therefore$ **ec is key for 'R'.**

S.56 (c)

The '$\wedge$' operator in tuple calculus will have same effect as the '$\cap$' **intersection** operator in relational algebra.

S.57 (c)

The above statement can be represented using the following expression.

$\mathbf{sum_{salary}(employee)}$

The result of this query is a relation with a single attribute, containing a single row with a numeral value corresponding to the **sum of all the salaries of all employees working at the department.**

S.58 (d)

To express all the vertices we use Project operator 'π' and to select particular value we specify some predicate or conditions of selection which is not possible for the above problem rather it will be very complicated. In other three cases it is possible to give particular conditions for selection operator.

S.59 (c,d)

The above expression is unsafe, because it allows values in the result that are not in the domain of the expression., i.e., $\{t \mid \neg(t \in R_1)\}$

In the expression (d)

$\{t \mid \exists u \in R_1 \ (t[A] = u\ [A] \wedge \neg \exists s \in R_2 \ (t[A] = s\ [A])\}$

Hence, the 2nd part ($\neg \exists s \in R_2$) implies s does not exist in R_2. Since all relations are finite, an infinite no. of values for s does not appear in 'r'. Thus, it is not possible, in general, to test the second part of the formula, without considering an infinite no. of potential values for 't'.

S.60 (c)

(i) $\sigma_{\theta_0}(E_1 \bowtie_0 E_2) = (\sigma_{\theta_0}(E_1)) \bowtie_0 E_2$ when θ_0 is condition only on attributes of E_1.

(ii) $\sigma_{\theta_0}(E_1 \bowtie_0 E_2) = E_1 \bowtie_0 (\sigma_{\theta_0}(E_2))$ when θ_0 is condition only on attributes of E_2.

It distributes when all the attributes in selection condition θ_0 involve only the attributes of one of expressions (E_1) being joined.

S.61 (c)

When Relational Calculus is added with some additional properties (restriction) it is called **safe Relational calculus which is equivalent to Relational algebra.**

S.62 (a)

$R_1(A, B, C)$

$R_2(\underline{D}, E)$

C is the foreign key in R_1 and referring to primary key to R_2.

D is the primary key of R_2.

In relation R_2 column D values are subset of R_1 column C. Because of integrity constraints. So $\Pi_D(R_2) - \Pi_C(R_1)$ is empty.

S.63 (a)

The minimum and maximum number of tuples in given natural join operation is minimum of these min (120, 8) = **8**.

S.64 (a)

Superclass hide the information to the outside world so each id of an employee must be implemented in superclass.

Name is also an important attribute of employee so must be implemented in the superclass. Salary of an employee differ by category and department so it is a function that must be implemented in subclass.

S.65 (d)

The given query computes the **names of girl students with more marks than all the boy students.**

S.66 (c)

The highest degree of concurrency in a relational database is provided by **Row level locking.**

S.67 (c)

Given

$R = (A, B, C, D)$

$r_1 = \pi_{A, B, C}(r)$

$r_2 = \pi_{A, D}(r)$

$s = r_1 * r_2$

All tuples in r is also tuples of so $r \subset s$.

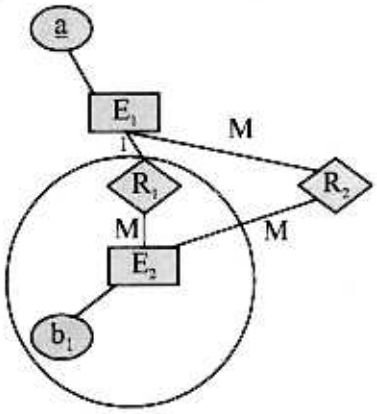
S.68 (d)

$R = (A, B, C, D, E, H)$

$FD = \{A \rightarrow B, BC \rightarrow D, E \rightarrow C, D \rightarrow A\}$

The candidate keys of R is **AEH, BEH, DEH** because all of these generates the {A, B, C, D, E, H}

S.69 (b)



R_1 key b

R_2 key ab

E_1 key a

E_2 key b

R_1 and E_2 can merge because keys are same.

Hence,

One table for E1;

One table for E2;

One table for R2;

Total **3 Tables**

Remember that only one to many relationship can be represented with entity set from one's side, because each entity set can be associated with at most one entity of another set.

S.70 (c)

If (2, 4) is deleted then 2 is the primary key but in (5, 2) and (7, 2) 2 is the foreign key so these must be deleted. The primary key for **(5, 2)** and **(7, 2)** is 5 and 7 respectively but in **(9, 5)** 5 is the foreign key so it is also deleted.

S.71 (c)

There are two plans mainly plan 1 and plan 2. In plan 1 first of all the records pair is selected then they are joined but in plan 2 all paid records are joined first and then the records are checked. The seek time of disk is 4 mS and data transfer rate is 300 MB/S So **if x = 5000 then plan 1 executes faster than plan 2 for all databases.**

S.72 (c)

Step 1: $\Pi_{studId}(\sigma_{sex="female"}(studInfo))$

Selects the females from studInfo table and projects their studId.

Step 2:

$\Pi_{studId}(\sigma_{sex="female"}(studInfo)) \times \Pi_{courseId}(enroll)$

Provides only the "courseId" from "enroll" table whose "studId" are projected.

Step 3:

$\Pi_{courseId}(\Pi_{studId}(\sigma_{sex="female"}(studInfo)) \times \Pi_{courseId}(enroll) - enroll)$

Reduces the selected "courseId" from "courseId" of enroll, i.e., providing the remaining "courseId", i.e., of male students and projecte them.

Hence, result is **courses in which only male students are enrolled**

S.73 (c)

The query $\{e.name \mid employee(e) \wedge (\forall x)[\neg empolyee(x) \vee x.supervisorName \neq e.name \vee xsex = "male"]\}$ computes the **name of employees with no immediate female subordinates.**

S.74 (a)

Here we require only two tables to represent M, N, P, R1, R2, because there are two relations R1 and R2 are two relation. In relation tables, we can include fields of M, N and P.

Relation R1 is one to many from P to M and R2 is one to many from P to N. But N is a weak entity. There is also total participation of tables in relations so we can merge M and P as one table and P and N as other table.

S.75 (a)

The correct attribute set is **{M1, M2, M3, P1}**. Since, merging P and M into one result is non-normalised talbes as P2 depends only on one of the key values P1, so, it has to be removed. This can be done without the loss of information as P1 and P2 are also in other table which has attributes P1, P2, N1 and N2 having primary key as P1. So, attribute set for tables are: {M1, M2, M3, P1} and {P1, P2, N1, N2}.

S.76 (c)

R and S are two relations

$R(P, Q, R_1, R_2, R_3)$

$S(P, Q, S_1, S_2)$

I. $\Pi_P(R \bowtie S)$: The query join the relation R and S then project the column P only.

II. $\Pi_P(R) \bowtie \Pi_P(S)$: The query project the column P from R and S then join these projected column so this produces same result as in I.

III. $\Pi_P(\Pi_{P,Q}(R) \cap \Pi_{P,Q}(S))$: The given query project separately the column P and Q in both relations R and S. The intersection produces only those column which are common in both and finally projection produces the result as the column P so this query is also equivalent to I and II.

8.2 NORMALIZATION

LEVEL–1

Q.1 Indicate which of the following statements are true:

A relation database which is in 3NF may still have undesirable data redundancy because there may exist:

(a) transitive functional dependencies

(b) non-trivial functional dependencies involving prime attributes on the right side

(c) non-trivial functional dependencies involving prime attributes only on the left side

(d) non-trivial functional dependencies involving only prime attributes

Q.2 Let us consider the following declaration

R represents n entity and the set X, Y of attributes represents the key of R, then if R represents a one–to–one relationship between entity E_1 and E_2 then which of the following is correct?

(a) The FD $Y \rightarrow X$ will hold only

(b) The FD $X \rightarrow Y$ will hold only

(c) (a) and (b) hold together

(d) Neither (a) nor (b) holds

Q.3 Given two sets of Function Dependencies (FDs) F and G over a relation scheme R, if G covers F and if no proper subset $G'(G' \subseteq G)$ covers F, then G is called

(a) determinant cover

(b) nonredundant cover

(c) nondeterminant cover

(d) redundant cover

Q.4 Spurious tuples are

(a) the multiple entries with same value

(b) the tuples with null values, that exist in the original relation

(c) the tuples with null values, that did not exist in the original relations

(d) the tuples with null values

Q.5 If F is a set of FDs on a relation scheme R, then F^+, the closure of F, is the smallest set of FDs such that $F^+ \supseteq F$ and no FD can be derived from F by using the interference axioms that are not contained in F^+.

(a) it is assumed to contain all the attributes that appear in F

(b) whole statement is incorrect

(c) F^+ i.e. closure is not possible

(d) none of these

Q.6 A primary key if combined with a foreign key creates

(a) many-to-many relationship between the tables that connect them

(b) network model between the tables that connect them

(c) parent child relationship between the tables that connect them

(d) none of the above

Q.7 Manager's salary details are hidden from the employee. This is

(a) external level data hiding

(b) physical level data hiding

(c) conceptual level data hiding

(d) none of the above

Q.8 Consider the following set of functional dependencies on the scheme (A, B, C).

$A \rightarrow BC$

$B \rightarrow C$

$A \rightarrow B$

$AB \rightarrow C$

The canonical cover for this set is

(a) $A \rightarrow B$ and $B \rightarrow C$

(b) $A \rightarrow BC$ and $AB \rightarrow C$

(c) $A \rightarrow BC$ and $A \rightarrow B$

(d) $A \rightarrow BC$ and $B \rightarrow C$

LEVEL–2

Q.9 Which of the following statement is correct?

(a) $F \models Y \rightarrow X$ iff $X^+ \subseteq Y$

(b) $F \models X \rightarrow Y$ iff $X^+ \subseteq Y$

(c) $F \models Y \rightarrow X$ iff $Y \subseteq X^+$

(d) $F \models X \rightarrow Y$ iff $Y \subseteq X^+$

Q.10 Let R = (A, B, C, D) and F = {$A \rightarrow B$, $A \rightarrow C$, $BC \rightarrow D$} then which of the following is correct?

(a) $F \models B \rightarrow D$

(b) $F \models A \rightarrow B$

(c) $F \models A \rightarrow D$

(d) None of these

Q.11 Let R = (A, B, C, D) and

$F = \{A \rightarrow B, A \rightarrow C, BC \rightarrow D\}$

then $A \rightarrow D$ is in F^+

Then which of the following is correct?

(a) $A \rightarrow D$ is in F^+ is always true

(b) $A \rightarrow D$ is in F^+ but, for that $D \rightarrow A$ must be satisfied

(c) $A \rightarrow D$ is not in F^+

(d) None of these

Q.12 Consider the following relation scheme pertaining to the information about a student maintained by an university:

STDINF (Name, Course, Phone_No, Major, Prof, Grade)

then this scheme is decomposed into the relation schemes

STUDENT (Name, Phone_No, Major, Grade)

COURSE (Course, Prof)

Then select the correct statement, if it is bad decomposition

(a) Due to loss of information

(b) Due to redundancy and update anomaly

(c) The above decomposition is not at all bad

(d) Both (a) and (b)

Q.13 A decomposition of relation scheme R <(X, Y, Z), F> into R_1<(X, Y), F_1> and R_2 <(X, Z), F_2> is lossless if

(a) the common attributes X of either R_1 or R_2 form a superkey of atleast one of these i.e. $X \rightarrow Y$ or $X \rightarrow Z$

(b) the common attributes X of R_1 and R_2 form a superkey of atleast one of these i.e. $X \rightarrow Y$ or $X \rightarrow Z$

(c) every functional dependency in R can be logically derived from the functional dependencies either of R_1 and R_2 but not both

(d) every functional dependency in R can be logically derived from the functional dependencies of R_1 and R_2.

Q.14 Consider the following relation R

Name	Student#	Course	Grade
Mahesh	22	VB 6.0	A
Suraj	28	JAVA	B
Ketan	38	J2EE	C
Ketki	05	.net	D

Then identify the incorrect statement about relation R.

I. The relation R has two overlapping candidate keys

II. The relation R is in 3NF

III. The relation R is in BCNF

IV. The relation R has a disadvantage of repetition of data

(a) IV

(b) III

(c) II

(d) I

Q.15 A decomposition of a relation scheme R <S, F> into the relation schemes $R_i (1 \le i \le n)$, then if $R \subset \Pi_{R1}(R) \bowtie \Pi_{R2}(R) \bowtie \ldots\ldots \bowtie \Pi_{Rn}(R)$ then such a decomposition is called

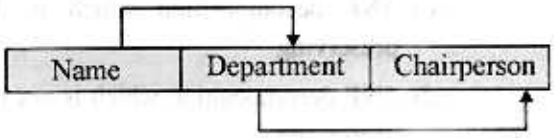
(a) dependency preserving

(b) lossy

(c) Neither (a) nor (b)

(d) Both (a) and (b)

Q.16 Consider the following relationship



then which of the following statement is correct?

(a) Name is the key and Chairperson is fully functional dependent on the key

(b) Name and Department are the keys and Chairperson is fully functional dependent on the key

(c) Name is the key and Chairperson is transitively dependent on the key

(d) Name and Department are the keys and Chairperson is transitively dependent on the keys

Q.17 Consider the following relation R(A, B, C, D, E)

A	B	C	D	E
a_1	b_1	c_2	d_1	e_1
a_2	b_2	c_1	d_2	e_2
a_3	b_1	c_2	d_1	e_3
a_3	b_3	c_3	d_3	e_4
a_1	b_2	c_1	d_2	e_5
a_4	b_4	c_4	d_4	e_6
a_3	b_2	c_1	d_2	e_7
a_5	b_4	c_4	d_4	e_8

Which of the following statement is correct?

I. For the relation R, the FD B → CD is satisfied and by projectivity, B → C and B → D

II. For the relation R, the FD B → C and C → D are satisfied and hence by transitivity, B → D

(a) II

(b) I

(c) Both I and II

(d) Neither I nor II

Q.18 Given the relation R(A, B, C) and the set F = {AB → C, B → D, D → B} of functional dependencies, then the candidate key/s of the relation is/are?

(a) AB, BD

(b) AB, AD

(c) AD

(d) AB

Q.19 The highest normal form of the relation R(A, B, C, D) if the following FDs are satisfied by relation.

F = {AB → D, AC → BD, B → C}

(a) BCNF

(b) 3NF

(c) 2NF

(d) 1NF

Q.20 Consider the relation scheme of the relation SCHEDULE shown below. What is the highest normal form of this relation?

SCHEDULE(Stud_ID, Class, Stud_Name, Stud_Major, Class_Time, Building_Room, Instructor)

Assume the following functional dependencies

Stud_ID → Stud_Name
Stud_ID → Stud_Major
Class → Class_Time
Class → Building_Room
Class → Instructor

(a) BCNF
(b) 3NF
(c) 2NF
(d) 1NF

Q.21 Given the following relation instant

P	Q	R
1	4	2
1	5	3
1	6	3
3	2	2

Which of the following functional dependencies are satisfied by the instance?

(a) PR → Q and Q → P
(b) QR → P and P → R
(c) QR → P and Q → R
(d) PQ → R and R → Q

LEVEL–3

Q.22 Consider the following declaration

F = {W → X, X → Y, W → XY} then which of the following statement is correct about F^+?

I F^+ includes W → W, X → X, Y → Y
II. F^+ includes W → X, X → Y, W → XY
III. F^+ includes W → Y, W → Z

(a) I, II, III
(b) II, III
(c) I, II
(d) I, III

Q.23 Let's assume that

F = {A → BC, CD → E, E → C, D → AEH, ABH → BD, DH → BC}

then $(CD)^+$ under {F – (CD → E)} is equal to

(a) ABCDEH
(b) BCDEH
(c) ABCEH
(d) ABCD

Q.24 If F = {A → BC, CD → E, E → C, D → AEH, ABH → BD, DH → BC} then canonical cover for F is

(a) {A → B, A → C, E → C, D → H, ACH → D}
(b) {A → B, E → C, D → A, D → H, AH → D}
(c) {A → B, A → C, E → C, D → A, D → E, D → H, AH → D}
(d) None of these

Q.25 Consider the relation scheme,

<(ABCD), {AB → C, C → A}>

the decomposition obtained finally by above relation scheme is in

(a) BCNF decomposition which is dependency preserving
(b) BCNF decomposition which is not dependency preserving
(c) 3NF decomposition which is dependency preserving
(d) 3NF decomposition which is not dependency preserving

Q.26 Find the candidate key for the relation R(A, B, C, D, E, F)

A → D
B → E F
E → C

(a) BE
(b) AB
(c) DE
(d) CD

Q.27 The BCNF decomposition of the relation scheme SHIPPING with the following set of functional dependencies

SHIPPING (Ship, Capacity, Date, Cargo, Value)

Ship → Capacity

ShipDate → Cargo

CargoCapacity → Value

is

(a) R_1 (Cargo, Capacity, Value) with the FD CargoCapacity → Value

R_2 (Ship, Capacity) with the FD Ship → Capacity

R_3 (Ship, Date, Cargo) with the FD ShipDate → Cargo

(b) R_1 (Ship, Capacity) with the FD Ship → Capacity

R_2 (Ship, Date, Cargo, Value) with the FD ShipDate → Cargo

(c) Both (a) and (b)

(d) Neither (a) nor (b)

Q.28 Using the candidate key obtained in the above question, normalize the relation R(A, B, C, D, E, F) to 2NF with functional dependencies A → D, B → EF

(Assume R is in 1NF)

(a) R_1 (A, B, E)

R_2 (D, E, F)

R_3 (D, C)

(b) R_1 (A, B, D)

R_2 (B, C, D)

R_3 (E, F)

(c) R_1 (A, B, D)

R_2 (B, E, F)

R_3 (A, B)

(d) R_1 (A, B, C)

R_2 (B, E, F)

R_3 (A, D)

Q.29 Consider the following functional dependencies in a database

$D \rightarrow A$ $A \rightarrow E$

$N \rightarrow R$ $R \rightarrow N$

$C \rightarrow C_n$ $C \rightarrow I$

$(R, C) \rightarrow G$

The relation (R, N, D, A) is

(a) in BCNF

(b) in 3NF but not in BCNF

(c) in 2NF but not in 3NF

(d) none of these

GATE QUESTIONS

Q.30 For a database relation R (a, b, c, d), where the domains of a, b, c, d include only atomic values, only the following functional dependencies and those that can be inferred from them hold:

a → c

b → d

This relation is **[GATE 1997]**

[2-Marks]

(a) in first normal form but not in second normal form

(b) in second normal form but not in third normal form

(c) in third normal form

(d) none of the above

Q.31 Which of normal form is considered adequate for normal relational database design?

[GATE 1998]
[1-Mark]

(a) 2 NF

(b) 5 NF

(c) 4 NF

(d) 3 NF

Q.32 Consider the schema R = (S T U V) and the dependencies S → T, T → U, U → V and V → S. Let R = (R1 and R2) be a decomposition such that R1 ∩ R2 = ϕ. The decomposition is:

[GATE 1999]

[2–Marks]

(a) not in 2NF

(b) in 2NF but not in 3NF

(c) in 3NF but not in 2 NF

(d) in both 2NF and 3 NF

Q.33 Given the following relation instance

X	Y	Z
1	4	2
1	5	3
1	6	3
3	2	2

Which of the following functional dependencies are satisfied by the instance? [GATE 2000]

[2–Marks]

(a) XY → Z and Z → Y

(b) YZ → X and Y → Z

(c) YZ → X and X → Z

(d) XZ → Y and Y → X

Q.34 Consider a schema R(A, B, C, D) and functional dependencies A → B and C → D. Then the decomposition of R into R_1(AB) and R_2(CD) is

[GATE 2001]

[1–Mark]

(a) dependency preserving and lossless join

(b) lossless join but not dependency preserving

(c) dependency preserving but not lossless join

(d) not dependency preserving and not lossless join

Q.35 Relation R with an associated set of functional dependencies F, is decomposed into BCNF. The redundancy (arising out of functional dependencies) in the resulting set of relation is

[GATE 2002]

(a) Zero [1–Mark]

(b) More than zero but less than that of an equivalent 3NF decomposition

(c) Proportional to the size of F^+

(d) Indeterminate

Q.36 Relation R is decomposed using a set of functional dependencies F, and relation S is decomposed using another set of functional dependencies, G. One decomposition is definitely BCNF, the other is definitely 3NF, but it is not known which is which. To make a guaranteed identification, which one of the following tests should be used on the decomposition? (Assume that the closures of F and G are available)

[GATE 2002]

(a) Dependency – preservation [2–Marks]

(b) Lossless – join

(c) BCNF definition

(d) 3NF definition

Q.37 Consider the following functional dependencies in a database:

Date_of_Birth → Age

Age → Eligibility

Name → Roll_Number

Roll_number → Name

Course_number → Course_name

Course_number → Instructor

(Roll_number, Course_number) → Grade

The relation (Roll_number, Name, Date_of_birth, Age) is [GATE 2003]

[2–Marks]

(a) in second normal normal form but not in third normal form

(b) in third but not in BCNF

(c) in BCNF

(d) in none of the above

Q.38 The relation scheme Student Performance (name, courseNo, rollNo, grade) has the following functional dependencies:

name, courseNo → grade

Roll No., courseNo → grade

name → rollNo

rollNo → name

The highest normal form of this relation scheme is **[GATE 2004]**

[2–Marks]

(a) 2 NF

(b) 3 NF

(c) BCNF

(d) 4 NF

Q.39 A relation Empdtl is defined with attribute empcode (unique), name, street, city, state and pincode. For any pincode, there is only one city and state. Also, for any given street, city and state, there is just one pincode. In normalization terms, Empdtl is a relation in

[IT-GATE 2004]
[2-Marks]

(a) 1NF only

(b) 2NF and hence also in 1NF

(c) 3NF and hence also in 2NF and 1NF

(d) BCNF and hence also in 3NF, 2NF and 1NF

Q.40 A table has fields F1, F2, F3, F4, F5 with the following functional dependencies

F1 → F3 F2 → F4 (F1.F2) → F5

In terms of Normalization, this table is in

[IT-GATE 2005]

[1 Mark]

(a) 1 NF

(b) 2 NF

(c) 3 NF

(d) None of these

Q.41 Which one of the following statements about normal forms is FALSE?

[GATE 2005]

[1–Mark]

(a) BCNF is stricter than 3NF

(b) Loss less, dependency-preserving decomposition into 3NF is always possible

(c) Loss less, dependency-preserving decomposition into BCNF is always possible

(d) Any relation with two attributes is BCNF

Q.42 The following functional dependencies are given:

AB → CD, AF → D, DE → F, C → G, F → E, G → A

Which one of the following options is false?

[GATE 2006]

[2–Marks]

(a) $\{CF\}^+ = \{ACDEFG\}$

(b) $\{BG\}^+ = \{ABCDG\}$

(c) $\{AF\}^+ = \{ACDEFG\}$

(d) $\{AB\}^+ = \{ABCDFG\}$

Q.43 Which one of the following statement is FALSE?

[GATE 2007]

[2–Marks]

(a) Any relation with two attributes is in BCNF

(b) A relation in which every key has only one attribute is in 2NF

(c) A prime attribute can be transitively dependent on a key in 3NF relation.

(d) A prime attribute can be transitively dependent on a key in a BCNF relation.

Q.44 Consider the following relational schemes for a library database:

Book(Title, Author, Catalog_no, Publisher, Year, Price)

Collection(Title, Author, Catalog_no)

Within the following functional dependencies:

I. Title, Author → Catalog_no

II. Catalog_no → Title Author Publisher Year

III. Publisher Title Year → Price

Assume {Author, Title} is the key for both schemes. Which of the following statements is true?

[GATE 2008]

[2–Marks]

(a) Both Book and Collection are in BCNF

(b) Both Book and Collection are in 3NF only

(c) Book is in 2NF and Collection is in 3NF

(d) Both Book and Collection are in 2NF only

Common Data For Questions 45 to 46:

Consider the following relational schema:

Suppliers(sid:integer,sname: string, city:string, street:string)

Parts(pid:integer, pname:string, color:string)

Catalog(sid:integer, pid:integer, cost:real)

Q.45 Consider the following relational query on the above database:

```
SELECT S.name
FROM Suppliers S
WHERE S.sid NOT IN (SELECT C.sid
                    FROM Catalog C
                    WHERE C.pid NOT IN
                    (SELECT P.pid
                    FROM Parts P
                    WHERE P.color<>'BLUE'))
```

Assume that relations corresponding to the above schema are not empty. Which one of the following is the correct interpretation of the above query?

[GATE 2009]

[2 Marks]

(a) Find the names of all supplies who have supplied a non–blue part

(b) Find the name of all supplies who have not supplied a non–blue part

(c) Find the name of all supplies who have supplied only blue part

(b) Find the name of all supplies who have not supplied only blue part

Q.46 Assume that, in the suppliers relation above, each supplier and each street within a city has a unique name, and (sname, city) forms a candidate key. No other functional dependencies are implied other than those implied by primary and candidate keys. Which one of the following is TRUE about the above schema?

[GATE 2009]

[2 Marks]

(a) The schema is in BCNF

(b) The schema is in 3NF but not in BCNF

(c) The schema is in 2NF but not in 3NF

(d) The schema is not in 2NF

ANSWER KEY

1	a	2	c	3	b	4	c	5	a
6	c	7	a	8	d	9	d	10	c
11	a	12	d	13	b	14	c	15	b
16	c	17	c	18	b	19	b	20	d
21	c	22	c	23	a	24	c	25	b
26	b	27	c	28	d	29	c	30	a
31	d	32	b	33	b	34	c	35	a
36	c	37	d	38	a	39	b	40	a
41	c	42	c	43	d	44	c	45	a
46	b								

SOLUTIONS

S.1 (a)

Transitive functional dependencies

Explanation If all the transitive dependencies are not eliminated, we may have to use null value to represent some of the possible meaningful relationships among data items, and there is the problem of repetition of information.

S.2 (c)

For the given situation in the question, FD $X \rightarrow Y$ and $Y \rightarrow X$ will **holds together** since R represents a one to one relationship.

S.4 (c)

Spurious tuples are **the tuples with null values that did not exist in the original relations.**

S.5 (a)

The explanation given in the question is definition of closure. In this if R is not specified then **it is assumed to contain all the attributes that appear in F.**

S.9 (d)

$$F \models X \rightarrow Y \text{ iff } Y \subseteq X^+$$

Suppose that $Y \subseteq X^+$. Then by the definition of X^+, $X \rightarrow A$ can be derived form F using the inference rules for each $A \in Y$. By rules, $F \models X \rightarrow A$ for each $A \in Y$ and by additivity rule, $F \models X \rightarrow Y$.

Now suppose that $F \models X \rightarrow Y$. Then by completeness of the inference rules, $X \rightarrow Y$ can be derived from F using them. By projectivity, $X \rightarrow A$ can be derived for each $A \in Y$. This clearly implies that $Y \subseteq X^+$ by the definition of X^+.

S.10 (c)

R = (A, B, C, D)

F = {A → B, A → C, BC → D}

Then, **F ⊨ A → D** (F logically implies A → D)

S.11 (a)

R = (A, B, C, D) and F = {A → B, A → C, BC → D}

Since, A → B and A → C, they by additivity A → BC

Now since BC → D, then by transitivity A → D

i.e. F ⊨ A → D and thus **A → D is in F^+ is true.**

S.12 (d)

(a) ⇒ **Loss of information**, because we lose the fact that a student has a given grade in a particular course.

(b) ⇒ **Redundancy and update anomaly**, because the data for the attributes Phone_No and Major are repeated

S.13 (b)

A decomposition of given relation scheme is lossless if **the common attributes X of R_1 and R_2 form a superkey of at least one of these i.e. $X \rightarrow Y$ or $X \rightarrow Z$.**

S.14 (c)

The relation **R is not in BCNF** because the dependence student# → Name and Name → student# are nontrivial and their determinants are not superkeys of R. But, it is a 3NF relation.

S.15 (b)

A decomposition of a relation R<S, F> into the relation schemes $R_i (1 \leq i \leq n)$ is said to be a lossless join decomposition or simply lossless if for every relation R(R) that satisfies the FD in F, the natural join of the projections of R gives the original relation R i.e.

If $R \subset \Pi_{R1}(R) \bowtie \Pi_{R2}(R) \bowtie \ldots\ldots \bowtie \Pi_{Rn}(R)$ then the decomposition is called **lossy**.

S.16 (c)

From the relation scheme R,

R (Name, Department, Chairperson) and the functional dependencies

F = {Name → Department, Department → Chairperson} and **Name is the key and Chairperson is transitively dependent on the key** since Name → Department → Chairperson.

S.17 (c)

From relation R, by the rule of projectivity and transitivity we get I and II as correct statement

S.18 (b)

AB and AD are the two candidate keys of this relation. That is, either one of these two sets of attributes functionally determines any other attribute in the relation

AB is a candidate key

(1) AB → A and AB → B (Reflexivity axiom)

(2) AB → C (Given)

(3) AB → B (From step 1) and B → D (Given) then AB → D (Transitivity axiom)

Since AB determines every other attribute of the relation we have that AB is a candidate key.

AD is a candidate key

(1) AD → A and AD → D (Reflexivity axiom)

(2) AD → D from (1) and D → B (Given then AD → B (Transitivity axiom)

(3) AD → B from(2) and AB → C (Given) then AAD → C (Pseudo transitivity axiom). Also we can rewrite AAD → C as A → C

Since AD determines every other attribute in the relation we have that AD is a candidate key.

S.19 (b)

The keys of this relation are : AB and AC. The prime attributes are : {A, B, C} Attribute D of relation is in 2NF. **The relation is in 3NF** because there is only one nonprime attribute; therefore, a transitivity dependency between two different non–prime attribute cannot exist.

The relation is not in BCNF because B → C and B is not a superkey of the relation.

S.20 (d)

As per the given data, these are some partial dependencies on the key,

For example : Class → Building_Room or Stud_ID → Stud_Major

Therefore, the highest form of the relation is in **1NF**.

S.21 (c)

From given data,

Q =	R =	P =	Q =	R =
4	2	1	4	1
5	3	1	5	1
6	3	1	6	1
2	2	3	2	3

Here, one pair of value of 'Q' and 'R' must always point to one value of 'P', unlike others.

For example: in (d) PQ → R and R → Q. Here 2 → 4 as well as 2 → 2 which is not allowed.

P =	Q =
2	4
3	5
3	6
2	2

S.22 (c)

$F = \{W \rightarrow X, X \rightarrow Y, W \rightarrow XY\}$

then F^+ includes the set of I and II and $W \rightarrow Y$

(I) follow from Reflexivity

(II) follow, since FDs are in F and hence in F^+.

Since $W \rightarrow XY$, then by projectivity, $W \rightarrow X$ and $W \rightarrow Y$. However, F^+ does not contain an FD, $W \rightarrow Z$, because Z is not contained in the set of attributes that appears in F.

S.23 (a)

Given that, $F = \{A \rightarrow BC, CD \rightarrow E, E \rightarrow C, D \rightarrow AEH, ABH \rightarrow BD, DH \rightarrow BC\}$ then the FDs $CD \rightarrow E$ and $DH \rightarrow BC$ are redundant. We find that $(CD)^+$ under $\{F - (CD \rightarrow E)\}$ is equal to **ABCDEH** and since the right hand side of the FDs $D \rightarrow E \subseteq (CD)^+$ under $\{F - (CD \rightarrow E)\}$, $\{F - (CD \rightarrow E)\} \models CD \rightarrow E$.

S.24 (c)

$F = \{A \rightarrow BC, CD \rightarrow E, E \rightarrow C, D \rightarrow AEH, ABH \rightarrow BD, DH \rightarrow BC\}$ then a nonredundant cover for F $\{A \rightarrow BC, E \rightarrow C, D \rightarrow AEH, ABH \rightarrow BD\}$. The FD $ABH \rightarrow BD$ can be decomposed into the FDs $ABH \rightarrow B$ and $ABH \rightarrow D$.

Now since, the FD $A \rightarrow B$ and $AH \rightarrow D$. We also notice that $AH \rightarrow B$ is redundant since the FD $A \rightarrow B$ is already in F.

That gives us the canonical cover as **$\{A \rightarrow B, A \rightarrow C, E \rightarrow C, D \rightarrow A, D \rightarrow E, D \rightarrow H, AH \rightarrow D\}$**

S.25 (b)

Given relation scheme is $<(ABCD), \{AB \rightarrow C, C \rightarrow A\}>$

None of the FDs are redundant, so the given set is a nonredundant cover.

Using the FD, $AB \rightarrow C$, we decompose this into the relation schemes $<(ABC)\ \{AB \rightarrow C, C \rightarrow A\}>$ and $<(ABD), \{\ \}>$

The scheme $<(ABC), \{AB \rightarrow C, C \rightarrow A\}>$ can be further decomposed into the schemes $<(AC), \{C \rightarrow A\}>$ and $<(CBC)\ \{\ \}>$

Thus, it is in **BCNF but not dependency preserving**.

S.26 (b)

$R(A, B, C, D, F) \leftarrow$ Given

$A \rightarrow D$

$B \rightarrow E\ F$

$E \rightarrow C$

$F^+(A) = \phi$

$\because A \rightarrow A$

$\therefore A \rightarrow \{A\}$

$\because A \rightarrow D$

$\therefore A \rightarrow \{A, D\}$

$F^+(B) = \phi$

$\because B \rightarrow B$

$\therefore B \rightarrow \{B\}$

$\because B \rightarrow EF$

$\therefore B \rightarrow \{B, E, F\}$

$F^+(AB) = \phi$

$AB \rightarrow A$

$AB \rightarrow B$

$\therefore AB \rightarrow \{A, B\}$

$\because A \rightarrow D$

$AB \rightarrow DB$

$\because DB \rightarrow D$

$\therefore AB \rightarrow D$

$\therefore AB \rightarrow (A, B, D)$

$\because B \rightarrow EF$

$B \rightarrow E, B \rightarrow F$

$\because E \rightarrow C$

$\therefore B \rightarrow C$

$\therefore AB \rightarrow C$

$\therefore \{A, B, C, D\}$

$\therefore B \rightarrow EF$

$\therefore$ **$AB \rightarrow \{A, B, C, D, E\}$**

S.27 (c)

First we find the nonredundant cover of the given set of FDs. There are no redundant FDs in the set, hence the given set of FDs is a nonredundant cover.

Since, there is a FD Ship $\rightarrow$ Capacity and since Ship $\rightarrow$ SHIPPING we replace SHIPPING with the relation R_1 (Ship, Capacity)

Formed with the FD in question and R_2 (Ship, Date, Cargo, Value). Consider the relation R2 : the FD ShipDate → Cargo is a nontrivial FD in the nonredundant cover. However, since ShipDate → ShipDate Cargo value, the relation R_2 is BCNF with decomposition

R_1(Ship, capacity) with the FD, Ship → capacity

R_2(Ship, Date, Cargo, Value) with the FD ShipDate → Cargo

Another BCNF decomposition of SHIPPING is obtained when we consider the FD cargocapacity → value first. This gives as the following decompositions

R_1(Cargo, capacity, value) with the FD cargocapacity → Value

R_2(Ship, Capacity) with the FD Ship → Capacity

R_3(Ship, Date, Cargo) with the FD ShipDate → Cargo.

Both the decompositions are depending preserving.

S.28 (d)

Assuming R is in 1 NF

Since D (non key) is functionally dependent on A (A → D), It is not fully functionally dependent on AB (Candidate)

∴ R is not 2NF

∴ We decompose R as

R_1 (A, B, C, E, F)

R_2 (A, D)

In R_1, since E and F (nonkey) are functionally dependent on B(B → EF), they are not full functionally dependent on AB (candidate).

∴ R_1 is not in 2NF

We decompose R_1 as

R_{11}(A, B, C)

R_{12}(B, E, F)

∴ **R_1(A, B, C)**

R_2(B, E, F)

R_3(A, D).

S.29 (c)

D → A, A → E, N → R, R → N, C → C_n, C → I, (R, C) → G

From the given relation

D → E (By transitivity Rule)

C → I (By transitivity Rule)

So, it is **not in 3NF** because in 3NF relation every non–prime attribute is non–transitively and fully dependent on the every candidate key. **In 2NF** all nonprime attributes are fully functionally dependent on the relation keys.

S.30 (a)

All the values must be atomic values that means a prime-value must point to only one value not a list of values. Here, a, b, c, d include only atomic values. Only the following functional dependencies.

a → c

b → d holds so it is in 1NF

∴ **It cannot be in 2NF.**

S.31 (d)

3NF will be adequate for normal relational database design since it considers the following conditions:

1. $\alpha \rightarrow B$ is a trivial functional dependency.
2. α is superkey for R.
3. Each attribute A in $\beta - \alpha$ is contained in a candidate key for R.

Which is sufficient for normal relational database. Where as 5NF and 4NF are used for joint dependencies and multivalued dependency respectively.

S.32 (b)

R = (S T U V)

S → T, T → U, U → V, V → S

implies S → S

∴ **It is in 2NF**, i.e., it is fully functional dependent, and the values are atomic values, prime attributes point to one value only and not list of values.

∴ (given) $R_1 \cap R_2 = \phi$

∴ **It is not possible to be in 3NF;**

S.33 (b)

X	Y	Z
1	4	2
1	5	3
1	6	3
3	2	2

Y =	Z =	X =
4	2	1
5	3	1
6	3	1
2	2	3

Y =	Z =
4	2
5	3
6	3
2	2

Here 1 pair of value of 'Y' and 'Z' must always point to one value of 'X' unlike others for eg. in (a). $XY \rightarrow Z$ and $Z \rightarrow Y$.

Hence $2 \rightarrow 4$ as well as $2 \rightarrow 2$ which is not allowed.

Z =	Y =
2	4
3	5
3	6
2	2

S.34 (c)

R(A, B, C, D)

R_1(AB)

R_2(CD)

$F_1 = (A \rightarrow B)$

$F_2 = \{C \rightarrow D\}$

All the original functional dependency can be derived from F_1 and F_2, hence the decomposition is **dependency-preserving**.

The attribute B does not functionally determine either 'A' or 'C' or 'D'.

The attribute D does not functionally determine either 'A' or 'B' or 'C'.

∴ It is **not lossless join** (or it is lossy).

S.35 (a)

If a relation schema is in BCNF, then all functional dependencies are of the form "superkey determines a set of attributes," or the dependency is trivial. Thus, a BCNF schema cannot have any transitive dependencies.

As we know if all the transitive dependencies are not eliminated, we may have to use **null value** to represent some of the possible meaningful relationships, among data items, and there is the problem of repetition of information.

S.36 (c)

Since the closures of 'F' and 'G' are available it will be more beneficial and systematic to use **BCNF definition** for guaranteed identification. We cannot use 3NF definition as it will be satisfied by both 3NF and BCNF decomposition. Whereas, BCNF definition test will be satisfied only by BCNF decomposition and not by 3NF. And we are given that one decomposition is 3NF and other is BCNF.

S.37 (d)

The functional dependency is as follows

Data_of_Birth → Age – 1

Age → Eligibility – 2

Name → Roll_Number – 3

Roll_number → Name – 4

Course_number → Course_name – 5

Course_number → Instructor – 6

(Roll_number; Course_number) → Grade

Date-of-Birth → Age, it violates the 3NF and 2NF.

So the relation (Roll_number, Name, Date-of-Birth, Age) **is in 1NF.**

S.38 (a)

The functional dependency of the relation is

name, course No → grade – 1

roll No, course No → grade – 2

name → roll No. – 3

roll No → name – 4

Dependency 3 and 4 are transitive but they are prime attribute so we will break this relation upto 3NF.

From the function it is clear that there is no repetition of attributes. Hence, it is in 1NF. There is no partial dependency, hence it is 2NF and

name → roll No.

roll No → name

Since, there is transitive dependency it is not in 3NF, so **highest normal form of this relation is 2NF.**

S.39 (b)

Emp dtl {emp code, name, street, city, state, pincode}

Given functional dependency

Pincode → (city) (state)

(Street) city (state) → Pincode

This is in **1 NF and 2NF but not 3NF** because it contain transitive dependency.

S.40 (a)

Candidate (Primary Key) for this relation is [F1, F2] because [F1, F2] contains [F1, F2, F3, F4, F5] dependencies. But there is functional dependencies.

F1 → F3

F2 → F4

So **this relation have partial dependency,**

So it is in 1 NF.

S.41 (c)

Lossless, dependency preserving decomposition into BCNF is not possible for all classes it is only possible for some classes.

S.42 (c)

The algorithm for computing x^+ the closure of X under F is as follows.

$x^+ := x$

repeat

odd $x^+ = x^+$

for each functional dependency Y → Z in F do it $x^+ \supseteq Y$

then $x^+ := x^+ \cup Z$;

until(x^+ = odd x^+);

Compute {AF}$^+$ = {AF}

= {AF D} AF → D

= {AF D E} F → E

S.43 (d)

Statement (d) is false because in BCNF relation a prime attribute can't be transitively dependent on a key.

S.44 (c)

Book(Title, Author, Catalog-no., Publisher, Year, Price)

Collection(Title, Author, Catalog-no.)

The FD are

I Title, Author → Catalog no.

II. Catalog-no. → TitleAuthorPublisherYear

III. PublisherTitleYear → Price

In the relation book there is a transitivity dependency by I, II and III so **Book is in 2NF.**

In the relation collection there is n fully transitivity dependency **so collection is in 3NF.**

S.45 (a)

Supplier sells other than blue part it can be red or green or both.

S.46 (b)

(sname, city) form a candidate key so prime attributes are sname and city.

given street, city → sname

right hand side of functional dependency is prime attribute and LHS does not form candidate key. Therefore **the given schema is in 3NF but not in BCNF.**

STRUCTURED QUERY LANGUAGE

8.3

LEVEL–1

Q.1 Null values is SQL indicate:

I. zero value

II. value is unknown

III. value does not exist

(a) Only III

(b) Only II & III

(c) Only I & II

(d) All I, II & III

Q.2 SELECTION in SQL is achieved by

(a) PROJECT

(b) WHERE

(c) FROM

(d) SELECT

Q.3 Like 'Amit\%shah%' ESCAPE'\' matches

(a) gives error

(b) all strings beginning with "Amit\%shah"

(c) all strings beginning with "Amit%shah"

(d) all strings beginning with "Amit shah"

Q.4 The five aggregation operators in SQL are

(a) SUM, AVG, IN, DISTINCT, COUNT

(b) SUM, AVG, MIN, MAX, COUNT

(c) SUM, AVG, MIN, MAX, DISTINCT

(d) SUM, AVG, IN, ALL, ANY

Q.5 The AS clause can appear in

(a) SELECT and WHERE clause

(b) SELECT and FROM clause

(c) FROM clause and WHERE clause

(d) SELECT clause only

Q.6 Which of the following statements are equivalent

I. LIKE '_ _ _%'

II. LIKE '%_ _ _'

III. LIKE '%_ _%'

IV. LIKE '%_ _ _%'

V. LIKE '%_%_%_%'

(a) I, II, III, IV and V

(b) I, II, III and IV

(c) I, II, IV and V

(d) I and II only

Q.7 Projection in SQL is achieved by

(a) WHERE

(b) FROM

(c) PROJECT

(d) SELECT

Q.8 Which of the following is used to add new attribute (column) in the existing relation schema?

(a) DROP

(b) CREATE

(c) INSERT

(d) ADD

Q.9 Choose the odd man out :

AVG, INT, DATE, BOOLEAN

(a) BOOLEAN

(b) DATE

(c) INT

(d) AVG

Q.10 LIKE 'ab\\cd%"ESCAPE'\'

The above statement matches

(a) Error in SQL

(b) All strings beginning with "abcd%"

(c) All strings beginning with "abcd"

(d) All strings beginning with "ab\cd"

Q.11 Which of the following cannot be a triggering event for a Trigger

(a) UPDATE

(b) DELETE

(c) INSERT

(d) None of the above

Q.12 Which is the correct order, if all the six clauses given below appears in a query

(a) SELECT, FROM, WHERE, GROUP BY, HAVING, ORDER BY

(b) SELECT, FROM, WHERE, ORDER BY, HAVING, GROUP BY

(c) SELECT, FROM, WHERE, HAVING, ORDER BY, GROUP BY

(d) SELECT, FROM, WHERE, HAVING, GROUP BY, ORDER BY

Q.13 Would the user use the DML or the DDL to do each task?

(I) Define a new table for keeping soil and light needs

(II) Add a flower to the inventory

(III) Add a new zone to the zone table

(a) DDL, DML, DML

(b) DML, DDL, DDL

(c) DML, DML, DDL

(d) DDL, DDL, DML

Q.14 An operation that will increase the length of a list is

(a) modify

(b) look-up

(c) insert

(d) all of the above

Q.15 In SQL, which command is used to add a column line integrity constraint to a table

(a) ALTER TABLE

(b) MODIFY TABLE

(c) INSERT COLUMN

(d) ADD COLUMN

Q.16 In SQL, which command(s) is (are) used to change a table's storage characteristics?

(a) CHANGE TABLE

(b) MODIFY TABLE

(c) ALTER TABLE

(d) None of the above

Q.17 In SQL, which command(s) is (are) used to create a synonyms for a schema object

(a) CREATE SAME

(b) CREATE SYNONYM

(c) CREATE SCHEMA

(d) None of the above

Q.18 In SQL, GRANT command is used to

(a) choose auditing for specific SQL commands

(b) grant system privileges, roles and object privileges to uses and roles

(c) allow user to create data bases

(d) allow user to access data bases

Q.19 Which of the following contains a complete record of all activity that affected the contents of a data base during a certain period of time?

(a) Transaction log

(b) Query language

(c) Report write

(d) Data manipulation language

Q.20 In SQL, which command(s) is(are) used to remove rows form a table.

(a) TRUNCATE

(b) DELETE

(c) REMOVE

(d) Both (a) and (b)

Q.21 Which of the following is not a low-high level operator

(a) Join

(b) Project

(c) Update

(d) Select

Q.22 Which of the following is a low-level operator

(a) Directory

(b) Delete

(c) Update

(d) Insert

Q.23 The language used in application programs to request data from the DBMS is referred to as the

(a) QUERY language

(b) DDL

(c) DML

(d) None of the above

Q.24 Which of the following command is (are) used to recompile a stored procedure in SQL?

(a) MODIFY PROCEDURE

(b) ALTER PROCEDURE

(c) COMPILE PROCEDURE

(d) None of the above

Q.25 Which function is used to convert a data to a character string?

(a) CDOW ( )

(b) DOW ( )

(c) DTOW ( )

(d) DTOC ( )

Q.26 Entity set Transaction has the attributes transaction number, date, amount.

Entity set Account has the attributes account number, customer name, balance.

Which is the discriminator of the weak entity?

(a) date

(b) {Account number, date}

(c) Transaction number

(d) Account number

Q.27 What does the / command do?

(a) Re-executes the most recently executed command

(b) Re-executes the non SQL*Plus command that was recently executed.

(c) Does nothing

(d) Prints the character /

Q.28 The owner of the DUAL table is

(a) MANAGER

(b) SCOTT

(c) SUPERUSER

(d) SYS

Q.29 You are executing SELECT statement, In the display, each row that is displayed spans more than a line and you see a line after a set of 5 records. You can fix this problem by using the

(a) SET SCREENWIDTH command

(b) SET LINESIZE and SET PAGESIZE commands

(c) SET PAGESIZE command

(d) SET LINESIZE command

LEVEL–2

Q.30 Consider the following relational schemas,

Movie(movie_title, movie_year, producer)

StarsIn(star_name, movie_title, movie_year)

Wrtie an SQL query to perform the following

Movie ⋈ StarsIn

(a)
```
SELECT  movie_title, movie_year,
        producer, stars_name
FROM    Movie, StarsIn
WHERE   Movie_movie_title =
        StartIn.movie_title
```

(b)
```
SELECT  movie_title, movie_year,
        producer, stars_name
FROM    Movie, StarsIn
```

(c)
```
SELECT  *
FROM    Movie, StarsIn
```

(d) None of these

Q.31 Which of the following statement/statements is true.

I. In SQL we can create virtual tables

II. SQL is only Data manipulation language

III. WHERE clause applies to output of a GROUP BY command

IV. HAVING clause applies to columns and expressions for individual rows

(a) I, III, IV

(b) I

(c) All of the above

(d) I, II, III

Q.32 Suppose we are having relation schema as Student(name, student_id, degree_level) with primary key as student_id

I. INSERT INTO student VALUES ("Hemant", 1928, "B.E.")

II. DELETE FROM student

III INSERT INTO student VALUES ("Hemant", 1220, "B.TECH")

IV. ALTER TABLE student ADD (subject varchar(20))

V. ALTER TABLE student DROP subject

What will be the result of above sequence?

(a) In Student table we have one tuple with value "Hemant" 1928 an "B.E."

(b) In Student table we have one tuple with value "Hemant", 1220, "B.TECH"

(c) In Student table we add new attributes as subject

(d) Gives error. Since we deleting table.

Q.33 Which of the following queries are equivalent to each other

(i)
```
SELECT  *
FROM    PRODUCT
WHERE   P_PRICE BETWEEN 50.00
        AND 100.00
```

(ii)
```
SELECT  *
FROM    PRODUCT
WHERE   P_PRICE <= 50.00 AND
        P_PRICE >= 100.00
```

(iii)
```
SELECT  *
FROM    PRODUCT
WHERE   P_PRICE >= 50.00 AND
        P_PRICE <= 100.00
```

(iv)
```
SELECT  *
FROM    PRODUCT
WHERE   P_PRICE <= 100.00 AND
        P_PRICE >= 50.00
```

(a) (iii), (iv)

(b) (i), (iii), (iv)

(c) (ii), (iv)

(d) (i), (iii)

Q.34 Consider the following SQL query

```
SELECT    L
FROM      R
WHERE     C
```

where L is a list of expressions, R is a relation, and C is a condition. The equivalent relational algebra expression is _____

(a) $\sigma_c(\pi_L(R))$

(b) $\pi_L(\sigma_c(R))$

(c) $\sigma_L(\pi_c(R))$

(d) $\pi_c(\sigma_L(R))$

Q.35 Suppose P, Q and R are unary (one-component) relations, each having attribute A alone, then what is the output of the SQL query,

```
SELECT    P.A
FROM      P, Q, R
WHERE     P.A = Q.A  OR  P.A = R.A
```

when (i) P is non-empty

(ii) R is empty

(a) $P \cap Q \cap R$, ϕ (empty set)

(b) $P \cap (Q \cup R)$, ϕ (empty set)

(c) $P \cap Q \cap R$, $P \cap Q$

(d) $P \cap (Q \cup R)$, $P \cap Q$

Q.36 Which of the following statements is (are) true?

I. The INSERT INTO command allows the insertion of only one row at a time

II. The DELETE command allows the deletion of only one row at a time

III. The UPDATE command allows the updation of only one row at a time

IV. The UPDATE command allows the updation of only one attribute for a given table at a time.

(a) Only I, II and IV

(b) Only I and II

(c) Only III

(d) Only I

Q.37 Consider the relational schema

BookInfo(id, title, author, publication, year)

Write a SQL code to delete J.A. Jance book from the table

(a) DROP FROM BookInfo

WHERE author = VALUE(J.A. Jance);

(b) DROP author

WHERE author = 'J.A. Jance';

(c) DELETE FROM BookInfo

WHERE author = 'J.A. Jance';

(d) None of these

Q.38 The SQL statement

SELECT SUBSTR('123456789', INSTR ('abcabcabc', 'b'), 4) FROM DUAL ; prints

(a) 456789

(b) 1234

(c) 2345

(d) 6789

Q.39 Table Employee has 10 records. It has a non-NULL SALARY column which is also UNIQUE. The SQL statement

SELECT COUNT(*) FROM EMPLOYEE WHERE SALARY > ANY (SELECT SALARY FROM EMPLOYEE);

prints

(a) 0

(b) 5

(c) 9

(d) 10

LEVEL-3

Q.40 Consider the following database schema of relation Employee

Employee(Emp#, Name, Age)

The following SQL query

```
SELECT  *
FROM    Employee
WHERE   Age<=28 OR Age>28;
```

will give

(a) Tuples of Employee relation with non-NULL age

(b) Tuples of Employee relation with Age > 28

(c) Tuples of Employee relation with Age <= 28

(d) Copy of Employee relation

Q.41 Consider the following relations:

Employee (Name, Address, Age)

Write a SQL query that gives the names of the tow employees who share an address. The output should contain minimum no. of tuples possible

(a)
```
SELECT  Name
FROM    Employee
WHERE   Employee.Address = Employee.
        Address
```

(b)
```
SELECT  E1.Name, E2.Name
FROM    Employee AS E1, Employee AS
        E2
WHERE   E1.Address = E2.Address AND
        E1.Name<E2.Name
```

(c)
```
SELECT  E1.Name, E2.Name
FROM    Employee AS E1, Employee AS
        E2
WHERE   E1.Address = E2.Address AND
        E1.Name<>E2.Name
```

(d)
```
SELECT  E1.Name, E2.Name
FROM    Employee AS E1, Employee AS
        E2
WHERE   E1.Address = E2.Address
```

GATE QUESTIONS

Q.42 Which of the following is/are correct?

[GATE 1999]

[2-Marks]

(a) An SQL query automatically eliminates duplicates

(b) An SQL query will not work if there are no indexes on the relations

(c) SQL permits attribute names to be repeated in the same relation

(d) None of the above

Q.43 In SQL, relations can contain null values and comparisons with null values are treated as unknown. Suppose all comparisons with a null value are treated as false. Which of the following pairs is not equivalent?

[GATE 2000]

[2-Marks]

(a) x = 5; not (not (x = 5))

(b) x = 5; x > 4 and x < 6, where x is an integer

(c) x ≠ 5; not (x = 5)

(d) none of these

Q.44 Given relations r(w, x) and s(y, z), the result of

```
select distinct w, x
from r, s
```

is guaranteed to be same as r, provided

[GATE 2000]

[2-Marks]

(a) r has no duplicates and s is non-empty

(b) r and s have no duplicates

(c) s has no duplicates and r is non-empty

(d) r and s have the same number of tuples

Q.45 Consider the set of relations shown below and the SQL query that follow:

Students: (Roll_number, Name, Date_of_Birth)

Courses: (Course_number, Course_name, Instructor)

Grades: (Roll_number, Course_number, Grade)

select distinct Name

from Students, Courses, Grades

where Students.Roll_number = Grades.Roll_number

and Courses.Instructor = Korth

and Coures.Course_number = Grades.Course_number

and Grades.grade = A

Which of the following sets is computed by the above query? **[GATE 2003]**

[2-Marks]

(a) Names of students who have got an A grade in all courses taught by Korth

(b) Names of students who have got an A grade in all courses

(c) Names of students who have got an A grade in at least one of the courses taught by Korth

(d) None of the above

Q.46 Consider the following SQL query

select distinct $a_1, a_2, \ldots, a_m$

from $r_1, r_2, \ldots, r_m$

where P

For an arbitrary predicate P, this query is equivalent to which of the following relational algebra expressions? **[GATE 2003]**

[1-Mark]

(a) $\prod_{a_1,a_2,\ldots,a_n} \sigma_P(r_1 \times r_2 \times \ldots \times r_m)$

(b) $\prod\!\!\prod_{a_1,a_2,\ldots,a_n} \sigma_P(r_1 \bowtie r_2 \bowtie \ldots \bowtie r_m)$

(c) $\prod_{a_1,a_2,\ldots,a_n} \sigma_P(r_1 \cup r_2 \cup \ldots \cup r_m)$

(d) $\prod_{a_1,a_2,\ldots,a_n} \sigma_P(r_1 \cap r_2 \cap \ldots \cap r_m)$

Q.47 The employee information in a company is stored in the relation

Employee (name, sex, salary, deptName)

Consider the following SQL query

```
select deptName
    from Employee
    where sex = 'M'
group by deptName
having avg(salary)>
    (select avg (salary) from Employee)
```

It returns the names of the department in which **[GATE 2004]**

[2-Marks]

(a) the average salary is more than the average salary in the company

(b) the average salary of male employees is more than the average salary of all male employees in the company

(c) the average salary of male employees is more than the average salary of employees in the same department

(d) the average salary of male employees is more than the average salary in the company

Q.48 A relational database contains two table student and department in which student table has columns roll_no, name and dept_id and department table has columns dept_id and dept_name, the following insert statements were executed successfully to populated the empty tables:

Insert into department values (1, 'Mathematics')

Insert into department values (2, 'Physics')

Insert into student values (1, 'Navin', 1)

Insert into student values (2, 'Mukesh', 2)

Insert into student values (3, 'Gita', 1)

How many rows and columns will be retrived by the following SQL statement?

Select * from student, department

[IT-GATE 2004]

(a) 0 row and 4 columns **[2-Marks]**

(b) 3 rows and 4 columns

(c) 3 rows and 5 columns

(d) 6 rows and 5 columns

Q.49 A table T1 in a relational database has the following rows and columns:

Roll no.	Marks
1	10
2	20
3	30
4	Null

The following sequence of SQL statements was successfully executed on table T1. Update T1 set marks = marks + 5

Select avg(marks) from T1

What is the output of the select statement?

[IT-GATE 2004]

[2-Marks]

(a) 18.75

(b) 20

(c) 25

(d) Null

Q.50 Consider the two tables in a relational database with columns and rows as follows:

Table: Student

Roll_no	Name	Dept_id
1	ABC	1
2	DEF	1
3	GHI	2
4	JKL	3

Table: Department

Dept_id	Dept_Name
1	A
2	B
3	C

Roll_no is the primary key of the Student table, Dept_id is the primary key of the Department table and Student.Dept_id is a foreign key from Department.Dept_id.

What will happen if we try to execute the following two SQL statements?

(i) update Student set Dept_id = Null where Roll_no = 1

(ii) update Department set Dept_id = Null where Dept_id = 1 **[IT-GATE 2004]**

[2-Marks]

(a) Both (i) and (ii) will fail

(b) (i) will fail but (ii) will succeed

(c) (i) will succeed but (ii) will fail

(d) Both (i) and (ii) will succeed

Q.51 A company maintains records of sales made by its salespersons and pays them commission based on each individual's total sales made in a year. This data is maintained in a table with following schema:

salesinfo= (salespersonid, totalsales, commission)

In a certain year, due to better business results, the company decides to further reward its salespersons by enhancing the commission paid to them as per the following formula.

If commission < = 50000, enhance it by 2%

If 50000 < commission < = 100000, enhance it by 4%

If commission > 100000, enhance it by 6%

The IT staff has written three different SQL scripts to calculate enhancement for each slab, each of these scripts is to run as a separate transaction as follows:

T1 Update salesinfo

Set commission = commission * 1.02

Where commission < = 50000;

T2 Update salesinfo

Set commission = commission * 1.04

Where commission > 50000 and commission is <=100000;

T3 Update salesinfo

Set commission = commission * 1.06

Where commission > 100000;

Which of the following options of running these transactions will update the commission of all salespersons correctly? **[IT-GATE 2005]**

[2-Marks]

(a) Execute T1 followed by T2 followed by T3

(b) Execute T2, followed by T3; T1 running concurrently throughout

(c) Execute T3 followed by T2; T1 running concurrently throughout

(d) Execute T3 followed by T2 followed by T1

Q.52 A table 'student' with schema (roll, name, hostel, marks) and another table 'hobby' with schema (roll, hobbyname) contains records as shown below.

Table student				Table hobby	
Roll	Name	Hostel	Marks	Roll	Hobbyname
1798	Manoj Rathod	7	95	1798	Chess
2154	Soumic Banerjee	5	68	1798	Music
2369	Gumma Reddy	7	86	2154	Music
2581	Pradeep Pendse	6	92	2369	Swimming
2643	Suhas Kulkarni	5	78	2581	Cricket
2711	Nitin Kadam	8	72	2643	Chess
2872	Kiran Vora	5	92	2643	Hockey
2926	Manoj Kulkalikar	5	94	2711	Volleyball
2959	Hemant Karkhanis	7	88	2872	Football
3125	Rajesh Doshi	5	82	2926	Cricket
				2959	Photography
				3125	Music
				3125	Chess

The following SQL query is executed on the above tables:

select hostel

from student natural join hobby

where marks > = 75 and roll between 2000 and 3000;

Relations S and H with the same schema as those of these two tables respectively contain the same information as tuples. A new relation S' is obtained by the following relational algebra operation:

$S' = \Pi_{hostel}((\sigma_{s.roll=H.roll}(\sigma_{marks>75 \text{ and } roll>2000 \text{ and } roll<3000}(S))X(H))$

The difference between the number of rows output by the SQL statement and the number of tuples in S' is: **[IT-GATE 2005]**

[2-Marks]

(a) 6

(b) 4

(c) 2

(d) 0

Q.53 In an inventory management system implemented at a trading corporation, there are several tables designed to hold all the information. Amongst these, the following two tables hold information on which items are supplied by which suppliers, and which warehouse keeps which items along with the stock-level of these items.

Supply = (supplierid, itemcode)

Inventory = (itemcode, warehouse, stocklevel)

For a specific information required by the management, following SQL query has been written.

```
Select distinct STMP supplierid
From supply as STMP
Where not unique (Select ITMP.supplierid
    From Inventory, Supply as ITMP
    Where STMP.supplierid = ITMP.supplierid
    And ITMP.itemcode = Inventory.itemcode
    And Inventory.warehouse = 'Nagpur');
```

For the warehouse at Nagpur, this query will find all suppliers who **[IT-GATE 2005]**

[2-Marks]

(a) do not supply any item

(b) supply exactly one item

(c) supply one or more items

(d) supply two or more items

Q.54 Nested loop join algorithm is employed to perform the join, with the most appropriate choice of table to be used in outer loop, the number of block accesses required for reading the data are: **[IT-GATE 2005]**

[2-Marks]

(a) 800000

(b) 40080

(c) 32020

(d) 100

Q.55 The relation **book** (title, price) contains the title and prices of different books. Assuming that no two books have the same price, what does the following SQL query list? **[GATE 2005]** **[2-Marks]**

```
select title
from book as B
where (select count(*)
       from book as T
       where T.price>B.Price)<5
```

(a) Titles of the four most expensive books

(b) Title of the fifth most inexpensive book

(c) Title of the fifth most expensive book

(d) Titles of the five most expensive books

Q.56 Consider the relation enrolled (student, course) in which (student, course) is the primary key, and the relation paid (student, amount) where student is the primary key. Assume no null values and no foreign keys or integrity constraints. Given the following four queries:

Query 1: select student from enrolled where student in (select student form paid)

Query 2 : select student from paid where student in (select student from enrolled)

Query 3 : select E. student from enrolled E, paid P where E. student = P. student

Query 4 : select student from paid where exists (select * from enrolled where enrolled.student = paid.student)

which one of the following statements is correct?

[GATE 2006]

[2-Marks]

(a) All queries return identical row sets for any database

(b) Query 2 and Query 4 return identical row sets for all databases but there exist databases for which Query 1 and Query 2 return different row sets on the relations

(c) There exist databases for which Query 3 returns strictly fewer rows than Query 2

(d) There exist databases for which Query 4 will encounter an integrity violation at runtime

Q.57 Consider the relation account (customer, balance) where customer is a primary key and there are no null values. We would like to rank customers according to decreasing balance. The customer with the largest balance gets rank 1. Ties are not broken but ranks are skipped: if exactly two customers have the largest balance then each get rank 1 and rank 2 is not assigned.

Query 1: Select A.customer, count (B.customer) from account A, account B where A.balance <= B.balance group by A.customer

Query 2: Select A.customer, 1 + count (B.customer) form account A, account B where A.balance < B.balance group by A.customer

Consider the statements about Query 1 and Query 2.

1. Query 1 will produce the same row set as Query 2 for some but not all databases
2. Both Query 1 and Query 2 are correct implementation of the specification
3. Query 1 is a correct implementation of the specification but Query 2 is not
4. Neither Query 1 nor Query 2 is a correct implementation of the specification
5. Assigning rank with a pure relational Query takes less time than scanning in decreasing balance order and assigning ranks using ODBC

Which two of the above statements are correct?

[GATE 2006]

[2-Marks]

(a) 2 and 5

(b) 1 and 3

(c) 1 and 4

(d) 3 and 5

Q.58 Consider the table **employee** (empId, name, department, salary) and the two queries Q_1, Q_2 below. Assuming that department 5 has more than one employee, and we want to find the employees who get higher salary than anyone in the department 5, which one of the statements is **TRUE** for any arbitrary employee table?

[GATE 2007]

Q_1 : Select e.empId **[2-Marks]**
From employee e
Where not exists
(Select * From employee s Where s.department = "5" and s.salary >= e.salary)

Q_2 : Select e.empId
From employee e
Where e.salary > Any
(Select distinct salary From employee s where s.department = "5")

(a) Q_1 is the correct query.
(b) Q_2 is the correct query.
(c) Both Q_1 and Q_2 produce the same answer.
(d) Neither Q_1 nor Q_2 is the correct query.

Q.59 Let R and S be relational schemes such that R = {a, b, c} and S = {c}. Now consider the following queries on the database:

I. $\pi_{R-S}(r) - \pi_{R-S}(\pi_{R-S}(r) \times s - \pi_{R-S,S}(r))$

II. $\{t \mid t \in \pi_{R-S}(r) \wedge \forall u \in s\ (\exists v \in r(u = v[s] \wedge t = v[R-S]))\}$

III. $\{t \mid t \in \pi_{R-S}(r) \wedge \forall v \in r\ (\exists u \in s(u = v[s] \wedge t = v[R-S]))\}$

IV. Select R.a, R.b
form R, S
where R.c = S.c

Which of the above queries are equivalent?

[GATE 2009]

[2-Marks]

(a) I and II
(b) I and III
(c) II and IV
(d) III and IV

ANSWER KEY

1	b	2	b	3	c	4	b	5	b
6	c	7	d	8	d	9	d	10	d
11	d	12	a	13	a	14	a	15	d
16	c	17	b	18	b	19	a	20	d
21	c	22	a	23	a	24	b	25	d
26	d	27	b	28	d	29	b	30	d
31	b	32	b	33	b	34	b	35	b
36	d	37	c	38	c	39	c	40	a
41	b	42	d	43	c	44	a	45	c
46	a	47	d	48	d	49	b	50	c
51	d	52	a	53	d	54	b	55	d
56	a	57	c	58	b	59	c		

SOLUTIONS

S.1 (b)

Null values in SQL indicates that values is **either unknown or does not exist**.

S.2 (b)

The selection operation of relational algebra, is available in the **WHERE clause**. The expression that may follow WHERE include conditional expression like those found in common languages such as C or JAVA. We may build expressions by comparing values using the six common comparison operators : =, < >, <, >, <= and >=. The values that can be compared include constants and attributes of the relations mentioned after FROM.

S.3 (c)

'Amit\%shah% 'ESCAPE'\' matches all strings beginning with "Amit%shah".

S.4 (b)

SQL uses the five aggregation operators **SUM, AVG, MIN, MAX and COUNT**. These operators are used by applying them to a scalar-valued expression, typically a column name, in a SELECT clause.

S.5 (b)

Using AS clause, we can rename both the relations and attributes. So, accordingly, it can appear in **FROM and SELECT clause** respectively.

S.6 (c)

I, II, IV and V corresponds to any string of atleast 3 characters.

S.7 (d)

In the SELECT clause, we may list some of the attributes of the relation mentioned in the FROM clause. The result will be projected onto the attributes listed.

Thus, the keyword **SELECT** in SQL actually corresponds most closely to the projection operation of the relational algebra.

S.8 (d)

The modifications in the relation schema are done by a statement that begins with the keyword ALTER TABLE and the name of the relation. We then have several options, and one of the most important is **ADD**.

Syntax:

ALTER TABLE relation ADD new_attribute datatype

eg. ALTER TABLE Employee ADD salary INT

The above statement will add a new attribute Salary to Employee relation.

S.9 (d)

INT, DATE and BOOLEAN are type in SQL, whereas, **AVG** is an aggregate function.

S.10 (d)

Since backslash (\ ) is an escape character, the character immediately following it will be considered as a normal character. Therefore, the second backslash (\ ) is considered as a normal character.

S.11 (d)

The triggering event can be any of the INSERT, DELETE or UPDATE. Hence, all of them are triggering event.

S.12 (a)

The correct order is,

SELECT, FROM, WHERE, GROUP BY, HAVING, ORDER BY.

Only the first two are compulsory, but we can't use a HAVING clause without a GROUP BY clause. Whichever additional clauses appear must be in the order listed above.

S.13 (a)

(I) Defining a new table would entail the use of the **DDL**. Creating the table and establishing the attributes are part of the data definition.

(II) and (III) entering new zone and flower information would be accomplished through the use of the **DML**. Both these activities entail manipulating data within currently established tables.

S.16 (c)

ALTER statements is Data Definition Language (DDL) command and used to modify an existing database object.

S.17 (b)

A **SYNONYM** is nothing more than an alias or alternate name for a table, view, sequence or other schema object.

S.18 (b)

GRANT (DCL) authorizes one or more users to perform an operation or a set of operations on an object.

or

GRANT option permits the specified user can grant privileges which that user possesses on that table to other users.

S.19 (a)

In the field of databases, a **transaction log** (also database log or binary log) is a history of actions executed by a database management system to guarantee ACID properties over crashes or hardware failure.

S.20 (d)

TRUNCATE - remove all records from a table.

DELETE - delete all record from a table.

S.30 (d)

The correct query is,

```
SELECT  movie_title, movie_year, producer,
        stars_name
FROM    Movie, StarsIn
WHERE   Movie.movie_title =
        StarsIn.movie_title   AND
        Movie.movie_year =
        StarsIn.movie_year
```

For natural join, we have to compare all the attributes which are common in the relation concerned.

S.31 (b)

The only correct statement is I that is **in SQL we can create virtual tables.**

SQL is not data manipulation language but also definition language.

WHERE clause applies to columns and expressions for individual rows and while the HAVING clause is applied to the output of GROUP BY command.

S.32 (b)

First we insert values in student table as "Hemant", 1928, "B.E." Then we delete tuple from Student but table is still known to the database although it is an empty relation.

After that we again insert tuple into student having values "Hemant", 1220, and B.TECH".

After that by using ALTER command we add one attribute as subject.

After that we again use **ALTER** command to drop attribute subject.

So we remain with student relation having values **"Hemant", 1220, "B.TECH"**.

S.33 (b)

All (i), (iii), (iv) three queries give the same output whereas the query (ii) will give a empty relation.

S.34 (b)

The FROM clause gives the relation or relations to which the query refers. The WHERE clause is a condition, much like a selection-condition in a relational algebra. The SELECT clause tells which attributes of the tuples matching the condition are produced as part of the answer. Therefore, we start with the relation in the FROM clause, apply to each tuple whatever condition is indicated in the WHERE clause, and then project onto the list of attributes and/or expressions in the SELECT clause.

S.35 (b)

When P is non-empty, the given SQL query gives $\mathbf{P \cap (Q \cup R)}$. But when P is empty, the output is empty. Because, if we use the Cartesian-product approach, we start with $P \times Q \times R$, which is empty, since R is empty.

S.36 (d)

INSERT INTO command can be used to insert only one row at a time. If we have to add more than one row, then we have to use that many INSERT INTO commands.

The syntax of DELETE is,

```
DELETE FROM   table_name
WHERE         condition
```

The DELETE command can delete more than one row at a time depending upon the condition in the WHERE clause. All the above row satisfying the condition will be deleted.

And finally the UPDATE command allows the updation of more than one row and more than one attribute at a time.

S.37 (c)

The right keyword to be used is DELETE. The record query is,

```
DELETE FROM BookInfo
WHERE author = 'J.A. Jance';
```

S.38 (c)

INSTR('abcabcabc', 'b') is 2. So,

SUBSTR('123456789', INSTR('abcabcabc', 'b') 4) is equivalent to SUBSTR('123456789', 2, 4).

S.39 (c)

This query counts the number of employees who get more than the minimum salary. From the 10 employees, we need to exclude all those employees who are getting the minimum salary. Since the SALARY column is UNIQUE, only one employee will be getting the minimum salary.

S.40 (a)

SQL conditions, as appear in WHERE clauses of select–from–where statements, apply to each tuple in some relation, and for each tuple, one of the three truth values, TRUE, FALSE or UNKNOWN is produced. However, only the tuples for which the condition has the value TRUE become part of the answer, tuples with either UNKNOWN or FALSE as value are excluded from the answer.

Initialy, we would expect to get a copy of the Employee relation, since each employee has a age that is either 28 or less or that is greater than 28.

However, suppose there are Employee tuples with NULL in the Age component. Then both comparison Age <= 28 and Age > 28 evaluate to UNKNOWN. The OR of two UNKNOWN's is UNKNOWN. Thus, for any tuple with a NULL in the Age component, the WHERE clause evaluates to UNKNOWN. Such a tuple is not returned as part of the answer to the query. Therefore, true meaning of the given query is **'All the Employee tuples with non–NULL value for Age'.**

S.41 (b)

The second condition in the WHERE clause, E1.Name<E2.Name, says that the name of the first employee precedes the name of the second employee alphabetically. If this condition were omitted, then tuple variables E1 and E2 could both refer to the same tuple as in option (d)

But option (c) also seems to be correct. But if we use <> (not-equal) as comparison operation, then we would get output as

E1.Name	E2.Name
Manish	Veeresh
Veeresh	Manish
.	.
.	.
.	.

Here, Manish and Veeresh have the same address but both the tuples give the same set to two employees. Since, in the question, it is mentioned that output should have minimum no. of tuples. Option (b) is the correct option as it gives only one tuple for a given pair.

S.42 (d)

SQL query cannot eliminate duplicates on its own and may even work without indexes and it does not permits repetition.

S.44 (a)

The above query will select distinct w, x from r, s and is guaranteed to be same as r and this will be possible only if **r has no duplicates** of the same value and there must atleast some attributes in **'s' i.e. is must not be empty**.

S.45 (c)

There are three relations

Select distinct name, select the name of students and then there are three predicates

Courses.insturctor = korth specify the courses thought by korth.

The other two predicate specify that student can earn a grade A from courses so, the SQL query compute.

Name of the students who have got an A grade in at least one of the courses taught by korth.

S.46 (a)

The given SQL is

Select distinct $a_1, a_2, \ldots, a_m$

from $r_1, r_2, \ldots, r_m$

where P

All possible combination of tuples from $r_1, r_2, \ldots, r_n$ is denoted by $r_1 \times r_2 \times \ldots \times r_m$

If P is a predicate then select the all condition is denoted by $\sigma_P (r_1 \times r_2 \times \ldots \times r_m)$

If we wants to select only some tuples in the relation then composite expression for above SQL is

$$\prod_{a_1, a_2, \ldots, a_n} \sigma_P (r_1 \times r_2 \times \ldots \times r_m)$$

S.47 (d)

Given relation is

Employee (name, Sex, Salary, deptName)

SQL query is

```
Select deptName,
from Employee
Where Sex = 'M'
Group by deptName
having avg(Salary) > (Select avg (Salary) from Employee)
```

This will retrieve the department in which **average salary of male employee is more than the average salary in the company**.

S.48 (d)

After populating the table

Student:

Roll no.	Name	Dept-id
1	Navin	1
2	Mukesh	2
3	Gita	1

Department:

Dept-id	Dept-name
1	Mathematics
2	Physics

"Select * from student, department" this query will execute natural join first and will retrieve all the row and column. Hence **6 rows and 5 columns** will retrieve, which is same as cartesian product of these table.

S.49 (b)

After the updation, new table will be

Roll no.	Marks
1	15
2	25
3	35
4	5

$$\text{Average} = \frac{15+25+35+5}{4}$$

$$= \frac{80}{4} = 20$$

Average = 20

S.50 (c)

First query will successfully execute and after executing this statement attribute dept-id of student table with Roll_no = 1 becomes 'NULL' which is foreign key from department's dept-id. Now, second statement will not execute, because condition will not satisfy in this case, by any row.

S.51 (d)

Correct sequence of updation is.

T3 followed by T2 followed by T1.

$\because$ T3 updates only those records that have commission more than 10,000.

Similarly T2 and T1

But if we update T1 first then it may be possible that in some records commission will be more than 50,000 and it can update again by T2.

S.52 (a)

Table student		Table hobby		
Roll	Name	Hostel	Marks	Hobbyname
1798	Manoj Rathod	7	95	Chess
1798	Manoj Rathod	7	95	Music
2154	Soumic Banerjee	5	68	Music
* 2369	Gumma Reddy	7	86	Swimming
* 2581	Pradeep Pendse	6	92	Cricket
* 2643	Suhas Kulkarni	5	78	Hockey
* 2872	Kiran Vora	5	92	Football
* 2711	Nitin Kadam	8	72	Vollyball
* 2926	Manoj Kulkalikar	5	94	Football
* 2959	Hemant Karkhanis	7	88	Photography
* 3125	Rajesh Doshi	5	82	Music
* 3125	Rajesh Doshi	5	82	Chess
* 2643	Suhas Kulkarni	5	78	Chess

* lines denote the final query.

required difference is

{7,6,5,5,8,5,7,5,5,5} – {[illegible],5,8} = 6

S.53 (d)

∵ In cascaded query, internal query executes first then outside query.

By internal query we get those suppliers that supply more than two or two items but they are not distinct.

By outer query we get only distinct suppliers who **supply two or more than two items.**

S.54 (b)

The Nested loop join algorithm for relation R and S is

for each tuple r in R do

for each tuple s in S do

If r and s satisfy the join condition

Then output the tuple <r, s>

This algorithm will involve $n_r * b_s + b_r$ block transfer where b_r and b_s number of blocks in relation R and S respectively.

So $n_r * b_s + b_r$

$= 200 \times 20 + 80 = 40080$

S.55 (d)

The given SQL query compute **"Titles of the five most expensive books"**.

S.56 (a)

All query 1, 2, 3, 4 produces the identical row sets for any database.

S.57 (c)

Consider the query 1.

Query 1:

Select A . customer

count (B . customer)

from account A, account B

where A . balance <= B . balance group by A. customer

The query 1 computes the group of customer where the balance of first group is less than or equal to another group.

Query 2:

Select A . customer, 1 + count (B . customer)

form account A, account B

Where A . balance <B . balance group by A. customer

So some rows of query 1 is same as query 2 but not all results are equal. Both query 1 and query 2 doesn't compute the required problem rank the customers according to decreasing balance and the customer with the largest balance gets rank 1.

S.58 (b)

The table is

employee (empId, name, department, salary)

Query 2 compute the employees who get higher salary than anyone in the department 5, but query 1 doesn't compute because after where there is no clause or condition for computing the desire result.

Hence **query 2 is correct**.

8.4 File Organization Techniques

LEVEL–1

Q.1 A collection of field is called a record with respect of DBMS, a record corresponds to
(a) Tuple
(b) Relation
(c) File
(d) Attribute

Q.2 Commonly, a database consists of a _____ process that provides data from secondary storage to one or more _____ processes that are application using the data.
(a) slave, master
(b) master, slave
(c) client, server
(d) server, client

Q.3 RAID stands for
(a) Rapid Action In Disaster
(b) Random Access Internal Disks
(c) Rapid Application Interface Design
(d) Redundant Arrays of Independent Disks

Q.4 The linked list of deleted records is often called as
(a) useless
(b) overflow
(c) pointers
(d) free list

Q.5 Two disks are called mirrors of each other if
(a) they share the same address space in the main memory
(b) the second disk is the continuation of the first
(c) they hold identical copies of data
(d) they contain blocks of a single file

Q.6 At the root of a B–tree there are atleast
(a) 5 used pointers
(b) 4 used pointers
(c) 3 used pointers
(d) 2 used pointers

Q.7 Each block of B–tree will have space for
(a) cannot be determined
(b) n search–key values, and n + 1 pointers
(c) n + 1 search–key values and n pointers
(d) n search–key values, and n pointers

Q.8 Match the following:

(i)	Ordered indices	(A)	Sorted ordering
(ii)	Hash indices	(B)	Exponential function
		(C)	Uniform distribution

(a) (i) – (C), (ii) – (A)

(b) (i) – (B), (ii) – (C)
(c) (i) – (A), (ii) – (C)
(d) (i) – (A), (ii) – (B)

Q.9 What is true for variable length record.

I. Storage of multiple record types in a file

II. Record types that allow variable lengths for one or more field

III. Record types that allow repeating fields

IV. It is difficult to delete a record from this structure. The space occupied by the record to be deleted must be filled with some other record of file.

(a) All of the above
(b) Only I and IV
(c) I, II , III
(d) I and II

Q.10 The smallest individual unit of a magnetic disk is

(a) Platter
(b) Cylinder
(c) Sector
(d) Track

Q.11 A date is usually represented as

(a) fixed length character string
(b) variable length character string
(c) real
(d) integer

Q.12 The SQL VARCHAR type actually allocate an array of (n + 1) bytes. The first byte holds the number of bytes in the string. The string then cannot exceed n characters, and n itself cannot exceed.

(a) 256
(b) 255
(c) 128
(d) 127

Q.13 A simple form of checksum is based on the parity of all the bits in the sector. If there is an odd number of 1's among a collection of bits then we say that bits have odd parity, or that their parity bit is 1. Similarly, if there are an even number of 1's among the bits, then we say that bits have even parity, or that their parity bit is 0.

Any one-bit error in the collection of bits and parity bit results in a sequence of bits that has

(a) even no. of zeros
(b) odd no. of zeros
(c) even parity
(d) odd parity

Q.14 A tree is said to be balanced if

(a) it has even no. of leaf nodes
(b) it has even on. of nodes excluding root
(c) it has even no. of nodes including root
(d) none of these

Q.15 An index file is an example of

(a) Sequential file
(b) Main memory data block
(c) Application of indexes
(d) None of these

Q.16 An indexing operation

(a) establishes an index for a file
(b) sorts a file using two keys
(c) sorts a file using a single key
(d) both (a) and (b)

Q.17 Two files may be joined into a third file if

(a) they have no records with the same value in the common field
(b) they have field in common
(c) they have row in common
(d) both (a) and (b)

Q.18 What deletes the entire file except the file structure?

(a) PACK
(b) ZAP
(c) DELETE
(d) ERASE

Q.19 A simple form of checksum is based on the parity of all the bits in the sector. If there is an odd number of 1's among a collection of bits then we say that bits have odd parity, or that their parity bit is 1. Similarly, if there are an even number of 1's among the bits, then we say that bits have even parity, or that their parity bit is 0.

The number of 1's among a collection of bits and their parity bit is always

(a) depends on the collection of bits
(b) even
(c) odd
(d) none of these

Q.20 A hash function h is defined as

$h(i) = i^2 \bmod 8$

Find the value of h(8) and h(18)

(a) 0, 4

(b) 0, 2

(c) 1, 4

(d) 1, 2

Q.21 The concept of locking can be used to solve the problem of

(a) deadlock

(b) lost update

(c) inconsistent data

(d) uncommitted dependency

LEVEL–2

Common Data For Questions 22 to 23:

Suppose N is an interior node whose capacity is n keys and n + 1 pointers, and N has just been assigned n + 2 pointers because of a node splitting below. So we created a new node M, which will be the sibling of N, immediately to its right.

Q.22 How many pointers will be at N

(a) $\left\lfloor \frac{n+1}{2} \right\rfloor$ pointers

(b) $\left\lceil \frac{n+1}{2} \right\rceil$ pointers

(c) $\left\lfloor \frac{n+2}{2} \right\rfloor$ pointers

(d) $\left\lceil \frac{n+2}{2} \right\rceil$ pointers

Q.23 Suppose the first $\left\lceil \frac{n}{2} \right\rceil$ keys stay with N, while the last $\left\lfloor \frac{n}{2} \right\rfloor$ keys move to M. Note that there is always one key K in the middle left over. Which of the following is true of K?

I. K indicates the smallest key reachable via the first of M's children

II. K directly points to the data block

III. K will be used by the parent of N and M to divide searches between those two nodes.

(a) I and III only

(b) I and II only

(c) II and III only

(d) I, II and III

Q.24 State whether the following statements are True or False

I. In closed hashing there is provision for overflow buckets

II. In open hashing there are no overflow buckets.

(a) False, False

(b) False, True

(c) True, False

(d) True, True

Common Data For Questions 25 to 26:

The Megatron–747 disk has the following characteristics, which are typical of a large, vintage–2001 drive.

- There are eight platters providing sixteen surfaces
- There are 2^{14} or 16,384 tracks per surface
- There are on average 2^7 or 128 sectors per track
- There are 2^{12} or 4096 bytes per sector

Q.25 A single track can hold

(a) 64 K bytes

(b) 128 K bytes

(c) 512 K bytes

(d) 1024 K bytes

Q.26 The capacity of the disk is

(a) 2^7 K bytes

(b) 2^{37} bytes

(c) 2^7 M bytes

(d) 2^{37} K bytes

Common Data For Questions 27 to 28:

6 files F1, F2, F3, F4, F5 and F6 have 100, 200, 50, 80, 120, 150 records respectively.

Q.27 In what order should they be stored so as to optimize activity? Assume each file is accessed with the same frequency.

(a) Ordering is immaterial as all files are accessed with the same frequency

(b) F1, F2, F3, F4, F5, F6

(c) F2, F6, F5, F1, F4, F3

(d) F3, F4, F1, F5, F6, F2

Q.28 The average access time will be

(a) 210 units

(b) 293 units

(c) 256 units

(d) 268 units

Q.29 Consider the following schedule:

Schedule	T_{12}	T_{13}
Read(A)	Read(A)	
$A := f_1(A)$	$A := f_1(A)$	
Read(A)		Read(A)
$A := f_2(A)$		$A := f_2(A)$
Write(A)		Write(A)
Write(A)	Write(A)	

The above schedule produce graph which is

(a) Lock precedence graph

(b) Cyclic precedence graph

(c) Acyclic precedence graph

(d) None of these

LEVEL–3

Q.30 Suppose block hold either three records, or ten key–pointer pairs. As a function n, the number of records, how many blocks do we need to hold a data file if we use sparse index

(a) $\frac{23n}{30}$

(b) $\frac{13n}{30}$

(c) $\frac{17n}{30}$

(d) $\frac{11n}{30}$

Q.31 Assume a file of 10,000 records distributed over 100 blocks, i.e., every block has 100 records. Also assume that every record is equally likely to be accessed. In trying to locate a particular record, we first examine the index, which is assumed to be within a single block. To locate the block containing the required record, we have to examine each index entry. The number of comparisons required are

(a) 1000

(b) 110

(c) 100

(d) 101

Q.32 The hash function

hash = key mod size and linear probing are used to insert the keys

37, 38, 72, 48, 98, 11, 56 into the hash table with indices 0 ..... 6. The order of the keys in the array are given by

(a) 98, 56, 37, 38, 72, 11, 48

(b) 98, 11, 37, 38, 72, 56, 48

(c) 11, 48, 37, 38, 72, 98, 56

(d) 72, 11, 37, 38, 56, 98, 48

Q.33 Suppose block hold either three records, or ten key–pointer pairs. As a function n, the number of records, how many blocks do we need to hold a data file if we use a dense index

(a) $\frac{23n}{30}$

(b) $\frac{17n}{30}$

(c) $\frac{13n}{30}$

(d) $\frac{11n}{30}$

GATE QUESTIONS

Q.34 There are five records in a database.

Name	Age	Occupation	Category
Rama	27	CON	A
Abdul	22	ENG	A
Jeniffer	28	DOC	B
Maya	32	SER	D
Dev	24	MUS	C

There is an index file associated with this and it contains the values 1, 3, 2, 5 and 4. Which one of the fields is the index built from?

[GATE 1998]

[1–Mark]

(a) Age

(b) Name

(c) Occupation

(d) Category

Q.35 B^+-trees are preferred to binary trees in databases because **[GATE 2000]**

[1–Mark]

(a) Disk capacities are greater than memory capacities

(b) Disk access is much slower than memory access

(c) Disk data transfer rates are much less than memory data transfer rates

(d) Disks are more reliable than memory

Q.36 In the index allocation scheme of block to a file, the maximum possible size of the file depends on **[GATE 2002]**

[2–Marks]

(a) the size of the blocks, and the size of the address of the blocks

(b) the number of blocks used for the index, and the size of the blocks

(c) the size of the blocks, the number of blocks used for the index, and the size of the address of the blocks

(d) None of the above

Q.37 The order of an internal node in a B^+ tree index is the maximum number of children it can have. Suppose that a child pointer takes 6 bytes, the search field values takes 14 bytes, and the block size is 512 bytes. What is the order of the internal node? **[GATE 2004]**

[2–Marks]

(a) 24

(b) 25

(c) 26

(d) 27

Q.38 Which one of the following is a key factor for preferring B^+-trees to binary search trees for indexing database relations? **[GATE 2005]**

[1–Mark]

(a) Database relations have a large number of records

(b) Database relations are sorted on the primary key

(c) B^+-trees require less memory than binary search trees

(d) Data transfer from disks is in blocks

Q.39 The order of a leaf node in a B^+-tree is the maximum number of (value, data record pointer) pairs it can hold. Given that the block size is 1 K bytes, data record pointer is 7 bytes long, the value field is 9 bytes long and a block pointer is 6 bytes long, what is the order of the leaf node?

[GATE 2007]

[2–Marks]

(a) 63

(b) 64

(c) 67

(d) 68

Q.40 A clustering index is defined on the field which are of type **[GATE 2008]**

[1–Mark]

(a) Non-key and ordering

(b) Non-key and non-ordering

(c) Key and ordering

(d) Key and non-ordering

Q.41 Consider a file of 16384 records. Each record is 32 bytes long and its key field is of size 6 bytes. The file is ordered on a non-key field, and the file organization is unspanned. The file is stored in a file system with block size 1024 bytes, and the size of a block pointer is 10 bytes. If the secondary index is built on the key field of the file, and a multi-level index scheme is used to store the secondary index, the number of first-level and second-level blocks in the multi-level index are respectively

[GATE 2008]

[2–Marks]

(a) 8 and 0

(b) 128 and 6

(c) 256 and 4

(d) 512 and 5

Q.42 The following key values are inserted into a B^+-tree in which order of the terminal nodes is 3, and that of the leaf nodes is 2, in the sequence given below. The order of internal nodes is the maximum number of tree pointers in each node, and the order of leaf nodes is the maximum number of data items that can be stored in it. The B^+-tree is initially empty.

10, 3, 6, 8, 4, 2, 1 The maximum number of times leaf nodes would get split up as a result of these insertions is

[GATE 2009]

[2–Marks]

(a) 2

(b) 3

(c) 4

(d) 5

ANSWER KEY

1	a	2	d	3	d	4	d	5	c
6	d	7	b	8	c	9	c	10	c
11	a	12	b	13	d	14	d	15	a
16	a	17	d	18	b	19	b	20	a
21	b,c,d	22	d	23	a	24	d	25	c
26	b	27	d	28	d	29	b	30	d
31	d	32	a	33	c	34	c	35	b
36	b	37	c	38	d	39	b	40	a
41	c	42	a						

SOLUTIONS

S.1 (a)

Attributes are represented by fixed or variable–length sequences of bytes, called "fields". Fields, in turn, are put together in fixed or variable–length collection called "records", which correspond to **tuples** or objects.

S.2 (d)

The **server** and **client** processes may be on one machine, or the server and the various **clients** can be distributed over many machines.

S.3 (d)

Redundant arrays of independent disks (RAID) are a collection of variety of disk–organization techniques and have been proposed to achieve performance and reliability.

S.4 (d)

A **free list** is a data structure used in a scheme for dynamic memory allocation. It operates by connecting unallocated regions of memory together in a linked list, using the first word of each unallocated region as a pointer to the next.

S.5 (c)

There are situations where it makes sense to have **two or more disks hold identical copies of data**. The disks are said to be mirrors of each other. One important motivation is that the data will survive a head crash by either disk, since it is still readable on a mirror of the disk that crashed.

S.7 (b)

There is a parameter n associated with each B–tree index, and this parameter determines the layout of all blocks of the B–tree. Each block will have space for **n search–key values and n + 1 pointers**. In fact, a B–tree block is similar to the index blocks except that B–tree block has an extra pointer along with n key–pointer pairs.

S.8 (c)

Ordered indices are based on a **sorted ordering** of the values. **Hash indices** are based on a **uniform distribution** of values across a range of buckets. The bucket to which a value is assigned is determined by a function, called a hash function.

S.10 (c)

A magnetic disk is divided into tracks and sectors out of which **sectors are the smallest indivisible unit.**

S.11 (a)

The format of DATE type is fixed. A date can be represented just as we would represent any other fixed length character string. Therefore, a date is usually represented as a **fixed length character string**.

S.12 (b)

Since length of the string is sorted in 1 byte, the maximum value of $n = (1111\ 1111)_2 = 255$

S.13 (d)

Since, the correct data including both collection of bits and a parity bit is always even a one bit error will result in **odd parity** of resultant sequence of bits. And there is no relation between number of zeros and parity as here parity is concerned only with number of ones.

S.14 (d)

The tree is balanced means that all paths from the root to a leaf have the same length.

S.15 (a)

The key–pointer pairs in index file can be treated as records sorted by the value of the search key. Therefore an index file is a type of **sequential file**.

S.19 (b)

Here, it is given that, if we have even number of ones then parity bit is 0. Therefore, total number of ones is even. And if we have odd number of ones then parity bit is 1. Therefore, again total number of ones will be **even**.

S.20 (a)

$\because \quad h(i) = i^2 \bmod 8$

$\therefore \quad h(8) = 64 \bmod 8 = \mathbf{0}$

$h(18) = 324 \bmod 8 = \mathbf{4}$

S.22 (d)

At N, we leave $\left\lceil \frac{n+2}{2} \right\rceil$ **pointers**, in sorted order and move to M the remaining $\left\lfloor \frac{n+2}{2} \right\rfloor$ pointers.

S.23 (a)

The middle left-over key K goes neither with N or M. The leftover K indicates the smallest key reachable via the first of M's children. Although this key doesn't appear in N or M, it is associated with M, in the sense that it represents the smallest key reachable via M. Therefore K will be used by the parent of N and M to divide searches between two nodes.

S.24 (d)

In closed hashing, bucket overflow is handled by using overflow bucket. If a record must be inserted into a bucket b and b is already full, the system provides an overflow bucket for b, and inserts the record into the overflow bucket. If the overflow bucket is also full, the system provides another overflow bucket, and so on.

Under an alternative approach, called open hashing, the set of bucket is fixed, and there are no overflow chains. Instead if the bucket is full, the system insert records in some other bucket in the initial set of bucket B. One policy is to use the next bucket (in cyclic order) that has space; this policy is called linear probing.

S.25 (c)

Since, 1 track has 2^7 sectors and each sector can hold 2^{12} bytes,

A single track can hold $2^7 \times 2^{12}$ bytes

$= 2^{19}$ bytes

$= 2^9.2^{10}$ bytes

$= 2^9$ K bytes $\quad \because 2^{10}$ bytes = 1 K bytes

$=$ **512 K bytes**

S.26 (b)

There are 16 surfaces and on each surface there are 2^{14} tracks.

$\therefore$ Capacity of disk = (No. of surfaces) × (No. of tracks per surface) × (Capacity of each track)

$= 2^4 \times 2^{14} \times 2^{19} =$ **2^{37} bytes**

S.27 (d)

Since the access is sequential, greater the distance, greater will be access time. Since all the files are referenced with equal frequency, overall time can be reduced by arranging them as **F3, F4, F1, F5, F6, F2**.

S.28 (d)

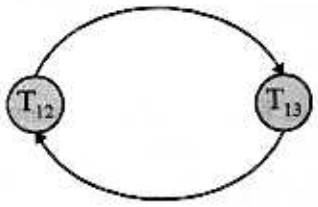
Since each file is referenced with equal frequency and each record in a particular file can be referenced with equal frequency, average access time will be

$$\frac{25+(50+40)+(50+80+50)+.....}{6} = \mathbf{268}$$

approximately.

S.29 (b)

The graph obtained from given schedule is cyclic precedence graph.



S.30 (d)

No. of blocks to store only the data = n/3

Now, for sparse index, we keep one key-pointer pair for each block. Since there are n/3 blocks, we need to store n/3 pairs. But one block can store 10 key-pointer pairs. Therefore no. of blocks required to store n/3 key-pointer pairs

$$= \frac{\frac{n}{3}}{10} = \frac{n}{30}$$

$\therefore$ Total no. of blocks $= \frac{n}{3} + \frac{n}{30} = \mathbf{\frac{11n}{30}}$

S.31 (d)

Search for	#Comparison
First entry	1
Second entry	2
Third entry	3
⋮	⋮
99th Entry	99
100th Entry	100

The total number of comparisons made is 100*(101)/2 = 5050 and the average number of comparison per access is 50.5. By similar reasoning, we know that the average number of comparison required for the actual record from the data blocks (it also contains 100 entries) is also 50.5. Therefore, the average number of comparisons required is **101**.

Shortcut Method:

The value can also be calculated using the expression 1 + (m + s)/2.

Since in our example the block size, s is 100 and the number of blocks m is 100,

we get, Answer = **101**.

S.32 (a)

Key data is 37, 38, 72, 48, 98, 11, 56

For $37 \rightarrow \frac{37}{7}$ = It is put on 2

0	1	2	3	4	5	6
98	56	37	38	72	11	48

38 mod 7 = 3

72 mod 7 = 2

48 mod 7 = 6

98 mod 7 = 0

11 mod 7 = 4

56 mod 7 = 0

S.33 (c)

Since, there are n records and each can hold 3 records, we get

No. of blocks to store only the data = n/3

.....(1)

Now, for dence index, we keep one key–pointer pair for each block, we will need n/10 extra blocks to store these pairs as each block can store 10 key–pointer pairs .....(2)

from (1) and (2)

$\therefore$ Total number of blocks $= \frac{n}{3} + \frac{n}{10} = \frac{\mathbf{13n}}{\mathbf{30}}$

S.34 (c)

Here the index file is associated with the database with values 1, 3, 2, 5 and 4 and which is applicable to the field occupation.

where CON index = 1 DOC index = 2

ENG index = 3 MUS index = 4

SER index = 5

S.35 (b)

B^+-tree are associated with memory. Binary trees are associated with disk. B^+ trees trend to be fat and short unlike thin and tall binary trees. In a Binary-tree requires 20 node accesses where as B^+ tree requires 4 block reads.

The structûral simplicity of a B^+ tree is preferred by many database system implementators.

S.36 (b)

No. of blócks used for index and size of the blocks are required to calculate the maximum possible size of the file.

S.37 (c)

Size of pointer = 6 byte

Size of search field value takes 14 bytes

Block size = 512

Let, The order of internal node = P

$\Rightarrow$ (P – 1)14 + P * 6 $\leq$ 512

$\Rightarrow$ P $\leq$ 26.3

P = 26

S.38 (d)

The transfer of data from disk to primary memory is in the form of data blocks, if a data block is large than indexing is easy. Due to this B^+ tree is better than binary search tree, data structures large amount of data can be access.

S.39 (b)

Let the order of leaf node is n.

Block size 1K = 1024 bytes

So, 6 + 7n + (n–1) 9 = 1024

on, 6 + 7n + 9n – 9 = 1024

on 16n = 1027

n = 64 (approx)

S.40 (a)

If records of a file are physically **ordered** on a **non-key** field which doesn't have a distinct value for each record that field is called the clustering field.

S.41 (c)

Number of records = 16384

Size of record = 32 byte

The number of first level block = 2^8 = **256**

The number of second level block = 2^2 = **4**

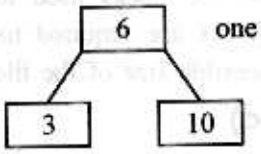
S.42 (a)

B^+-tree is initially empty

insert 10 :

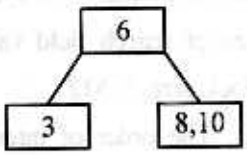
insert 3 :

insert 6 :

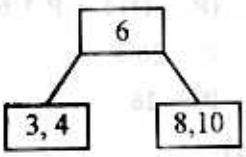


one split

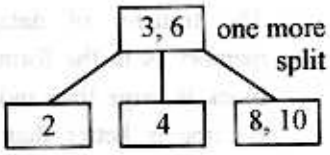
insert 8 :



insert 4 :

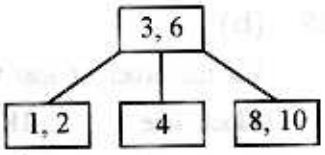


insert 2 :



one more split

insert 1 :



So total split = 2.

8.5 TRANSACTION MANAGEMENT

LEVEL–1

Q.1 Atomicity is ensured by the component

(a) Observable external writer

(b) Transaction–management component

(c) Recovery–management component

(d) Concurrency–control component

Q.2 Isolation is ensured by the component

(a) Observable external writer

(b) Transaction–management component

(c) Recovery–management component

(d) Concurrency–control component

Q.3 Which of the following must be idempotent?

(a) commit

(b) redo

(c) write

(d) read

Q.4 Fail–stop assumption is

(a) Hardware errors and bugs in the software but do not corrupt the non–volatile storage contents.

(b) Loss of the content of disk during a data transfer operation

(c) Entrance of system into an undesirable state

(d) No longer continuation of transaction because of some internal condition

Q.5 Consider the following two statements:

I. Before the transaction begins, it is hard to predict what data items need to be locked.

II. Since many of the data items may be locked but unused for a long time, thus data item utilization may be very low.

The above two statements indicate

(a) Disadvantages of deadlock recovery

(b) Disadvantages of deadlock detection

(c) Disadvantages of one of the approach of deadlock prevention

(d) Disadvantages of locking

Q.6 Durability is ensured by the component

(a) Observable external writer

(b) Transaction–management component

(c) Recovery–management component

(d) Concurrency–control component

Q.7 In wait–die scheme, transactions T_{23} and T_{24} have time stamp 10 and 15 respectively. If T_{24} request a data item held by T_{23} then

(a) T_{24} will be rolled back

(b) T_{24} will wait

(c) T_{23} will be rolled out

(d) T_{23} will wait

Q.8 For a transaction, log contains

I. A start-of-transaction marker

II. The transaction identifier

III. The record identifier

IV. The operation(s) performed on the records

(a) I, III, IV

(b) III, II, IV

(c) II, IV

(d) I, II, III, IV

Q.9 A trigger is

(a) a condition the system tests for the validity of the database user

(b) a statement that is executed by the user when debugging an application program

(c) a statement that enables to start any DBMS

(d) a statement that is executed automatically by the system as a side effect of a modification to the database.

Q.10 Which of the following schemes are used for ensuring atomicity?

(a) Log with deferred modification

(b) Log with immediate modification

(c) Shadow paging

(d) all of the above

LEVEL–2

Q.11 Consider transactions T_0 and T_1 which are defined as:

T_0 : read(A);
A : = A – 50;
write(A);
read(B);
B : = B + 50;
write(B)

T_1 : read(C);
C : = C – 100;
write(C);

A, B, C before execution were Rs. 1000, Rs. 2000, Rs. 700 respectively and the system crash occurs after write (B), then which of the following is correct?

(a) redo action will be taken

(b) database will appear as

A = 950

B = 2050

(c) log will appear as

$<T_0$ start>

$<T_0$, A, 950>

$<T_0$, B, 2050>

(d) none of the above

Q.12 In wait-die scheme, transactions T_{22} and T_{23} have time stamps 5 and 10 respectively. If T_{22} requests a data item held by T_{23} then

(a) T_{23} will be rolled back

(b) T_{23} will wait

(c) T_{22} will be rolled out

(d) T_{22} will wait

Q.13 In wound-wait scheme, transaction T_{22} and T_{23} have time stamps 5 and 10 respectively. If T_{22} request a data item held by T_{23} then

(a) T_{23} will be rolled back

(b) T_{23} will wait

(c) T_{22} will be rolled out

(d) T_{22} will wait

Q.14 Consider the following lock-compatible matrix

	A	B
A	True	False
B	False	False

Then which two modes are compatible with each other?

(a) None of the two modes are compatible

(b) Mode B is compatible with mode B

(c) Mode A is compatible with mode B

(d) Mode A is compatible with mode A

Q.15 Consider the following schedule

Which out of the following is true?

T_3	T_4
read(Q)	
	write(Q)
write(Q)	

(a) Schedule is equivalent to

T_3	T_4
	write(Q)
read(Q)	
write(Q)	

(b) Schedule is equivalent to

T_3	T_4
read(Q)	
write(Q)	
	write(Q)

(c) Schedule is not conflict serializable

(d) Schedule is conflict serializable

Q.16 Consider the transaction T_i which is defined as

T_i : read(A);

A : = A – 50;

write(A);

read(B);

B : = B + 50;

write(B);

Suppose that a system crash has occurred during the execution of T_i, after output (B_A) has taken place, but before output (B_B) was executed, where B_A and B_B denote the buffer blocks on which A and B reside. Then which out of the following is the possible recovery procedure.

(a) Do not re-execute T_i

(b) Re-execute T_i

(c) Either (a) or (b)

(d) Neither (a) nor (b)

Q.17 Consider the following schedule

T_3	T_4
lock – X(B)	
read(B);	
B := B – 50;	
write(B)	
	lock – S(A)
	read(A)
	lock – S(B)
lock – X(A)	

Which out of the following is correct?

(a) No deadlock

(b) Results in deadlock

(c) T_4 is holding a shared-mode lock on A thus T_3 is granted exclusive-mode lock on B

(d) T_3 is holding an exclusive-mode lock on B thus T_4 is shared-mode lock on B

Q.18 Consider the following situation:

I. Transaction T_{25} is waiting for transactions T_{26} and T_{27}

II. Transaction T_{27} is waiting for transaction T_{26}

III. Transaction T_{26} is waiting for transaction T_{28}

Above situation may result into:

(a) Data not sufficient

(b) No deadlock state

(c) Deadlock state

(d) Starvation of T_{25}

Q.19 Let A and B be two accounts that are accessed by transaction T_1 and T_2. Transaction T_1 transfers Rs. 50 from account B to account A. Transaction T_2 displays the total amount of money in accounts A and B (for consistency)

T_1	T_2
lock – X(B)	
read(B);	
B := B – 50;	
write(B);	
unlock(B),	
	lock – S(A)
	read(A)
	unlock(A)
	lock S(B)
	read(A)
	unlock(B)
	display(A + B)
lock – X(A)	
read(A),	
A := A + 50;	
write(B);	
unlock(B);	

Which of the following is correct?

(a) T_1 unlocked data item B too early

(b) T_2 unlocked data item B too early

(c) T_2 unlocked data item A too early

(d) Either in the order T_1, T_2 or the order T_2, T_1 transaction T_2 will display the same value

LEVEL–3

Q.20 Consider transaction T_0 and T_1 which are defined as

T_0 : read(A);
A : = A – 50;
write(A);
read(B);
B : = B + 50;
write(B);

T_1 : read(C);
C : = C – 100;
write(C)

A, B, C before execution were Rs. 1000, Rs. 2000, Rs. 700 respectively and the system crash occurs after write(C), then which of the following is correct?

(a) Database will appear as
A = Rs. 950
B = Rs. 2050
C = Rs. 600

(b) redo(T_1) is performed

(c) redo(T_0) is performed

(d) log will appear as
<T_0 start>
<T_0, A, 950>
<T_0, B, 2050>
<T_0 commit>

Common Data For Questions 21 to 22:

Consider the following transaction T_0 and T_1

<T_0 start>
<T_0, A, 1000, 950>
<T_0, B, 2000, 2050>
<T_0 commit>
<T_1 start>
<T_1, C, 700, 600>
<T_1 commit>

Q.21 If the system crashed just after log record for the step

write C

of transaction T_1 has been written to stable storage.

The log at the time of crash will be:

(a) $<T_0$ start$>$
$<T_0$, A, 950$>$
$<T_0$, B, 2050$>$
$<T_0$, commit$>$
$<T_1$, start$>$
$<T_1$, C, 600$>$
$<T_1$ commit$>$

(b) $<T_0$ start$>$
$<T_0$, A, 950$>$
$<T_0$, B, 2050$>$
$<T_0$ commit$>$
$<T_1$ start$>$
$<T_1$, C, 600$>$

(c) $<T_0$ start$>$
$<T_0$, A, 950$>$
$<T_0$, B, 2050$>$

(d) None of the above

Q.22 If solution of 5 was the log at the time of crash. Then what will be the output of A, B, and C after recovery.

(a) A = 950
B = 2050
C = 600

(b) A = 950
B = 2050
C = 700

(c) A = 1000
B = 2000
C = 700

(d) None of the above

GATE QUESTIONS

Q.23 For the schedule given below, which of the following is correct:

1. Read A	2. Read B
3. Write A	4. Read A
5. Write A	6. Write B
7. Read B	8. Write B

[Gate 1999]

[2-Marks]

(a) This schedule is serializable and can occur in a scheme using 2PL protocol.

(b) This schedule is serializable but cannot occur in a scheme using 2PL protocol.

(c) This schedule is not serializable but can occur in a scheme using 2PL protocol

(d) This schedule is not serializable and cannot occur in a scheme using 2PL protocol

Q.24 Which of the following scenarios may lead to an irrecoverable error in a database system?

[Gate 2003]

[1-Mark]

(a) A transaction writes a data item after it is read by an uncommitted transaction

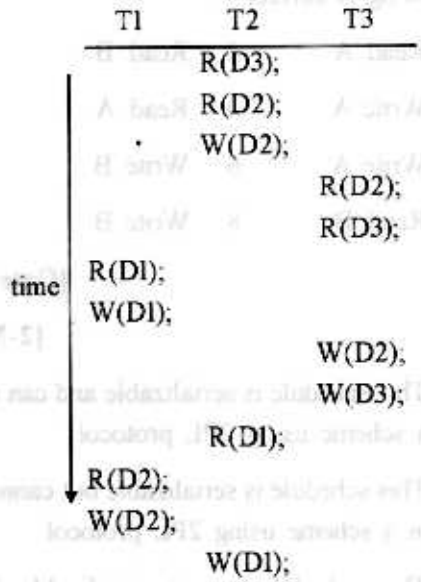
(b) A transaction reads a data item after it is read by an uncommitted transaction

(c) A transaction reads a data item after it is written by committed transaction

(d) A transaction reads a data item after it is written by an uncommitted transaction

Q.25 Consider three data items D1, D2 and D3, and the following execution schedule of transaction T1, T2 and T3. In the diagram, R(D) and W(D) denote the actions reading and writing the data item D respectively. **[Gate 2003]**

[2-Marks]



Which of the following statement is correct?

(a) The schedule is serializable as T2; T3; T1;

(b) The schedule is serializable as T2; T1; T3;

(c) The schedule is serializable as T3; T2; T1;

(d) The schedule is not serializable

Q.26 Consider the following schedule S of transactions T1 and T2:

T1	T2
Read (A)	
A=A – 10	
	Read (A)
	Temp = 0.2 * A
	Write (A)
	Read (B)
Write (A)	
Read (B)	
B = B + 10	
Write (B)	
	B = B + Temp
	Write (B)

Which of the following is TRUE about the schedule S? **[IT-GATE 2004]**

[2-Marks]

(a) S is serializable only as T1, T2

(b) S is serializable only as T2, T1

(c) S is serializable both as T1, T2 and T2, T1

(d) S is serializable either as T1 or as T2

Q.27 Amongst the ACID properties of a transaction, the 'Durability' property requires that the changes made to the database by a successful transaction persist **[IT-GATE 2005]**

[1 Mark]

(a) except in case of an Operating System crash

(b) except in case of Disk crash

(c) except in case of a power failure

(d) always, even if there is a failure of any kind

Q.28 Consider the following log sequence of two transactions on a bank account, with initial balance 12000, then transfer 2000 to a mortgage payment and, then apply a 5% interest.

1. T_1 start
2. T_1 B old = 12000 new = 10000
3. T_1 M old = 0 new = 2000
4. T_1 commit
5. T_2 start
6. T_2 B old = 10000 new = 10500
7. T_2 commit

Suppose the database system crashed just before log record 7 is written. When the system is restarted, which one statement is true of the recovery procedure? **[GATE 2006]**

[1-Mark]

(a) We must redo log record 6 to set B to 10500

(b) We must undo log record 6 to set B to 10000 and then redo log records 2 and 3

(c) We need not redo log records 2 and 3 because transaction T_1 has committed

(d) We can apply redo and undo operation in arbitrary order because they are idempotent

Q.29 Consider the following schedules involving two transactions. Which one of the following statements is TRUE? **[GATE 2007]**

[2-Marks]

S_1 : $r_1(X)$; $r_1(Y)$; $r_2(X)$; $r_2(Y)$; $w_2(Y)$; $w_1(X)$

S_2 : $r_1(X)$; $r_2(X)$; $r_2(Y)$; $w_2(Y)$; $r_1(Y)$; $w_1(X)$

(a) Both S_1 and S_2 are conflict serializable

(b) S_1 is conflict serializable and S_2 is not conflict serializable

(c) S_1 is not conflict serializable and S_2 is conflict serializable

(d) Both S_1 and S_2 are not conflict serializable

Q.30 Consider two transaction T_1 and T_2, and four schedules S_1, S_2, S_3, S_4 of T_1 and T_2 as given below:

T_1 : $R_1[x]$ W_1 [x] W_1 [y]

T_2 : $R_2[x]$ R_2 [y] W_2 [y]

S_1 : $R_1[x]$ R_2 [x] R_2 [y] W_1 [x] W_1 [y] W_2 [y]

S_2 : $R_1[x]$ R_2 [x] R_2 [y] W_1 [x] W_2 [y] W_1 [y]

S_3 : $R_1[x]$ W_1 [x] R_2 [x] W_1 [y] R_2 [y] W_2 [y]

S_4 : $R_2[x]$ R_2 [y] R_1 [x] W_1 [x] W_1 [y] W_2 [y]

Which of the above schedules are conflict-serializable? **[GATE 2009]** **[2-Marks]**

(a) S_1 and S_2

(b) S_2 and S_3

(c) S_3 only

(d) S_4 only

ANSWER KEY

1	b	2	d	3	b	4	a	5	c
6	c	7	a	8	d	9	d	10	d
11	c	12	d	13	a	14	d	15	c
16	d	17	b	18	b	19	a	20	c
21	b	22	b	23	a	24	d	25	c
26	d	27	d	28	c	29	c	30	b

SOLUTIONS

S.1 (b)

Ensuring atomicity is the responsibility of the database system itself, specifically, it is handled by a component called the **transaction management component**.

S.2 (d)

Ensuring isolation property is the responsibility of a component of the database system called the **Concurrency-management component**.

S.3 (b)

The **redo** operation must be idempotent, that is, executing it several times must be equivalent to executing it once.

S.4 (a)

The assumption that **hardware errors and bugs in the software bring the system to a halt, but do not corrupt the nonvolatile storage contents,** is known as the fail-stop assumption.

S.5 (c)

One approach of **deadlock prevention** ensures that no cyclic waits can occur by ordering the requests for locks, or requiring all locks to be acquired together. Thus each transaction locks all its data items before it begins execution. Also the given two statements are the **disadvantages of the approach of deadlock prevention**.

S.6 (c)

Ensuring durability is the responsibility of a component of the database system called the **Recovery–management component** because it guarantees that transactions that have committed will survive permanenetly.

S.7 (a)

In wait–die scheme, when transaction T_i requests a data item currently held by T_j and time stamp of T_j is smaller than that of T_i, then T_i is rolled back. Thus when T_{24} requests a data item held by T_{23}, then **T_{24} will be rolled back**.

S.8 (d)

A database log record is made up of:

(i) Log Sequence Number: A unique id for a log record.

(ii) Prev LSN: A link to the last log record.

(iii) Transaction ID number: A reference to the database transaction generating the log record.

(iv) Type: Describs the type of database log record.

(v) Information about the actual changes that triggered the log record to be written.

S.11 (c)

The log at the time of the crash appears as in option (c). When the system comes back up, no redo action need to be taken, since no commit record appears in the log. The values of A and B remain Rs. 1000 and Rs. 2000 respectively.

S.12 (d)

In wait–die scheme, when transaction T_i request a data item currently held by T_j, T_i is allowed to wait only if it has a time stamp smaller than that of T_j. Thus when T_{22} requests a data item held by T_{23}, then **T_{22} will wait**.

S.13 (a)

In wound–wait scheme, when transaction T_i requests a data item currently held by T_j, then T_j is rolled back if time stamp of T_j is larger than T_i. Thus for the given question data items will be preempted from T_{23} and **T_{23} will be rolled back**.

S.14 (d)

Let A and B represent arbitrary lock modes. Suppose that a transaction T_i request a lock of mode A on item Q on which transaction T_j ($T_i \neq T_j$) currently hold a lock of mode B. If transaction T_i can be granted a lock on Q immediately, in spite of the presence of the mode B lock, then we say mode A is compatible with mode B.

Such a function can be represented conveniently by a matrix.

An element comp(A, B) of the matrix has the value true if and only if mode A is compatible with mode B. As comp(A, A) = true, thus **mode A is compatible with mode A**.

S.15 (c)

The given schedule is **not conflict serializable**, since it is not equivalent to either the serial schedule $<T_3, T_4>$ or the serial schedule $<T_4, T_3>$.

S.16 (d)

Considering initial values of A and B being Rs. 1000 and Rs. 2000 respectively

(i) Re-execute T_i

This procedure will result in the value of A becoming Rs. 900, rather than Rs. 950.

Thus inconsistent.

(ii) Do not re-execute T_i

The current system state has values of Rs. 950 and Rs. 2000 for A and B respectively.

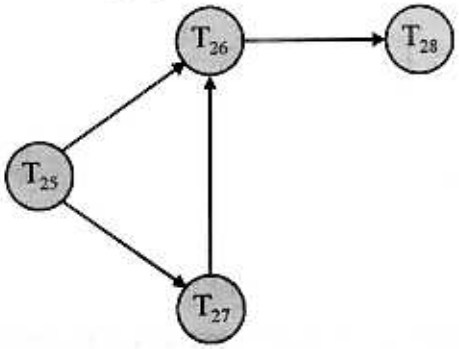
Thus inconsistent.

S.17 (b)

As T_3 is holding an exclusive–mode lock on B and T_4 is requesting a shared–mode lock on B, T_4 is waiting for T_3 to unlock B. Similarly T_4 is holding a shared–mode lock on A and T_3 is requesting an exclusive–mode lock on A, T_3 is waiting for T_4 to unlock A. Thus we have arrived at a state where neither of those transactions can ever proceed with its normal execution. This situation is called **deadlock**.

S.18 (b)

Wait–for graph for the above situation is:



Since the graph has no cycle, the system is **not in a deadlock state**.

S.19 (a)

Suppose that the values of accounts A and B are Rs. 100 and Rs. 200, respectively. For the given schedule transaction T_2 displays Rs. 250 and other way is not possible as a specified schedule is given.

For consistency, transaction T_2 should display a value with no loss of data. So it should display Rs. 300 instead of Rs. 250. The reason for this mistake is that **the transaction T_1 unlocked data item B too early**, as a result of which T_2 is in inconsistent state.

S.20 (c)

For the above mentioned procedure, the log will appear as

<T_0 start>

<T_0, A, 950>

<T_0, B, 2050>

<T_0 commit>

<T_1, start>

<T_1 C, 600>

When the system comes back up, the operation **redo(T_0) is performed**, since the record <T_0 commit> appears in the log on the disk redo(T_1) actions need not to be taken, since no <T_1 commit> appears in the log. Thus database will appear as after recovery:

A = Rs. 950

B = Rs. 2050

C = Rs. 700

S.22 (b)

When the system comes back, the operation redo T_0 is performed since the record

<T_0 commit>

appears in the log on the disk. After this operation is executed, the values of accounts **A and B are Rs. 950 and Rs. 2050,** respectively. The value of account **C remains Rs.700** because T_1 has not committed as yet.

S.23 (a)

T_1	T_2
Read(A)	
	Read(B)
Write(A)	
	Read(A)
	Write(A)
	Write(B)
Read(B)	
Write(B)	

The above schedule is **serializable.**

1. Swap the Read(B) instruction of T_1 with Read(A) instruction of T_2.
2. Swap the write (B) instruction of T_1 with write (A) instruction of T_2.
3. Swap the write (A) instruction of T_1 with the read (B) instruction of T_2.

T_1	T_2
Read(A)	
Write(A)	
Read(B)	
Write(B)	
	Read(B)
	Write(B)
	Read(A)
	Write(B)

Hence it is serializable schedule and can occur in scheme using 2 Phase-Locking Protocol (2PL) which ensures conflict serializability.

S.24 (d)

Whenever a data is written in database it must be committed otherwise it will not be saved in database and by that time if there is an error or unsafe operation of power failure occurs then the uncommitted data will be lost and hence unrecoverable.

S.25 (c)

The Schedule is serializable as T_3, T_2, T_1.

T1	T2	T3
	R(D3); R(D2); W(D2);	
		R(D2); R(D3);
R(D1); W(D1);		
R(D2); W(D2);	R(D1) W(D1);	W(D2); W(D3);

In transaction T3R(D2) conflict with original R(D2) in T2, because R(D2) in T3 is read after W(D2) in T2. Again a transaction T2, has R(D1) which conflict with R(D1) in T1 because it read R(D1) after W(D1) In transaction T1, R(D2) conflict with R(D2) in T2, because it is after W(D2) in T1. So the transaction is conflict serialization schedule as **T3, T2, T1**.

S.26 (d)

ACID properties of a transaction always persists, **even if there is a failure of any kind.**

S.28 (c)

In data base transaction system if transaction is commited then it becomes permanent there is no effect of any failure so **we need not redo log records 2 and 3 because transaction T_1 has committed**.

Since T_2 is not allowed to commit, we must undo log record 6.

S.29 (c)

Consider the table for transaction

time	S_1	S_2
↓	$r_1(X)$;	$r_1(X)$;
	$r_1(Y)$;	$r_2(X)$;
	$r_2(X)$;	$r_2(Y)$;
	$r_2(Y)$;	$w_2(Y)$;
	$w_2(Y)$;	$r_1(Y)$;
	$w_1(X)$;	$w_1(Y)$;

There is no serializable conflict in transaction S_1 but for statement $w_1(X)$; there is a conflict in S_2 but it is also serializable.

S.30 (b)

If we get serial schedule from conflicting schedule, then it is called as conflict serializable schedule.

Schedule S2

T1	T2
$R_1[X]$	
	$R_2[X]$
	$R_2[Y]$
$W_1[X]$	
	$W_2[Y]$
$W_1[Y]$	

By Swapping →

T1	T2
	$R_2[X]$
	$R_2[Y]$
	$W_2[Y]$
$R_1[X]$	
$W_1[X]$	
$W_1[Y]$	

dependency graph (T1) ← (T2) S2 have no cycles

Schedule S3

T1	T2
$R_1[X]$	
$W_1[X]$	
	$R_2[X]$
$W_1[Y]$	
	$R_2[Y]$
	$W_2[Y]$

By Swapping →

T1	T2
$R_1[X]$	
$W_1[X]$	
$W_1[Y]$	
	$R_2[X]$
	$R_2[Y]$
	$W_2[Y]$

dependency graph (T1) → (T2) S3 also have no cycles.

So S2 & S3 are conflict-serializable.

UNIT–9

INFORMATION SYSTEMS AND SOFTWARE ENGINEERING

UNIT–9

INFORMATION SYSTEMS AND SOFTWARE ENGINEERING

9.1 SOFTWARE PROCESS MODELS

LEVEL–1

Q.1 Which is the primary requirement validation mechanism.

(a) Requirement analysis

(b) Validation criteria

(c) Formal technical review

(d) None of these

Q.2 Dependency traceability table shows what?

(a) indicates how requirements are related to one another.

(b) categorizes requirements by the subsystem(s) that they govern.

(c) shows how requirements related to important customer observable system / product features.

(d) identifies the source of each requirement.

Q.3 Which leads to 'blocking states' in which some project team members must wait for the other members of the team to complete dependent tasks.

(a) ad-hoc approach of prototyping model

(b) iterative nature of spiral model

(c) linear nature of classic life cycle

(d) none of these

Q.4 What is an incremental software process model that emphasizes an extremely short development cycle.

(a) RAD

(b) Prototyping

(c) Spiral

(d) none of these

Q.5 Which of the following statements is true?

(a) DFD does not represent procedural information

(b) Dataflow diagram shows the flow of control

(c) Dataflow diagram is a type of flowchart

(d) None of these

Q.6 Which of the following is not true of Software Requirement Specification?

(a) A high-quality SRS is a prerequisite to high-quality software.

(b) An SRS provides a reference for validation of the final product.

(c) A high-quality SRS increases the development cost.

(d) An SRS establishes the basis for agreement between the client and the supplier on what the software product will do.

Q.7 User documentation consists of

(a) Training manuals, operations manuals, and reference manuals

(b) Description of the program logic in the form of algorithms

(c) Control flow diagrams and data flow diagrams

(d) All of the above

Q.8 To which phase of SDLC, is file conversion related?

(a) System design

(b) System development

(c) System analysis

(d) System implementation

Q.9 The main activity of the design phase of the system life cycle is to

(a) replace the old system with the new one

(b) develop and test the new system

(c) understand the current system

(d) propose alternatives to the current system

Q.10 During which phase, the requirement analysis is performed?

(a) system investigation phase

(b) system development phase

(c) system analysis phase

(d) none of these

Q.11 Structured design methodology is an approach to design that adheres to rules based on principles such as

(a) data flow analysis

(b) bottom-up design

(c) top-down refinement

(d) all of these

Q.12 In functional decomposition, the data flow diagram

(a) is ignored

(b) is partitioned according to the "closeness" of the datagrams and data storage items

(c) is partitioned according to the logical "closeness" of the actograms

(d) none of these

Q.13 Decision-Table is

(a) a way of representing multiple conditions

(b) a way of representing the information flow

(c) a way to get an accurate picture of the system

(d) all of these

Q.14 In Decision trees

(a) branch depends on the condition and decisions to be made

(b) root is drawn on the left and is the starting point on the decision sequence

(c) nodes represent the conditions and the right side of the trees testing the actions to be taken

(d) all of these

Q.15 Which of the following is not true of the conversion phase of the development life cycle?

(a) User and systems-personnel must work closely.

(b) Documentation must be emphasized.

(c) Non machine components of the system should be considered.

(d) Steps must be taken to phase out the old system.

Q.16 Which of the following activities do not belong to the Implementation phase of the SDLC?

(a) User training

(b) Program testing

(c) File conversion

(d) All of these

Q.17 In data flow diagram, an originator or receiver of data is usually designed by

(a) arrow

(b) rectangle

(c) circle

(d) square box

Q.18 The simplest model in software development is

(a) iterative

(b) waterfall model

(c) prototyping

(d) none of these

Q.19 A common reason for changing an information system is
(a) new technology
(b) new requirements
(c) problems in the existing system
(d) all of the above.

Q.20 The main purpose of the system investigation phase is to produce
(a) a design report
(b) a feasibility report
(c) a requirement report
(d) a planning report.

Q.21 In data flow diagrams, a parallel-lines symbol
(a) is a data store, data at rest, or a temporary repository of data
(b) represents the process
(c) represents a source or destination of system data
(d) none of these.

Q.22 Cost-benefit analysis
(a) Evaluates the tangible and non-tangible factors
(b) Compares the cost, with the benefits, of introducing a computer-based system
(c) Estimates the hardware and software costs
(d) All of the above.

Q.23 A programmer would most likely prepare a
(a) general system flow chart
(b) specific system flow chart
(c) specific program flow chart
(d) general program flow chart

Q.24 Software engineering primarily aims on
(a) reliable software
(b) reliable and cost effective software
(c) cost effective software
(d) none of these.

Q.25 The model which reduces the costs of development of software is
(a) iterative
(b) prototyping model
(c) waterfall model
(d) none.

Q.26 Which of the following would not be a major deliverable of the structured system analysis phase:
(a) prototype model
(b) data flow diagrams
(c) entity relationship diagrams
(d) data dictionaries.

Q.27 A picture of the movement of data between external entities and the processes and data stores within a system best describes a/an
(a) entity relationship diagram
(b) decision table
(c) data flow diagram
(d) structure chart.

Q.28 Functional decomposition is
(a) the process of discovering discrepancies between two or more sets of DFDs or discrepancies within a single DFD
(b) the extent to which all necessary components of a DFD have been included and fully described
(c) an iterative process of breaking the description of a system down into finer and finer detail, which creates a set of charts in which one process on a given chart is explained in greater detail on another chart.
(d) the conservation of inputs and outputs to a data flow diagram process when that process is decomposed to a lower level.

Q.29 DFD completeness is
(a) the extent to which all necessary components of a data flow diagram have been included and fully described
(b) the process of discovering discrepancies between two or more sets of DFDs or discrepancies within a single DFD
(c) the conservation of inputs and outputs to a DFD process when that process is decomposed to a lower level
(d) an iterative process of breaking the description of a system down into finer and finer detail, which creates a set of charts in which one process on a given chart is explained in greater detail on another chart.

Q.30 A data flow that appears on a higher-level DFD, but not on lower levels violates the DFD,
(a) Timing guideline
(b) Consistency guideline
(c) Completeness guideline
(d) Iterative development guideline.

Q.31 The lowest level of decomposition for a data flow diagram is
(a) Context DFD
(b) Unit DFD
(c) Primitive DFD
(d) level-0 DFD.

Q.32 Which of the items listed below is not one of the software engineering layers:
(a) Process
(b) Tools
(c) Methods
(d) Manufacturing.

Q.33 What are the three generic phases of software engineering?
(a) what, how, where
(b) definition, development, support
(c) programming, debugging, maintenance
(d) analysis, design, testing.

Q.34 The linear sequential model of software development is also known as the
(a) Fountain model
(b) Classical life cycle model
(c) Spiral model
(d) Chaos model.

Q.35 The rapid application development model is
(a) Another name for component-based development
(b) A useful approach when a customer cannot define requirements clearly
(c) A high speed adaptation of the linear sequential model
(d) All of the above.

Q.36 The incremental model of software development is
(a) A reasonable approach when requirements are well defined
(b) A revolutionary model that is not used for commercial products
(c) The best approach to use for projects with large development teams
(d) A good approach when a working core product is required quickly.

Q.37 The spiral model of software development
(a) Ends with the delivery of the software product
(b) Includes project risks evaluation during each iteration
(c) Is more chaotic than the incremental model
(d) All of the above.

Q.38 The concurrent development model is
(a) Another name for the rapid application development model
(b) Only used for development of parallel of distributed systems
(c) Often used for the development of client/server application.
(d) Used whenever a large number of change requests are anticipated.

Q.39 The component-based development model is
(a) Dependent on object technologies for support
(b) Not able to support the development of reusable components
(c) Only appropriate for computer hardware design
(d) Not cost effective by known quantifiable software metrics.

Q.40 Which of the following is not considered a player in the software process:
(a) customers
(b) sales people
(c) project managers
(d) end-users

Q.41 The model which is the best between all models is

(a) waterfall

(b) spiral

(c) iterative

(d) COCOMO model.

LEVEL–2

Q.42 Match the documents from Group A with their corresponding phase in the software life cycle from Group B.

A	B
1. Final user manual	(a) Design phase
2. Architectural design	(b) Implementation phase
3. SQA plan	(c) Feasibility phase
	(d) Project planning phase

(a) 1 → (c), 2 → (a), 3 → (b)

(b) 1 → (d), 2 → (a), 3 → (c)

(c) 1 → (a), 2 → (b), 3 → (c)

(d) 1 → (b), 2 → (a), 3 → (d)

Q.43 Order the following tasks in terms of the Waterfall model:

(A) project planning (B) requirements review

(C) high-level design (D) market analysis

(E) low-level design (F) design review

(G) implementation

(a) (B) (D) (A) (F) (C) (E) (G)

(b) (D) (A) (B) (C) (E) (F) (G)

(c) (B) (D) (A) (F) (E) (C) (G)

(d) cannot be determined

Q.44 Rapid prototyping proves the quality of a design by

(a) having the system simulate the real system

(b) having the system analyst present an overview of the design to the users, programmers and consultants.

(c) both (a) and (b)

(d) None of the above

Q.45 If there are N conditions specified, a complete decision table will have how many different combinations listed for which actions must be specified.

(a) N^2

(b) 2N

(c) 2^N

(d) N

Q.46 Which type of model is used for identifying software requirement.

(a) prototyping

(b) spiral model

(c) linear sequential

(d) none of these

Q.47 Exception handling, recovery, and conformance to some standards and formats are typically not included in the products developed using

(a) Waterfall model

(b) RAD model

(c) Spiral model

(d) Prototyping model

Q.48 Features traceability table

(a) shows how requirements relate to both internal and external system interfaces.

(b) categorizes requirements by the subsystem(s) that they govern.

(c) shows how requirements relate to important customer system/product features.

(d) both (a) and (b)

Q.49 Which software resides in read-only memory and is used to control products and system for the consumer and industrial markets.

(a) Web-based software

(b) Real-time software

(c) Embedded software

(d) System software

Q.50 Which of the following might be the output as result of using a CASE tool?

(a) flowcharts and dataflow diagrams

(b) prototypes and cost/benefit analysis

(c) programming code

(d) all of these

Q.51 Which report describes dissatisfaction of the customer with specific behavior of the system, usually software failures on errors.

(a) User manual

(b) Source code

(c) Defect report

(d) Test report.

Q.52 FAST stands for

(a) Facilitated Application Specification Techniques

(b) Future Analysis of Software Trends

(c) Fast Action Software Techniques

(d) Formal Analysis of Specification Table.

Q.53 To develop the system model, the system engineer allocates system elements to each of five processing regions within the template. Which of the following is not one of the five processing regions?

(a) Maintenance and self-test

(b) User Interfaces

(c) Input

(d) System Context Diagram

Q.54 Which is a quality management technique that translates the needs of the customer into technical requirements for software

(a) System Requirement Specification

(d) Validation criteria

(c) Quality function deployment (QFD)

(d) Prototyping.

GATE QUESTIONS

Q.55 The diagram that helps in understanding and representing user requirements for a software project using UML (Unified Modeling Language) is: **[IT–GATE 2004]**

[1–Mark]

(a) Entity Relationship Diagram

(b) Deployment Diagram

(c) Data Flow Diagram

(d) Use Case Diagram

ANSWER KEY

1	c	2	a	3	c	4	a	5	a
6	c	7	a	8	d	9	d	10	c
11	a	12	c	13	a	14	b	15	b
16	b	17	b	18	b	19	d	20	b
21	a	22	d	23	c	24	b	25	b
26	a	27	c	28	c	29	a	30	b
31	c	32	d	33	b	34	b	35	c
36	d	37	b	38	c	39	a	40	b
41	b	42	d	43	b	44	a	45	c
46	a	47	d	48	c	49	c	50	d
51	c	52	a	53	d	54	c	55	a

SOLUTIONS

S.3 (c)

The blocking state tends to be more prevalent at the beginning and end of a **linear sequential model**.

S.4 (a)

The **Rapid Application Development** (RAD) is a "high-speed" adaptation of the linear sequential model in which rapid development is achieved by using component-based construction.

S.5 (a)

DFD is not a flowchart. A DFD represents the flow of data, while a flowchart shows the flow of control and a **DFD does not represent procedural details**. So, while drawing a DFD, one must not get involved in procedural details.

S.6 (c)

A high-quality SRS reduces development cost. Due to lack of understanding of the role and importance of SRS, and in an effort to speed-up development and cut costs by eliminating "non-essential" activities, many software projects start with a low-quality SRS that is incomplete and full of ambiguities. Due to this most of the projects have cost and schedule overruns rather than reducing cost and time.

S.7 (a)

User documents must include the details about using the system, basic trouble shooting of the system and utilities of the system. This all can be provided through **training manuals, operations manuals and reference manuals**.

S.8 (d)

File conversion and user training are some of the activities of **system implementation phase**.

S.19 (d)

All of the given reasons generally give reason to the change the existing information systems.

S.20 (b)

In system investigation, a study is made whether the proposed system is **feasible or not**.

S.43 (b)

Order of major tasks in waterfall model

1. Market analysis
2. Project planning, cost estimating, requirement specification (may be done concurrently)
3. Requirement review
4. High-level design
5. Low-level design
6. Design review
7. Implementation

After Implementation

8. Unit testing
9. System testing
10. Acceptance testing

S.44 (a)

A prototype is good if it **simulates the real system**.

S.45 (c)

For each condition, there are two possibilities Yes (if condition is satisfied) and No (if condition is not satisfied). So for N conditions, **there are 2^N combinations possible**.

S.46 (a)

In prototyping, the quick design leads to the construction of a prototype. The prototype is evaluated by the customer/user and used to refine requirements for the software to be developed. Ideally, the **prototype serves as a mechanism for identifying software requirements**.

S.47 (d)

Only those features are included in the prototype that will have a valuable return form the user experience. **Exception handling, recovery, and conformance to some standards and formats are typically not included in prototypes**. In prototyping, as the prototype is to be discarded, there is no point in implementing

those parts of the requirements that are already well understood.

S.49 (c)

Embedded software resides in read-only-memory and can perform very limited functions (e.g., Keypad control for a washing m/c) or provide significant function and control capability (e.g., digital functions in an automobile such as fuel control and breaking systems.

S.50 (d)

Though not 100 percent, but CASE tools can perform all the given tasks to a good extent.

S.51 (c)

User manual: Describes how to use the finished software.

Source code: The actual product code

Test report: Describes what tests were done and how the system behaved.

S.52 (a)

Too often, customers and software engineers, rather than working as a team to identify and refine requirements, each defines its own "territory" and communicates through a series of memos, formed position papers, documents, and questions and answer session. History has shown that this approach doesn't work well. To overcome these problems, a number of independent investigators have developed a team-oriented approach to requirements gathering that is applied during early stages of analysis and specification. called **facilitated application specification techniques (FAST)**, this approach encourages the creation of a joint team of customers and developers who work together to identify the problem, propose elements of the solution, negotiate different approaches and specify a preliminary set of solution requirements.

S.53 (d)

The five processing regions are:

(i) user interface; (ii) input; (iii) system function and control; (iv) output and (v) maintenances and self-test.

Like nearly all modeling techniques used in system and software engineering, the system model template enables the analyst to create a hierarchy of details. A system context diagram (SCD) establishes the information boundary between the system being implemented and the environment in which the system is to operate.

S.54 (c)

QFD concentrates on maximizing customer satisfaction from the software engineering process. To accomplish this, QFD emphasizes an understanding of what is valuable to the customer and then deploys these values throughout the engineering process.

S.55 (d)

Use cases are used for understanding and representing user requirements for software project using UML.

SOFTWARE METRICS & PROJECT ESTIMATION

9.2

LEVEL–1

Q.1 Bang metric is a type of metric that has been proposed to quantify the size of the project.

(a) time based

(b) budget based

(c) requirement based/analysis based.

(d) none of these

Q.2 LOC can be used to normalize quality and/or productivity measures for

(a) Extended-Function point metrics

(b) Function-oriented metrics

(c) Size-oriented metrics

(d) none of these

Q.3 To what attribute of the software project does the metric, self-documentation refers to

(a) The use of standard data structure and types throughout the program.

(b) The degree to which the source code provides meaningful documentation.

(c) The degree to which the program monitors its own operation and identifies error that do occur.

(d) The degree to which the documentation of the source code can be automated.

Q.4 Layout Appropriateness (L.A.) is a design metric for

(a) Human/computer interfaces

(b) Maintenance

(c) Reusability

(d) Cohesiveness of a module

Q.5 System prototyping helps the designer in

(a) giving the demonstration of the software to the system manager

(b) making the programmers understand how the system will work

(c) communicating to the user, quickly, how the system, when developed, will look like and get a feed back

(d) all of these

Q.6 The ISO 9126 standard identifies how many key quality attributes

(a) 7

(b) 6

(c) 5

(d) 4.

Q.7 The expected value for the estimated variable (size) s, can be computed as a weighed average of the optimistic (S_{opt}), most likely (S_m) and pessimistic (S_{pess}) estimates using ____

(a) $(S_{opt} + 4S_m + S_{pess})/6$

(b) $(S_{opt} + 4S_m + S_{pess})/3$

(c) $(S_{opt} + S_m + S_{pess})/3$

(d) $(S_{opt} + 2S_m + 2S_{pess})/6$

Q.8 The model which estimates the total effort in terms of person, months of the technical project staff is

(a) COCOMO model.
(b) waterfall model
(c) prototyping
(d) spiral.

Q.9 Information hiding is to hide from user, details

(a) that are relevant to him
(b) that are not relevant to him
(c) that may be mailciously handled by him
(d) that are confidential

Q.10 Data structure suitable for the application is discussed in

(a) data design
(b) architectural design
(c) procedural design
(d) interface design

Q.11 Configuration management is not concerned with

(a) controlling changes to the source code
(b) choice of hardware configuration for an application
(c) controlling documentation changes
(d) maintaining versions of software

Q.12 Data Flow Diagram, Regular Expression and Transition Table can be combined to provide ..... for functional specification of systems software.

(a) decision table
(b) finite state automata
(c) event table
(d) none of the above

LEVEL–2

Q.13 Find the cost parameters from the given set of parameters

Project	Size (KLOC)	Cost (Programmer Months)
A	30	84
B	5	14
C	20	56
D	50	140
E	100	280
F	10	28

(a) $\alpha = 2.8, \gamma = 1$
(b) $\alpha = 3.8, \gamma = 0$
(c) $\alpha = 2.8, \gamma = 0$
(d) $\alpha = 3.8, \gamma = 1$

Q.14 In COCOMO model, a software cost estimation is doing well if it can estimate software development cost within how much of actual costs, and how much of the time.

(a) 20%, 70%
(b) 30%, 70%
(c) 70%, 30%
(d) 70%, 20%

Q.15 Estimate the cost parameters from the given set of data

Project	Size (KLOC)	Cost (programmer-months)
a	30	95
b	25	80
c	20	65
d	50	155
e	100	305
f	120	365

(a) $\alpha = 4, \gamma = 5$
(b) $\alpha = 3, \gamma = 0$
(c) $\alpha = 3, \gamma = 5$
(d) $\alpha = 4, \gamma = 0$

Q.16 A team ABC had identified seven subparts to their project. These are shown in table given below with their estimates of size of each subtask.

Part	Max Size	Best Guess	Min Size
1	20	30	50
2	10	15	25
3	25	30	45
4	30	35	40
5	15	20	25
6	10	12	14
7	20	22	25

i) Find the expected value of LOC for part 1.

(a) 31.6 KLOC

(b) 34 KLOC

(c) 33.33 KLOC

(d) 30 KLOC

ii) Find the approximate estimate of effort required in persons months for part 2 assuming the organization average productivity for systems of this type is 5 KLOC/pm.

(a) Cannot be determined

(b) 4 person months

(c) 3 person months

(d) 2 person months

iii) Find the approximate cost for the part 5 and 6 assuming the organization average cost is 20 $ for 100 LOC for systems of this type.

(a) Cannot be determined

(b) 6400 $

(c) 64 $

(d) 640 $

Q.17 The productivity for a project of 24 KLOC was found to be 12 LOC/programmer-day. If there were 10 programmers employed for the project and they worked 20 days a month, find the no. of months required to complete the project.

(a) 11 months

(b) 10 months

(c) 9 months

(d) 8 months

Q.18 Find the odd-man out

Parkison's law, Algorithmic cost estimation, Pricing to win, Top-down estimation

(a) Parkison's law

(b) Pricing to win

(c) Algorithmic cost estimation

(d) Top-down estimation.

Q.19 The basic LOC-based cost estimation is given by the formula

$$\text{cost} = \alpha * (\text{KLOC})^{\beta} + \gamma$$

which parameter reflects the fixed cost of doing any project?

(a) α

(b) β

(c) γ

(d) Cannot be determined

LEVEL–3

Q.20 A team XYZ is working on a software project. They have divided the project in 5 major functionalities along with their estimates of the size of each functionality.

Functionality	Optimistic	Most likely	Pessimistic
1	25	30	45
2	30	35	40
3	15	20	25
4	20	22	25
5	16	21	20

Table : Size Estimate (in KLOC)

i) Find the expected value of LOC for functionality 1?

(a) 31.60

(b) 30.33

(c) 30

(d) None of these

ii) Find the estimate (in terms of KLOC) for the whole project.

(a) 125 KLOC

(b) 130 KLOC

(c) 134 KLOC

(d) cannot be determined

iii) Find the cost of entire project whene the average cost for this type of project is \$250 per KLOC?

(a) cannot be determined

(b) \$32500

(c) \$25000

(d) \$12650

iv) The basic LOC based cost estimation is given by the formula,

$$\text{cost} = \alpha \times (\text{KLOC})^{\beta} + \gamma$$

which of the following options imply that the cost per KLOC increases as the size of the project increases.

(a) $\alpha > 1$ and $\beta = 1$

(b) $\beta > 1$ and independent of α

(c) $\alpha > 1$ and independent of β

(d) $\alpha > 1$ and $\beta < 1$

Common Data For Questions 21 to 27:

Use the information given below for estimation Basic COCOMO Table

Software Project	a_b	b_b	c_b	d_b
Organic	2.4	1.05	2.5	0.38
Semi detached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

Q. 21 Find the approximate effort in person months for a simpler application of 25 KLOC.

(a) 97

(b) 85

(c) 81.5

(d) 70.5.

Q.22 Find the approximate development time is programmer months for a simple application 5 KLOC.

(a) 13.0

(b) 5

(c) 6.6

(d) Data insufficient.

Q.23 Find the approximate development time required for a software project of size 50 KLOC.

(a) 5 pm

(b) 7 pm

(c) 13.8

(d) Data insufficient.

Q.24 Calculate COCOMO effort and development time for an organic project that is estimated to be 39800 lines of code.

(a) 15 M, 115 PM

(b) 115 PM, 15 M

(c) 20 PM, 15 M

(d) Cannot be determined.

Q.25 Find the approximate programmer effort in persons month for simple application program of 5 KLOC,

(a) 14

(b) 13

(c) 12

(d) Data insufficient.

Q.26 Find the approximate programmer effort in persons months for a software project called flight control software for aircrafts. Size of the software is 40 KLOC

(a) 403

(b) 301

(c) 115

(d) 187.

Q.27 Find the size of a complex program which requires 3.6 PM. The effort equation for the given program is given by,

$$E = 3.6 * (\text{KLOC})^{1.2}$$

(a) 1.2 KLOC

(b) 1000 LOC

(c) Data insufficient

(d) None of these.

GATE QUESTIONS

Q.28 In a software project, COCOMO (Constructive Cost Model) is used to estimate

[IT-GATE 2004]

(a) effort and duration based on the size of the software

(b) size and duration based on the effort of the software

(c) effort and cost based on the duration of the software

(d) size, effort and duration based on the cost of the software

Q.29 What is the availability of a software with the following reliability figures? **[IT-GATE 2004]**

Mean Time Between Failure (MTBF) = 25 days

Mean Time To Repair (MTTR) = 6 hours

(a) 1%

(b) 24%

(c) 99%

(d) 99.009%

Q.30 The availability of a complex software is 90%. Its Mean Time Between Failure (MTBF) is 200 days. Because of the critical nature of the usage, the organization deploying the software further enhanced it to obtain an availability of 95%. In the process, the Mean Time To Repair (MTTR) increased by 5 days.

What is the MTBF of the enhanced software? **[IT-GATE 2005]**

(a) 205 days

(b) 300 days

(c) 500 days

(d) 700 days

Q.31 The Function Point (FP) calculated for a software project are often used to obtain an estimate of Lines Of Code (LOC) required for that project. Which of the following statements is FALSE in this context. **[IT-GATE 2005]**

(a) The relationship between FP and LOC depends on the programming language used to implement the software.

(b) LOC requirement for an assembly language implementation will be more for a given FP value, than LOC for implementation in COBOL.

(c) On an average, one LOC of C++ provides approximately 1.6 times the functionality of a single LOC of FORTRAN.

(d) FP and LOC are not related to each other.

ANSWER KEY

1	c	2	c	3	b	4	a	5	c
6	b	7	a	8	a	9	c	10	a
11	b	12	b	13	c	14	a	15	c
16(i)	a	16(ii)	c	16(iii)	b	17	b	18	b
19	c	20(i)	a	20(ii)	b	20(iii)	b	20(iv)	b
21	d	22	c	23	d	24	b	25	b
26	b	27	b	28	c	29	c	30	c
31	c								

SOLUTIONS

S.2 (c)

Size-oriented software metrics are derived by normalizing quality and/or productivity measures by considering the size of the software that has been produced. In order to develop metrics that can be assimilated with similar metrics from other projects, we choose lines of code as our normalization value.

S.6 (b)

The ISO 9126 identifies **six key quality attributes:** Functionality, Reliability, Usability, Efficiency, Maintainability and Portability.

S.11 (c)

Software configuration management (SCM) is a set of activities that are designed to control change by identifying the work products that are likely to change, establishing relationships among them, defining mechanisms for managing different versions of these work products, controlling changes that are imposed, and auditing & reporting on the changes that are made.

S.13 (c)

Hence from the given data, we form the following equation,

$$\text{Cost} = 2.8 \times \text{size (KLOC)}$$

Comparing with

$$\text{Cost} = \alpha \times \text{size (KLOC)}^{\beta} + \gamma$$

we get $\alpha = 2.8, \gamma = 0, \beta = 1$.

S.14 (a)

COCOMO represents a comprehensive empirial model for software estimation. So it is assumed that if it can estimate software development costs within **20% of actual costs, 70% of the time**, then the cost estimation using COCOMO is doing fairly well.

S.15 (c)

Here from the given data, we form the following equation,

$\text{Cost} = 3 \times \text{size (KLOC)} + 5$

Comparing it with

$\text{Cost} = 2 \times \text{size (KLOC)} + \gamma$

We get $\alpha = 3, \gamma = 5$

S.16(i) (a)

We know that expected value of S (for LOC) is calculated as

$S = (S_{opt} + 4S_m + S_{pess})/6$

$S = (S_{max} + 4S_{\text{Best Guess}} + S_{min})/6$

$= (20 + 4 \times 30 + 50)/6 = 190/6$

$= \mathbf{31.6\ KLOC}$

S.16(ii) (c)

Using the same formula as used in previous problem, we will first find the expected value of LOC, i.e.

$S = (10 + 4 \times 15 + 25)/6$

$\mathbf{S = 96/6 = 15.8\ KLOC}$

$\therefore$ **Effort required = 15.8/5 = 3.16 pm ≈ 3pm**

S.16(iii) (b)

First we will find the expected value of LOC for both the projects combined

$\therefore S = S_1 + S_2$

$= (15 + 4 \times 20 + 25)/6 + (10 + 4 \times 12 + 14)/6$

$= 120/6 + 72/6 = 20 + 12$

$= 32$ KLOC

$\therefore$ Cost is 20 \$ for 100 LOC

$\therefore$ 200 \$ for 1000 LOC

i.e. 200 \$/KLOC

$\therefore$ Expected cost of subparts 5 and 6

$= 32 \times 200$

$= \mathbf{6400\ \$}$

S.17 (b)

Productivity is calculated by dividing the total delivered source lines by the programmer-days attributed to the project.

Here, productivity = 12 LOC/programmer-day

Delivered source lines = 24000

No. of programmers = 10

Let x be the no. of days required

$\therefore \quad 12 = \dfrac{24000}{10 \times x}$

$\therefore \quad x = \dfrac{24000}{12 \times 10} = 200$ days

$\therefore$ No. of months $= \dfrac{200}{20}$

($\because$ 20 work days for each month)

$= \mathbf{10\ months.}$

S.18 (b)

All the given options are cost estimation techniques. But in **'pricing to win'**, the cost of project depends on customer's capacity to spend whereas in other methods it depends on software functionality of the project.

S.19 (c)

Here from the formula, we can see that γ is independent of the number of KLOC. Hence parameter gamma, γ, **reflects the fixed cost of doing any project.**

S.20(i) (a)

We know that expected value of KLOC(s) is calculated as

$S = (S_{opt} + 4S_m + S_{pess})/6$

$S = (25 + 4 \times 30 + 45)/6$

$S = (25 + 120 + 45)/6$

$S = 190/6$

$\mathbf{S = 31.6}$

S.20 (ii) (b)

The KLOC for the whole project is given by the sum of KLOC of each individual functionality.

$\therefore$ $S_1 = 31.5$ KLOC form previous problem

Similarly,

$S_2 = 35$ KLOC

$S_3 = 20$ KLOC

$S_4 = 22.17$ KLOC

$S_5 = 20$ KLOC

$\therefore$ Total KLOC for the project

$= S_1 + S_2 + S_3 + S_4 + S_5$

$= 31.6 + 35 + 20 + 22.17 + 20$

$= 129.3$ KLOC

$\approx$ **130 KLOC**

S.20(iii) (b)

From the previous question, total KLOC for the project = 130 KLOC

$\therefore$ Total cost $= 130 \times 250$

$=$ **\$32500**

S.20(iv) (b)

Here, cost per KLOC must increase.

Therefore a value of β **greater than one** will increase the cost per KLOC. The value of entire project increases with increase in α, but it does not affect the cost per LOC. **Hence it is independent of α.**

S.21 (d)

Since it is given that in a simple application, $a_b = 2.4$, $b_b = 1.05$

$\therefore$ Effort $= 2.4 \times (25)^{1.05}$

$=$ **70.5 pm**

S.22 (c)

The formula for development time i.e. schedule equation is

$$c_b \times (E)^{d_b}$$

where E is the effort required

Here,

$E = a_b \times (KLOC)^{b_b}$

$a_b = 2.4$, $b_b = 1.05$

$E = 2.4 \times (5)^{1.05}$

$= 13.0$ pm

Now, from table,

$c_b = 2.5$, $d_b = 0.38$

$S = C_b \times (E)^{d_b}$

$= 2.5 \times (13.0)^{0.38}$

$= 6.63 \approx \mathbf{6.6}$

Note: Programmer month is same as persons month.

S.23 (d)

Since the type of project is not given, we cannot find the effort required.

S.24 (b)

An organic project uses the application formula,

Effort $= 2.4 \times (KLOC)^{1.05}$

Development time $= 2.5 \times (Effort)^{0.38}$

$\therefore$ Effort $= 2.4 \times (39.8)^{1.05} = 114.83$

$\approx$ **115 PM**

and Development time $= 2.5 \times (115)^{0.38} = 15.17$

$\approx$ **15 Months**

S.25 (b)

We know that, for COCOMO model,

Effort $= a_b (KLOC)^{b_b}$

Here, since the program is simple application,

$\therefore$ $a_b = 2.4$, $b_b = 1.05$

$\therefore$ Effort $= 2.4\ (5)^{1.05}$

$\approx$ **13.0 PM**

S.26 (b)

The flight control software comes under the category of Embedded mode as it is really complex and requires tight hardware, software and operational constraints.

$\therefore$ Here $a_b = 3.6,\ b_b = 1.2$

$\therefore$ Effort $= 3.6 \times (40)^{1.2}$

$= 301.14\ PM \approx \mathbf{301\ PM}$

S.27 (b)

The given equation is

$$E = 3.6 \times (KLOC)^{1.2}$$

Here

$E = 3.6\ PM$

$\therefore\ 3.6 = 3.6 \times (KLOC)^{1.2}$

$\therefore\ 1 = (KLOC)^{1.2}$

$\therefore\ KLOC = 1$

i.e. size = 1 KLOC

$= \mathbf{1000\ LOC}$

S.28 (c)

In a software project, COCOMO (Constructive Cost Model) is used to estimate effort and cost based on the duration of the software.

S.29 (c)

Availability = [MTTF/MTTF + MTTR]

Given MTBF = 25 days

$$MTTR = 6\ hours = \frac{6}{24}day$$

$$MTBF = MTTF + MTTR$$

$$\Rightarrow \quad MTTF = 25 - \frac{1}{4} = \frac{99}{4}days$$

MTTF = Mean-time-to-failure.

$$\therefore \text{ Availability} = \left[\frac{\frac{99}{4}}{\left(\frac{99}{4}+\frac{1}{4}\right)}\right]$$

$$= \frac{99}{4} \times \frac{4}{100} = 99\%$$

$\therefore$ **Availability = 99%**

S.30 (c)

Case-1:

Availability $A_1 = 90\%$

Mean Time Between failure

$MTBF_1 = 200$ days

Mean Time To Repair $(MTTR_1) = x$

$$MTBF_1 = MTTF_1 + MTTR_1$$

$$200 = MTTF_1 + x$$

$$MTTF_1 = 200 - x$$

$$A_1 = \left[\frac{MTTF_1}{(MTTF_1 + MTTR_1)}\right] \times 100\%$$

$$90 = \left[\frac{200-x}{200-x+x}\right] \times 100$$

$$200 - x = 180$$

$$x = 20$$

$\therefore \quad MTTR_1 = 20$

Case II.

Availability $A_2 = 95\%$

Mean Time To Repair $(MTTR_2) = x + 5$

$= 25$

$$A_2 = \left(\frac{MTTF_2}{MTTF_2 + MTTR_2}\right) \times 100$$

$$95 = \left(\frac{MTTF_2}{MTTF_2 + 25}\right) \times 100$$

$95\ MTTF_2 + 2375 = 100\ MTTF_2$

$5\ MTTF_2 = 2375$

$MTTF_2 = 475$

$\therefore \quad MTBF_2 = MTTF_2 + MTTR_2$

$= 475 + 25$

$= \mathbf{500\ days}$

S.31 (c)

There is no relationship between functionality of C++ code and FORTRAN code.

9.3

PROJECT PLANNING AND MANAGEMENT

LEVEL–1

Q.1 Find the odd man out

Forward engineering, Reengineering, Reverse engineering, Code restructuring

(a) Code engineering

(b) Reverse engineering

(c) Reengineering

(d) Forward engineering

Q.2 What is performed through the entire duration of the project.

(a) Risk monitoring

(b) Risk projection

(c) Risk identification

(d) Risk assessment

Q.3 The earned value of method uses a

(a) Formal Technical Review

(b) Summary Task Planning Sheet (STPS)

(c) RMMM Plan

(d) Salary report of all the team members.

Q.4 If there are n persons in a project, and all need to communicate, then the number of communication paths are

(a) 2n

(b) $2\log_2 n$

(c) $\log_2 n$

(d) None of these

Q.5 Which technique is used for project monitoring and control when faced with several deadline pressure.

(a) Tight control

(b) FAST

(c) Time boxing

(d) Earned value analysis

Q.6 What is the degree to which the design specifications are followed during manufacturing.

(a) Quality assurance

(b) Quality of conformance

(c) Quality of design

(d) None of these

Q.7 Which of the following include activities to gain in sight into product condition the "first time through" each process? (In context with quality costs)

(a) Standardization costs

(b) Failure costs

(c) Appraisal costs

(d) Prevention costs

Q.8 What is defined in statistical term as "the probability of failure-free operation of computer program in a specified environment for a specified time."

(a) Meantime to failure

(b) Fault tolerance

(c) Software reliability

(d) Software availability

Q.9 Which software product metric gives the measure of the average length of words and sentences in documents?

(a) SCI number

(b) Cyclomatic complexity

(c) LOC

(d) Fog index

Q.10 The number of levels in capability maturity model (CMM) is

(a) Depends upon the project

(b) 3

(c) 4

(d) 5

Q.11 SCM activities are developed not to

(a) report changes to others who may have an interest

(b) control change

(c) identify change

(d) none of these

Q.12 'A specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures.'

Which of the following fits the above definition?

(a) SCI

(b) Baselines

(c) Indicators

(d) Metrics

Q.13 Find the odd man out

(a) Decision support system

(b) Business information systems

(c) Management information systems

(d) Transaction processing systems

Q.14 Planning that concentrates on determining a few key areas where a manager feels performance information is vital to the success of the organization is

(a) business systems planning

(b) application

(c) critical success factors

(d) information technology architecture

Q.15 Planning teams simulate the role of information technology in various hypothetical business situation is

(a) change management

(b) end user involvement

(c) scenario approach

(d) planning for competitive advantage

Q.16 The maximum effort distribution in phases of software development is

(a) testing

(b) coding

(c) design phase

(d) requirement analysis

Q.17 The minimum effort distribution in the period of software development is in

(a) testing

(b) coding

(c) design phase

(d) requirement analysis

Q.18 Match the following.

A	B
1. Document restructuring	(a) Reviewed data structures
2. Code restructuring	(b) Updated internal code documentation
3. Data restructuring	(c) Useful and relevant document are developed

(a) 1 – (a), 2 – (b), 3 – (c)

(b) 1 – (c), 2 – (b), 3 – (a)

(c) 1 – (c), 2 – (a), 3 – (b)

(d) 1 – (a), 2 – (c), 3 – (b).

Q.19 Which of the following is not a KPA (Key Performance Area) required for obtaining maturity level 4 (managed)

(a) Process change management

(b) Software quality management

(c) Quantitative process management

(d) Both (a) and (c).

Q.20 What is the probability in a specified length of time.

(a) Tolerance
(b) Fault tolerance
(c) Reliability
(d) Quality Assurance.

Q.21 What is sometimes called a software probe.

(a) Software configuration management
(b) Formal technical review
(c) Baseline creation
(d) Executing a small set of randomly chosen test cases.

Q.22 Assuming the existence of a **start** and **end** nodes for a program graph, the total number of paths is equivalent to the ..... set of test data required to test the software.

(a) minimum
(b) maximum
(c) optimum
(d) supremum

LEVEL–2

Q.23 Match the following

	A		B
	Basic measures		**Description**
1.	Budgeted cost of work (BCW)	a.	The sum of the estimated effort for each work task that was scheduled to be completed by the specified time
2.	Budgeted cost of work scheduled (BCWS)	b	The sum of the estimated efforts for the work tasks that have been completed by the specified time.
3.	Budgeted cost of work performed (BCWP)	c.	The estimated effort for each work task.

(a) 1 – c, 2 – a, 3 – b
(b) 1 – c, 2 – b, 3 – a
(c) 1 – b, 2 – a, 3 – c
(d) 1 – a, 2 – c, 3 – b

Q.24 Match the following:

A		B	
1.	Project risks	a.	Maintenance problems
2.	Technical risks	b.	Requirement problems
3.	Business risks	c.	Losing budgetary or personnel commitment

(a) 1 → b, 2 → a, 3 → c
(b) 1 → a, 2 → c, 3 → b
(c) 1 → c, 2 → b, 3 → a
(d) none of these

Q.25 Which of the following is the complete and correct list of the software risk components?

(a) Project risks, Technical risks, Business risks
(b) Performance risk, Cost risk, Support risk, Schedules risk
(c) Performance risk, Cost risk, Support risk, Schedule risk
(d) Performance risk, Cost risk, Technical risk, Project risk

Q.26 Total duration of the project in calendar months can be estimated by

(a) $M = 4.1\ E^{0.36}$
(b) $M = 2.5\ E^{1.36}$
(c) $M = 4.1\ E^{1.36}$
(d) None of these

Q.27 What is a measure of the number functions that call some other functions (say X) and what is the number of functions which are called by function X.

(a) Cohesion, coupling
(b) Fan-out, Fan-in
(c) Reference index, net procedure calls
(d) None of these

Q.28 Find the odd man out

Software configuration management, software quality assurance, software project planning, process change management.

[Hint : Identify w.r.t. KPA's of the maturity level]

(a) Process change management

(b) Software project planning

(c) Software quality assurance

(d) Software configuration management

Q.29 Match the following:

1.	Identification	a.	Helps to ensure that the change has been properly implemented.
2.	Version	b.	Manages different version of configuration objects.
3.	Configuration audit	c.	Naming each software configuration item.
		d.	Takes final decision on the status and priority of change.

(a) 1 – b, 2 – d, 3 – a

(b) 1 – c, 2 – d, 3 – a

(c) 1 – c, 2 – b, 3 – a

(d) 1 – c, 2 – b, 3 – d

Q.30 Risk mitigation is a which type of activity and risk monitoring is a which type of activity.

(a) Problem Reduction, project tracking

(b) Problem solving, project tracking

(c) Project tracking, problem avoidance

(d) Problem Reduction, problem solving.

Q.31 What is the set of tasks that determines the shortest possible completion time.

(a) Basic cut off

(b) Gantt chart

(c) Critical path

(d) Minimal check list.

Q.32 Arrange the following in descending order of number of communication paths.

I. Democratic teams,

II. Chief programmer teams

III. Controlled Decentralized team.

(a) I, II, III

(b) II, I, III

(c) III, II, I

(d) I, III, II.

Q.33 What is the quality standard that applies to software engineering

(a) ISO 9000

(b) ISO 9001

(c) Both (a) & (b)

(d) None of these.

Q.34 Assuming that the tests are representative of the operational situation, calculate the reliability of a software system that has 10 errors in 200 cases.

(a) 0.95

(b) 0.25

(c) 0.05

(d) None of these.

Common data for Q.35 to Q.39

In a particular program, it is found that 1% of the code accounts for 50% of the execution time. To code the program in FORTRAN, it takes 100 man-days. Coding in assembly language is 10 times harder than coding in FORTRAN, but runs 5 times faster. Converting an existing FORTRAN program to an assembly language program is 4 times harder.

Q.35 To completely write the program in FORTRAN and rewrite the 1% code in assembly language, if a project team needs 13 days, the team consists of

(a) 13 programmers

(b) 10 programmers

(c) 8 programmers

(d) 100/13 programmers

Q.36 If 99% of the program is written in FORTRAN and the remaining 1% in assembly language, the percentage increase in the programming time compared to writing the entire program in FORTRAN and rewriting the 1% in assembly language is

(a) 10

(b) 5

(c) 13

(d) 8

Q.37 If the entire program is written in FORTRAN, the percentage increase in the execution time, compared to writing the entire program in FORTRAN and rewriting the 1% in assembly language is

(a) 0.9

(b) 8

(c) 0.8

(d) 9

Q.38 If 99% of the program is written in FORTRAN and the remaining 1% in assembly language, the percentage increase in the execution time, compared to writing the entire program in FORTRAN and rewriting the 1% in assembly language is

(a) 0.9

(b) 1

(c) 0.1

(d) 0

Q.39 If a weightage of 3 is given to the programmers effort and a weightage of 2 is given to the execution time, then coding 99% in FORTRAN and the 1% in assembly language performs better than coding in FORTRAN completely and rewriting the 1% in assembly language by a factor of about

(a) 1.5

(b) 1.2

(c) 1.1

(d) it does not perform better

Q.40 In unit testing of a module, it is found that for a set of test data, at the maximum 90% of the code alone were tested with the probability of success 0.9. The reliability of the module is

(a) greater than 0.9

(b) equal to 0.9

(c) at most 0.81

(d) at least 1/0.81

LEVEL–3

Q.41 Using the following time log to answer the questions

Day	Start	Stop	Interruptions	Task
Day 1	8.30	16.30	60 min for lunch	Module 1 coding
Day 2	9.00	17.00	30 min for lunch	Module 1 coding
Day 3	9.00	17.30	30 min for lunch 60 min for meeting	Module 2 coding
Day 4	7.30	12.00		Module 2 coding

Assume that Module 1 was 120 LOC and Module 2 was 80 LOC. Also take one programmer day as 400 minutes.

i) The programmer's productivity in LOC/day for Module 1 is

(a) Cannot be determined

(b) 65 LOC/programmer–day

(c) 60 LOC/programmer–day

(d) 55 LOC/programmer–day

ii) The productivity in LOC/day for module 2 is

(a) 63 LOC/programmer day

(b) 60 LOC/programmer day

(c) 55 LOC/programmer day

(d) 46 LOC/programmer day

iii) Find the average productivity of both the module combined.

(a) 61 LOC/programmer day

(b) 57 LOC/programmer day

(c) 51 LOC/programmer day

(d) 46 LOC/programmer day

Q.42 Find the overall risk exposure, RE, if the probability of occurrence of risk is 80% and the cost to the project should the risk occur can be taken as $20000.

(a) $250

(b) $1600

(c) $16000

(d) $2500.

Q.43 If an error happens every 2 days, what is the probability that the system will not fail for 4 days?

(a) 0.5

(b) 0.25

(c) 0.375

(d) 0.0625.

GATE QUESTIONS

Q.44 A software configuration management tool helps in [IT–GATE 2004]

[1–Mark]

(a) keeping track of the schedule based on the milestones reached

(b) maintaining different versions of the configurable items

(c) managing manpower distribution by changing the project structure

(d) all of the above

Q.45 Assume that the delivered lines of code L of a software is related to the effort E in person months and duration t in calendar months by the relation $LP*(E/B)^{1/3}*t^{4/3}$, where P and B are two constants for the software process and skills factor. For a software project, the effort was estimated to be 20 person months and the duration was estimated to be 8 months. However, the customer asked the project team to complete the software project in 4 months. What would be the required effort in person months?

[IT-GATE 2004]

(a) 10

(b) 40

(c) 160

(d) 320

Q.46 A software organization has been assessed to SEI CMM Level 4. Which of the following does the organization need to practice beside Process Change Management and Technology Change Management in order to achieveLevel 5?

[IT-GATE 2004]

[1 Mark]

(a) Defect Detection

(b) Defect Prevention

(c) Defect Isolation

(d) Defect Propagation

Q.47 A software project involves execution of 5 tasks T1, T2, T3, T4 and T5 of duraiion 10, 15, 18, 30 and 40 days, respectively. T2 and T4 can start only after T1 completes. T3 can start after T2 completes. T5 can start only after both T3 and T4 complete. What is the slack time of the task T3 in days?

[IT-GATE 2004]

[2-Marks]

(a) 0

(b) 3

(c) 18

(d) 30

ANSWER KEY

1	c	2	a	3	b	4	d	5	c
6	c	7	c	8	c	9	d	10	d
11	d	12	b	13	b	14	c	15	c
16	a	17	d	18	b	19	a	20	c
21	d	22	a	23	a	24	a	25	b
26	a	27	d	28	a	29	c	30	a
31	c	32	d	33	b	34	a	35	c
36	b	37	c	38	d	39	d	40	c
41(i)	d	41(ii)	d	41(iii)	c	42	c	43	d
44	b	45	d	46	b	47	b		

SOLUTIONS

S.1 (c)

Forward engineering, reverse engineering and code restructuring are activities presented in the reengineering process.

S.2 (a)

Risk monitoring is the activity of monitoring the status of various risks and their control activities. Like project monitoring, it is performed through the entire duration of the project.

S.3 (b)

An effective method of monitoring the progress of a project (particularly the phases of teh system design) is the earned value method.

The earned value method uses a **Summary Task Planning Sheet (STPS).** The STPS is essentially a Gantt chart, with each task having an entry in the chart.

S.4 (d)

If there are n persons and all need to communicate, then there are **n^2 communication paths.**

S.5 (c)

When faced with severe deadline pressure, experienced project managers use a monitoring and control technique called **'time boxing'**.

S.6 (c)

Quality of design: It is the quality which the producer of supplier is intending so offer to the customer. It is usually indicated by completeness and correctness of specifications during manufacturing.

Quality of conformance: It is the quality of product actually produced and delivered through the production or service process of the organization as per specifications or design.

S.7 (c)

Quality costs may be divided into costs associated with prevention, appraisal, and failure. **Appraisal costs** include activities to gain insight into product condition the "first time through" each process. Examples of appraisal costs include

- in-process and inter-process inspection
- equipment calibration and maintenance
- testing

S.9 (d)

Fog index is the measure of the average length of words and sentences in documents. The higher the value for the Fog index, the more difficult the document may be to understand.

S.10 (d)

The **five** levels of CMM are:

Level 1 : Initial

Level 2 : Repeatable

Level 3 : Defined

Level 4 : Managed

Level 5 : Optimizing

S.11 (d)

SCM (Software configuration management) activities are developed to

i) identify change

ii) control change

iii) ensure that change is being properly implemented

iv) report changes to others who may have an interest

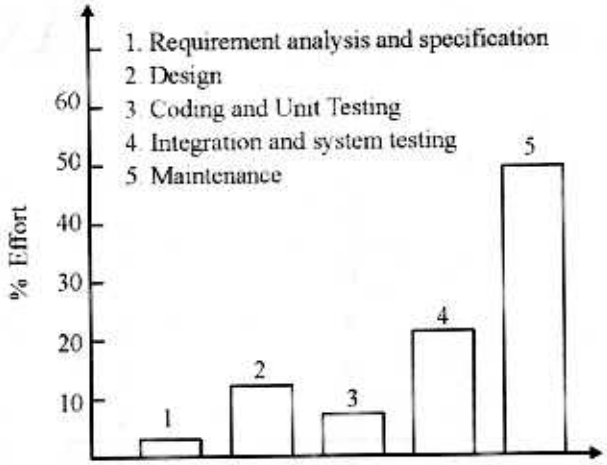
S.13 (b)

(a), (c) and (d) are types of business information systems.

S.14 (c)

The critical success factors (CSF) approach for information systems planning is based on the premise that the information requirements of an organization should be determined by its critical success factors i.e., a small key factors that manager consider vital critical to the success of the enterprise.

S.16 (a)



By observing the graph the maintenance phase normally requires the maximum effort. However, almong the development phases, the integration and system testing requires the max. effort.

S.19 (a)

Process change management is the key process area (KPA) which is considered or required for maturity level 5 (optimizing).

S.20 (c)

Reliability is the probability of not failing in a specified length of time. This is usually denoted by R(n), where n is the number of time units. If the time unit is days, then R(1) is the probability of not failing in 1 day.

S.26 (a)

The 18 M federal systems division found that the total duration, M in calender months can be estimated by $\mathbf{M = 4.1\ E^{0.36}}$

S.27 (d)

Fan-in and Fan-out are software product metrics. Fan-in is a measure of the number of functions that call some other function. Fan-out is the number of functions which are called by a function. A high value of fan-in means that X is tightly coupled to the rest of the design and changes to X will have extensive knock-on effects. A high value for fan-out suggests that the overall complexity of X might be high because of the complexity of the control logic needed to coordinate the called components. **Hence correct answer is Fan-in, Fan-out and not Fan-out, Fan-in.**

S.28 (a)

Option (b), (c) and (d) are KPAs defined across project maturity level 2. Whereas option (a) is KPA defined across project maturity level 5.

S.31 (c)

The **critical path** is the set of tasks, that determines the shortest possible completion time. The completion time will be longer if there are insufficient resources to do all the parallel activities. However, the completion time can never be made shorter by adding more resources.

S.32 (d)

In **democratic team**, the goal of the group are set by consensus, and input from every member is taken for major decisions. **This structure results in many communication paths**

The **chief programmer team,** in contrast to democratic teams, has a hierarchy. Here, the chief programmer is responsible for all major technical decisions of the project. **This structure, considerably reduces interpersonal communication.**

Controlled decentralized team tries to combine the strengths of the democratic and chief programmer teams. It consists of a project leader who has a group of senior programmers under him, while under each senior programmer is a group of junior programmers. **No. of communication paths here is less than that of democratic teams but more than that of chief programmer teams.**

S.33 (b)

ISO 9001 is the quality assurance standard that applies to software engineering. The standard contains 20 requirements that must be present for an effective quality assurance system.

ISO 9000 describes quality assurance elements in generic terms that can be applied to any business regardless of the products or services offered.

S.34 (a)

$F(1) = 10/200 = 0.05$

$\therefore \quad R(1) = 1 - 0.05 = 0.95$

(Here we are calculating reliability w.r.t. test cases instead of days)

i.e. $R(1) \Rightarrow$ Not failing for one test case)

S.35 (c)

Writing the whole program in FORTRAN takes 100 man-days. Rewriting the 1% code in assembly language takes 1% of 100 ×4 man-days (as converting in assembly is 4 times harder) = 4 man-days. Altogether 104 man-days. If it is completed in 13 days, 104/13 = **8 men** should be involved.

S.36 (b)

The first case takes 99 + 10 = 109 man-days. The second case takes 100 + 4 = 104 man-days. The required percentage is (109 – 104) × 100/100 = **5.**

S.37 (c)

Let the first case takes 100 units of time to execute. The second case will take 99 + (1/5) units of time, as coding the 1% in assembly language will take 1/5 units of time. Hence the required percentage is 0.8 × 100/100 = **0.8.**

S.38 (d)

In both the case, the final program will have the same 99% of the code in FORTRAN and the remaining 1% in assembly language. **Hence the execution time will remain the same.**

S.40 (c)

Since only 90% code alone is tested and that too with 90% of success, the reliability will be at most 0.81. It may increase or decrease if some more set of test data is given for testing the rest of the code. However, now the reliability is **0.81** only.

S.41(i)(d)

Time taken on day 1 = 8 hours – 1 hours = 7 hours = 420 min.

Time taken on day 2 = 8 hours – 0.5 hours = 7.5 hours = 450 min

∴ Total time taken for Module 1 is = 420 + 450 = 870 min

Now 400 minutes imply one programmer day

∴ 870 minutes imply 2.175 programmer-day.

$$\text{Productivity} = \frac{\text{Size of project}}{\text{No. of programmer day}} = \frac{120}{2.175}$$

$$= 55.172$$

$$\approx \textbf{55 LOC/programmer-day}$$

S.41(ii) (d)

Proceeding similarly as previous problem, we get total time taken for project 2 = 690 minutes

∴ No. of programmer days = 690/400 = 1.725 days

$$\text{Productivity} = \frac{\text{Size of project}}{\text{No. of programmer day}} = \frac{80}{1.725}$$

$$= 46.4 \text{ LOC/programmer day}$$

$$\approx \textbf{46 LOC/programmer day}$$

S.41(iii) (c)

Total programmer day for both the modules combined

= 2.175 + 1.725

= 3.9 days

Total size = 120 + 80 = 200 LOC

∴ Average productivity = 200/3.9 = 51.3 LOC/ programmer day

$$\approx \textbf{51 LOC/programmer day}$$

S.42 (c)

The overall risk exposure (RE), is determined using the following relationship,

$$RE = P \times C$$

Where P is the probability of occurrence for a risk and C is the project should the risk occur.

∴ RE = 80% × $20,000

= **$16000**

S.43 (d)

Reliability is the probability that not failing in a specified length of time. This is usually denoted by R(n), where n is the number of time units. If the time unit is days, then R(1) is the probability of not failing in 1 day. If we know R(1), then the probability that we can execute for n days without failure is

$$R(n) = R(1)^n$$

Here, an error happens every two days.

∴ F(1) = 0.5

∴ R(1) = 1 – F(1) = 1 – 0.5 = 0.5

∴ $R(4) = R(1)^4 = (0.5)^4 = 0.0625$

So, the probability that the system will not fail for 4 days is 0.0625.

S.44 (b)

Software configuration management tool help in maintaining different versions of configuration items.

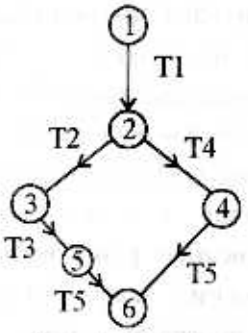
S.46 (b)

Defect Prevention

S.47 (b)

Slack Time - Indicates that the corresponding activity may consume more than its estimated time or start later than the earliest possible start time, without affecting the total duration of the project.

Flow graph of the tasks is



Slack time= Latest start time- earliest start time

= latest finish time – Earliest finist time

= 18 – 15

Slack time = 3 days.

SOFTWARE DESIGN

9.4

LEVEL–1

Q.1 A class in a design is said to be cohesive if

(a) all the attributes in the class not necessarily used by every method.

(b) all the attributes in the class are used by atleast one method.

(c) all the attributes in the class are used by every method.

(d) none of these

Q.2 In which type of coupling, is a portion of a data structure (rather than simple arguments) is passed in a module interface.

(a) Flag coupling

(b) Module coupling

(c) Stamp coupling

(d) Data coupling

Q.3 _____ address different aspects of the design model and is completed as the designer refines his representation of the software.

(a) Installation manual

(b) System specification

(c) Software requirements specification

(d) Design specification

Q.4 _____ of a relationship is _____ if there is no explicit need for the relationship to occur or the relationship is optional.

(a) Modality, 1

(b) Modality, 0

(c) Cardinality, many

(d) Cardinality, one

Q.5 Which design defines the relationship between major structural elements of the software and which design transforms structural elements of the software architecture into a procedural description of software components.

(a) architectural design, component level design

(b) interface design, data design

(c) architectural design, data design

(d) data design, component level design

Q.6 A system design aid should primarily

(a) help in graphical user interface

(b) generate code

(c) help in documentation

(d) help analyzing both data and activities

Q.7 Problem analysis is done during

(a) before system testing

(b) systems analysis phase

(c) system design phase

(d) all of these

Q.8 Which of the following is a tool in design phase?

(a) Information hiding

(b) Refinement

(c) Abstraction

(d) All of these

Q.9 In object oriented design of software:

(a) classes are always different

(b) classes are defined based on the attributes of objects

(c) objects inherit the properties of the class

(d) all of these

Q.10 Vertical partitioning is also called as

(a) factoring

(b) structured partitioning

(c) data transformation

(d) modulation designing

Q.11 What defines a collection of entities that have the same attributes

(a) Relationship set

(b) Records

(c) Entity type

(d) Domain.

Q.12 Find the odd man out

Entity relation diagram, Data flow diagram, Context diagram, State transition diagram.

(a) Context diagram

(b) Data flow diagram

(c) Entity relation diagram

(d) State transition diagram.

Q.13 In E-R diagram, multi-valued attributes are represented by

(a) double oval

(b) a dashed oval

(c) oval with a underlined attribute name

(d) simple ovals by decomposing the multi-valued attribute.

Q.14 According to Brooks, if n is the number of programmers in a project team then the number of communication paths is

(a) $n(n-1)/2$

(b) $n \log n$

(c) n

(d) $n(n+1)/2$

LEVEL–2

Q.15 Match the following:

1.	Coupling	a.	Strength of relations within a module
2.	Span of control	b.	Number of instructions composing a module
3.	Size	c.	Number of modules subordinate to calling module
		d.	The strength of relation between modules

(a) 1 – d, 2 – c, 3 – b

(b) 1 – d, 2 – b, 3 – c

(c) 1 – a, 2 – c, 3 – b

(d) None of these

Q.16 Which of the following forms a pair of complementary concepts?

(a) Cohesion, Coupling

(b) Modularity, Functional independence

(c) Abstraction, Refinement

(d) Both (a) & (c)

Q.17 Match the following user interface design principles in column A to the corresponding meaning in column B.

	A		B
1.	Consistency	a.	Comparable actions have comparable effects
2.	Minimal surprise	b.	The underlying implementation of the files and data structures should be hidden from user
3.	User familiarity	c.	Command punctuation should be similar

(a) 1 – c, 2 – a, 3 – b

(b) 1 – b, 2 – a, 3 – c

(c) 1 – c, 2 – b, 3 – a

(d) 1 – a, 2 – c, 3 – b

Q.18 Match the following:

1. Public	a.	Declarations that are accessible from outside the class anyone who can access an object of this class.
2. Protected	b.	Declaration that are accessible only from within the class.
3. Private	c.	Declarations that are accessible from within the class itself and from within subclasses.

(a) 1 – b, 2 – a, 3 – c

(b) 1 – a, 2 – c, 3 – b

(c) 1 – b, 2 – c, 3 – a

(d) 1 – a, 2 – b, 3 – c

Q.19 What is(are) the difference(s) between Decision Tables and Decision-Trees?

(a) Stages in software engineering process at which they are developed.

(b) Form of representation.

(c) One shows the logic while the other shows the process.

(d) All of the above.

Q.20 What can be used to specify the processing details implied by a bubble within a DFD.

(a) Data directory

(b) State transition diagram

(c) Process specification (PSPEC)

(d) Context model.

Q.21 In hash addressing the following hash function is used h(x) = x mod 5

If the hash function gives the bucket number then which of the following scalar elements (x) will be in bucket 2.

Note : Buckets are numbered from 0 to 4. Mod gives the remainder after integer division. The scaler elements are 5, 12, 17, 19, 21, 23, 32, 40 and 44

(a) 12, 32, 33

(b) 12, 17, 32

(c) 12, 17

(d) 12, 32

Q.22 Let M be a node that represents a if-then-else node in a Program Graph. Let the number of paths from its if part to the end node is y, and from the else part to the end nodes is z. If the number of paths from the start node to the node M is x , then the total number of paths through M is

(a) xy + z

(b) xz + y

(c) x + y + z

(d) x(y + z)

Q.23 According to PUTNAM, project effort is inversely proportional to the fourth power of development time, Doubling the development schedule for a 100 Person-Month(PM) project would reduce the project effort to

(a) 50 PM

(b) 7.16 PM

(c) 25 PM

(d) 6.25 PM

Q.24 To increase reliability, fault tolerance is included in the system in the form of multiple modules. If the problem can be solved by 5 different modules, each with probability of success 0.7, the probability that it can be solved even if 4 modules fail is approximately

(a) 0.3

(b) 0.03

(c) 0.49

(d) 0.05

GATE QUESTIONS

Q.25 Consider the following entity relationship diagram (ERD), where two entities E_1 and E_2 have a relation R of cardinality 1 : m.

The attributes of E_1 are A_{11}, A_{12} and A_{13} where A_{11} is the key attribute. The attributes of E_2, A_{21}, A_{22} and A_{23} where A_{21} is the key attribute and A_{23} is a multi valued attribute. Relation R does not have any attribute. A relational database containing minimum number of tables with each table satisfying the requirements of the third normal form (3NF) is designed from the above ERD. The number of tables in the database is

[IT-GATE 2004]

[2–Marks]

(a) 2

(b) 3

(c) 5

(d) 4

Q.26 Consider the entities 'hotel room', and 'person' with a many to many relationship 'lodging' as shown below:

If we wish to store information about the rent payment to be made by person(s) occupying different hotel rooms, then this information should appear as an attribute of

[IT-GATE 2005]

[1–Mark]

(a) Person

(b) Hotel room

(c) Lodging

(d) None of these

Q.27 The coupling between different modules of a software is categorized as follows:

I. Content coupling II. Common coupling

III. Control coupling IV Stamp coupling

V. Data coupling

Coupling between modules can be ranked in the order of strongest (least desirable) to weakest (most desirable) as follows: **[GATE 2009]**

[1–Mark]

(a) I – II – III – IV – V

(b) V – IV – III – II –I

(c) I – III – V – II – IV

(d) IV – II – V – III – I

ANSWER KEY

1	c	2	c	3	d	4	b	5	a
6	d	7	b	8	d	9	d	10	a
11	c	12	a	13	a	14	a	15	a
16	d	17	a	18	b	19	b	20	c
21	b	22	d	23	d	24	b	25	b
26	c	27	a						

SOLUTIONS

S.4 **Modality of a relationship is 0** if there is no explicit need for the relationship to occur or the relationship is optional. The modality is 1 if an occurrence of the relationship is mandatory.

S.12 Data Flow diagram, E-R diagram, S-T diagram are the notations used to conduct data modeling activity.

Whereas context diagram is actually a level 0 DFD.

S.16 **Abstraction & refinement are complementary concepts**. Abstraction enables a designer to specify procedure and data and yet suppress low-level details. Refinement helps the designer to reveal low-level details as design progress. Both concepts aid the designer in creating a complete design model as the design evolves.

Cohesion and coupling can also be considered as complementary to each other. Cohesion is a measure of the relative functional strength of a module. Coupling is a measure of the relative interdependence among modules. Using these two criteria, functional independence can be measured.

S.19 Both decision tables and decision trees provide the same information. Only the way of representation is different.

S.20 A data flow diagram (DFD) is a graphical representation that depicts information flow and the transforms that are applied as data move from input to output.

DFD graphical notation must be augmented with descriptive test. **A process specification (PSPEC) can be used to specify the processing details implied by a bubble within a DFD**. The process specification describes the input to a function, the algorithm that is applied to transform the input, and the output that is produced.

S.21 **(b)**

Bucket 2 will contain all the elements (x's) that give remainder 2 when divided by 5. **Numbers 12, 17 and 32** give remainder 2 when divided by 5.

S.22 **(d)**

There are x number of paths from the root node to the node M. Since the node M represents a if-then-else statement, it can take either true case or false. **So the total number of paths will be x(y + z).**

S.23 **(d)**

Doubling the developing time reduces the project effort by a factor of $2^4 = 16$. **So, the project effort will be 100/16 = 6.25 PM.**

S.24 **(b)**

Using binomial distribution, it is ${}^{n}c_x p^x q^{n-x}$. Here $n = 5$, $x = 1$, $p = 0.7$ and $q = 1 - p = 0.3$.

So, probability of solution is $= {}^{n}c_x p^x q^{n-x}$

$$= {}^{5}c_1 (0.7)^1 (1 - p)^{5-1}$$

$$= {}^{5}c_1 \times 0.7 \times (0.3)^4$$

$$= 0.02835$$

$$\approx \mathbf{0.03}$$

S.25 **(b)**

One for E_1

One for E_2

and one for multivalued attribute

S.26 **(c)**

The relation Lodging contains the combine information, about person and respective Hostel rooms.

So to store information about the rent payment person occupying an hotel room should appear as an attribute of lodging.

S.27 (a)

Correct order is

Content coupling

Common coupling

Control coupling

Stamp coupling

Data coupling

9.5 SOFTWARE TESTING

LEVEL–1

Q.1 White box testing is sometimes also called as
(a) glass-box testing
(b) beta testing
(c) alpha testing
(d) black-box testing

Q.2 Equivalence partitioning is a testing method that divides what into classes of data from which test cases can be derived.
(a) The internal constructs of a program
(b) The output domain of a program
(c) The input domain of a program
(d) None of these

Q.3 What is not testing but always occurs as the consequence of testing.
(a) Configuration review
(b) Debugging
(c) Verification
(d) Validation

Q.4 Boundary values analysis is a test case design technique that compliments
(a) Equivalence partitioning
(b) Black-box testing
(c) White-box testing
(d) Unit testing

Q.5 Black-box testing also called behavioral testing, focuses on
(a) the data flow among the modules
(b) the unstructured loops
(c) the functional requirements of the software
(d) the internal constructs of the program

Q.6 Internal programming logic is exercised using which type of testing.
(a) beta testing
(b) alpha testing
(c) black-box testing
(d) white-box testing

Q.7 What is the probability of finding an error for a good test.
(a) zero
(b) low
(c) high
(d) none of these

Q.8 In equivalence partitioning testing method, if an input condition specifies a range, which number is valid and which number is invalid equivalence classes are defined.
(a) 0, 3
(b) 1, 2
(c) 2, 1
(d) 3, 0

Q.9 Which type of testing is the re-execution of some subject of test of that have already been conducted to ensure that changes have not propagated unintended side effects.

(a) Validation testing
(b) Black-box testing
(c) Regression testing
(d) Integration testing

Q.10 The black-box concept

(a) is invoked by describing a system in terms of inputs and outputs, leaving the transformation process a black box
(b) assumes that inputs and outputs will remain stable
(c) assumes that the black box is independent
(d) all of these

Q.11 Sequential or series testing is

(a) testing changes made in an existing or a new program
(b) is checking the logic of one or more programs in the candidate system
(c) making sure that the new programs do in fact process certain transactions according to specification
(d) running the system with line data by the actual user

Q.12 Unit testing is

(a) testing changes made in an existing or a new program
(b) is checking the logic of one or more programs in the candidate system
(c) making sure that the new programs do in fact process certain transactions according to specification
(d) running the system with line data by the actual user

Q.13 The advantage of better testing in software development is in

(a) iterative
(b) prototyping
(c) waterfall model
(d) all of these

Q.14 Acceptance testing is

(a) making sure that the new programs do in fact process certain transactions according to specifications
(b) running the system with line data by the actual user
(c) is checking the logic of one or more programs in the candidate systems
(d) testing change made in an existing or a new program.

Q.15 Top-down design does not require

(a) stepwise refinement
(b) flow charting
(c) loop invariants
(d) modularity.

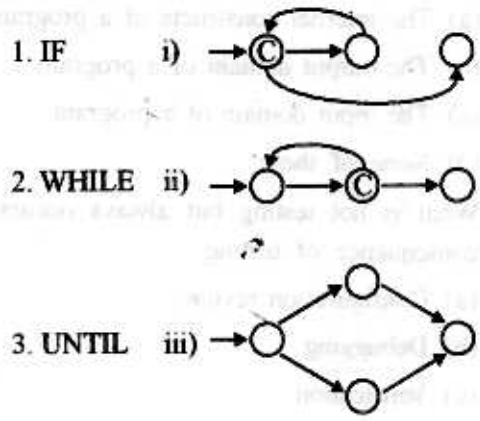
Q.16 Design phase will usually be

(a) random
(b) centrifuging
(c) top-down
(d) bottom-up.

LEVEL-2

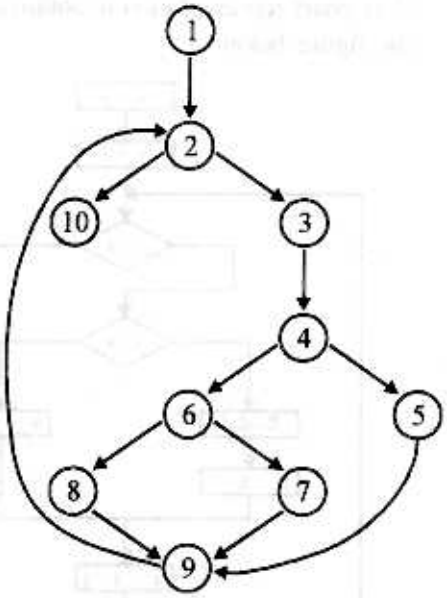
Q.17 Match the following

1. IF i)
2. WHILE ii)
3. UNTIL iii)



(a) 1 – (i), 2 – (iii), 3 – (ii)
(b) 1 – (iii), 2 – (ii), 3 – (i)
(c) 1 – (iii), 2 – (i), 3 – (ii)
(d) 1 – (ii), 2 – (i), 3 – (iii)

Q.18 Consider the flow graph given below:



i) The cyclomatic complexity number for the given flowgraph is:

(a) 6

(b) 5

(c) 4

(d) None of these

ii) Which paths constitute a basis set for the given flowgraph.

I) Path : 1 – 2 – 10

II) Path : 1 – 2 – 3 – 4 – 6 – 8 – 9 – 2 ...

III) Path : 1 – 2 – 3 – 4 – 6 – 8

IV) Path : 1 – 2 – 3 – 4 – 6 – 7 – 9 – 2 ...

V) Path : 1 – 2 – 3 – 4 – 5 – 9 – 2 ...

(a) I, IV, V

(b) I, II, IV, V

(c) I, II, IV

(d) I, V, III, IV

Q.19 'Exhaustive testing' is the execution of every possible test case. If a program has two integer inputs, then how many different test cases are possible on a 32 bit word m/c if we have to perform exhaustive testing.

(a) 4^{64}

(b) $2.(2)^{32}$

(c) 4^{32}

(d) 2^{32}

Q.20 Match the documents from group A with the corresponding phase in the software life cycle from group B.

A		B
1.	Test plan	a. Requirement phase
2.	Cost estimate	b. Testing phase
3.	Test report	c. Project planning phase
		d. Design phase

(a) 1 – a, 2 – c, 3 – b

(b) 1 – c, 2 – d, 3 – b

(c) 1 – b, 2 – d, 3 – a

(d) 1 – b, 2 – c, 3 – a

Q.21 A program P calls two subprograms P_1 and P_2. P_1 can fail 50% times and P_2 can fail 40% times. Then, P can fail

(a) 70%

(b) 60%

(c) 10%

(d) 50%

Q.22 In testing phase, the effort distribution is

(a) 50%

(b) 40%

(c) 20%

(d) 10%

Q.23 What are commonly used to predict the performances of an unknown system on a known, or atleast well-defined, task or workload

(a) Benchmarks

(b) Test cases

(c) Programmers

(d) Beta testing methods.

Q.24 Errors may be found by "outsiders" during

(a) alpha testing

(b) white box testing

(c) beta testing

(d) both (a) and (b).

Q.25 The two phases in documentation testing are

(a) task testing, behavioral testing

(b) review and inspection, live test

(c) alpha testing, beta testing

(d) benchmark testing, quality testing.

GATE QUESTIONS

Q.26 Consider the following program module:

```
int module1 (int x, int y)
while (x! = y) {
if (x > y)
        x = x – y;
else {  y = y – x;
} return x;
}
```

What is Cyclomatic complexity of the above module?

[IT-GATE 2004]

[2–Marks]

(a) 1

(b) 2

(c) 3

(d) 4

Q.27 A software was tested using the error seeding strategy in which 20 errors were seeded in the code. When the code was tested using the complete test suite, 16 of the seeded errors were detected. The same test suite also detected 200 non- seeded errors. What is the estimated number of undetected errors in the code after this testing?

[IT-GATE 2004]

[2–Marks]

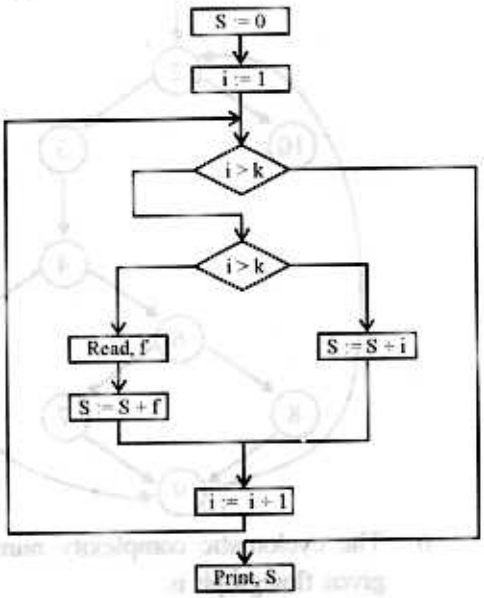
(a) 4

(b) 50

(c) 200

(d) 250

Q.28 To carry out white box testing of a program, in flow chart representation is obtained as shown in the figure below:



For basis path based testing of this program, its cyclomatic complexity is **[IT-GATE 2005]**

[2–Marks]

(a) 5

(b) 4

(c) 3

(d) 2

Q.29 Consider the following statements about the cyclomatic complexity of the control flow graph of a program module. Which of these are TRUE? **[GATE 2009]**

[2–Marks]

I. The cyclomatic complexity of a module is equal to the maximum number of linearly independent circuits in the graph.

II. The cyclomatic complexity of a module is the number of decisions in the module plus one, where a decision is effectively any conditional statement in the module.

III. The cyclomatic complexity can also be used as a number of linearly independent paths that should be tested during path coverage testing.

(a) I and II

(b) II and III

(c) I and III

(d) I, II and III

ANSWER KEY

1	a	2	c	3	b	4	a	5	c
6	d	7	c	8	b	9	c	10	d
11	b	12	a	13	a	14	b	15	c
16	c	17	c	18(i)	c	18(ii)	b	19	c
20	b	21	a	22	a	23	a	24	c
25	b	26	c	27	b	28	c	29	d

SOLUTIONS

S.1 (a)

White-box testing, sometimes called **glass-box testing**, is a test case design method that uses the control structure of the procedural design to derive test cases.

S.2 (c)

Equivalence partitioning is a black box testing method that divides the **input domain of a program** into classes of data from which test cases can be derived.

S.3 (b)

Debugging occurs as a consequence of successful testing. That is, when a test case uncovers an error, debugging is the process that results in the removal of the error.

S.4 (a)

Having determined the **partitions** of possible inputs the method of boundary value analysis has to be applied to select the most effective test cases out of these partitions.

S.5 (c)

Black-box testing enables the software engineer to derive sets of input conditions that will fully exercise **all functional requirements** for a program.

S.6 (d)

Internal programming logic is exercised using **'white-box'** testing that uses the control structure of the procedural design to derive test cases.

S.7 (c)

Testing is a process of executing a program with the intent of finding an error. A good test case is one that has a **high probability** of finding an as-yet undiscovered error.

S.8 (b)

In equivalence partitioning, equivalence classes are defined according to some guideline. For a range in input condition, **one valid and two invalid equivalence classes are defined**.

S.9 (c)

Whenever software is corrected, some aspect of the software configuration is changed. **Regression testing** is the activity that helps to ensure that change do not introduce unintended behaviour or additional errors.

S.17 (c)

These are the symbols used in construction of flow graph for the corresponding loop construct.

S.18 (c)

i) Cyclomatic complexity= Edges – Nodes + 2
= 12 – 10 + 2 = **4**

S.18 (b)

ii) In terms of flow graph, an independent path must move along at least one edge that has not been traversed before the path is defined. Basis set is a set of independent paths such that, if tests can be designed to force executing of these paths, every statement in the program will have been guaranteed to be executed at least one time. Here, **paths I, II, IV and V forms a basis set**.

S.19 (c)

Each 32 bit integer has 2^{32} possible values. Thus, a program with two integer inputs would have $2^{32} \times 2^{32}$ possible inputs.

$\therefore$ **No. of test case** $= 2^{64} = ((2)^2)^{32} = 4^{32}$

S.21 (a)

Here, failing due to P1 is 50%

i.e. (1 – 0.5)

& due to P2 is 40%

i.e. (1 – 0.4)

Hence, combined effect of both P1 & P2 on programme P is

$= 1 - (1 - 0.5)(1 - 0.4)$

$= 0.7$

So, probability of program P can fail is 70%.

S.23 (a)

A **benchmark** is a test that measures the performance of a system or subsystem on a well defined task or workload.

S.24 (c)

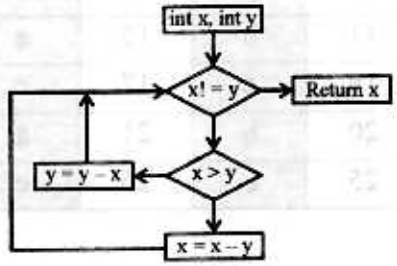
Alpha test is conducted as the developer's site by customer. Therefore, an outsider cannot use the system. But **in beta testing, test is conducted at customer's sites**. That is, beta test is a live application of the software in an environment that cannot be controlled by the developer.

S.25 (b)

Documentation testing can be approached in two phases. The first phase, **review and inspection**, examines the document or editorial clarity. The second phase, **live test**, uses the documentation in conjunction with the use of the actual program.

S.26 (c)

Making flow-chart –



Here, e = 7; n = 6

So, cyclomatic complexity = e – n + 2

= 7 – 6 + 2

= 3

S.28 (c)

In Basis Path Testing the value of the complexity measure is equal to the cyclomatic complexity of the flowgraph if all of the edges were undirected instead of directed. So, cyclomatic complexity = e – n + 2

where, e is no. of edges.

n is no. of nodes.

Now, here e = 10; n = 9 (In undirected condition)

So, cyclomatic complexity = 10 – 9 + 2

= 3

UNIT–10

COMPUTER NETWORKS

Unit–10

Computer Networks

INTRODUCTION TO ISO/OSI MODEL & PHYSICAL LAYER

10.1

LEVEL–1

Q.1 Which out of the following follow primary-secondary relationship between devices?

(a) Ring
(b) Mesh
(c) Star
(d) Bus

Q.2 Frequency range of coaxial cable is

(a) 100Hz–5MHz
(b) 100KHz–500MHz
(c) 100 Hz–500MHz
(d) None of these

Q.3 Which of the following is the greatest advantage of coax cabling?

(a) High security
(b) Physical dimensions
(c) Long distances
(d) Easily tapped

Q.4 NNTP

(a) protocol used for moving news articles around
(b) protocol used for teaching pages on world wide web
(c) protocol for mapping host names onto their network addresses
(d) None of these

Q.5 If the angle of refraction is 90 degrees and the angle of incidence is 68 degrees, then the critical angle would be

(a) 20
(b) 65
(c) 90
(d) 180

Q.6 Which of the following is true w.r.t ISDN channels?

(a) B is 64 kpbs digital PCM channel for voice or data
(b) B is 8 or 16 kbps digital channel
(c) B is 4 khz analog telephone channel
(d) H is 64 kpbs digital channel for internal ISDN signaling

Q.7 X.21 is a

(a) Physical layer protocol
(b) Network layer protocol
(c) Transport layer protocol
(d) Application layer protocol

Q.8 Voice band frequencies ranges from

(a) 0–3 kHz
(b) 430 MHz – 750 MHz
(c) 3 kHz – 300 GHz
(d) None of these

Q.9 The topology with highest reliability is
(a) Bus topology
(b) Star topology
(c) Mesh topology
(d) None of these

Q.10 In which topology, if there are n devices in a network, each device has n–1 ports for cables?
(a) Mesh
(b) Star
(c) Bus
(d) Tree

Q.11 A network that contains multiple hubs is most likely configured in which topology:
(a) Mesh
(b) Tree
(c) Bus
(d) None of these

Q.12 The physical layer in reference to the OSI model defines:
(a) Data link procedures that provide for the exchange of data via frames that can be sent and received
(d) The interface between X.25 network and packet mode device
(c) The virtual interface to packet switched services
(d) All of the above

Q.13 In fiber optics the source of signal is
(a) Infra-red wave
(b) Light wave
(c) Radio wave
(d) Very low frequency wave

Q.14 Virtual terminal (TELNET)
(a) Maps host name onto their network addresses
(b) Allow user on one machine to log onto a distant machine
(c) Move news articles around
(d) Fetch pages on world wide web

Q.15 Which out of following is not the principle of ISDN?
(a) Support of voice and non-voice application
(b) Support of switched and non-switched application
(c) Intelligence in the network
(d) Limited configuration

Q.16 Which of the following is not a property of fiber optic cabling?
(a) Easier to capture a signal than copper cabling
(b) Transmits at faster speeds than copper cabling
(c) Very resistant to interference
(d) Carries signals as light waves

Q.17 Layered protocols offers following advantages:
(a) It breaks the design problem into more manageable and smaller pieces
(b) It allows protocols to be changed without affecting higher or lower ones
(c) Both (a) and (b)
(d) None of the above

Q.18 What is the minimum number of wires, needed to send data over a serial communication link layer?
(a) 1
(b) 2
(c) 3
(d) 4

Q.19 Which data communication method is used to send data over a serial communication link?
(a) Simplex
(b) Full duplex
(c) Half duplex
(d) All of the above

Q.20 What is the main difference between synchronous and asynchronous transmission?
(a) The bandwidth required is different
(b) The pulse height is different
(c) The clocking is derived from the data in synchronous transmission
(d) The clocking is mixed with data in asynchronous transmission

Q.21 The purpose of preamble in an ethernet is

(a) Error checking

(b) Clock synchronization

(c) Collision avoidance

(d) Broadcast

Q.22 In OSI network architecture, the routing is performed by

(a) Transport layer

(b) Data link layer

(c) Network layer

(d) Session layer.

Q.23 Which of the following is an example of bounded medium?

(a) Coaxial cable

(b) Waveguide

(c) Fibre optic cable

(d) All of the above

Q.24 Wavelength Division Multiplexing is used in

(a) Coaxial cable

(b) Microwave transmission

(c) Fibre optic channels

(d) Satellite communication

Q.25 The slowest transmission speeds are those of

(a) Micro waves

(b) coaxial cable

(c) Fibre optic cable

(d) Twisted-pair wire

Q.26 The difference between a multiplexer and a statistical multiplexer is

(a) multiplexers use TDM (time division multiplexing), while statistical multiplexer uses FDM (frequency division multiplexing)

(b) multiplexers often waste the output link capacity while statistical multiplexers optimize its use

(c) multiplexers use the X.25 protocol, while statistical multiplexers use the ALOHA protocol

(d) statistical multiplexers need buffers while multiplexers do not need buffers

Q.27 End-to-end connectivity is provided from host-to-host in

(a) The transport layer

(b) The network layers

(c) The session layer

(d) It is a combined functionality of the network and the data link layer

Q.28 The Internet Control Message Protocol (ICMP)

(a) Allows gateways to send error and control messages to other gateways or hosts

(b) Provides communications between the Internet protocol software on one machine and the Internet protocol software on another

(c) Only reports error conditions to the original source, the source must relate errors to individual application programs and take action to correct the problem

(d) All of the above

Q.29 Working of the WAN generally involves

(a) Telephone lines

(b) Microwaves

(c) Satellites

(d) All of the above

Q.30 A network which is used for sharing data, software and hardware among several users owning microcomputers

(a) LAN

(b) MAN

(c) WAN

(d) VAN

Q.31 A front-end processor is

(a) A user computer system

(b) A processor in a large-scale computer that executes operating system instructions

(c) Preliminary processor of batch jobs

(d) A minicomputer that relieves main-frame computers at a computer centre of communications control functions

Q.32 The transfer of data from a CPU to peripheral devices of a computer is achieved through

(a) Computer ports

(b) Modems

(c) Interfaces

(d) Buffer memory

Q.33 Which of the following layer protocols are responsible for user and the application program support such as passwords, resource sharing, file transfer and network management?

(a) Layer 7 protocols

(b) Layer 6 protocols

(c) Layer 5 protocols

(d) Later 4 protocols

Q.34 In OSI model, which of the following layer transforms information from machine format into that understandable by user

(a) Application

(b) Session

(c) Presentation

(d) Physical

Q.35 Which layer of OSI determines the interface of the system with the user?

(a) Network

(b) Data-link

(c) Application

(d) Session

Q.36 Frequency range of twisted pair cable is

(a) 100 Hz-300 KHz

(b) 0 – 5 MHz

(c) 100 Hz – 5 MHz

(d) 300 KHz – 6 MHz

Q.37 In Asynchronous transmission, receiver

(a) Know when a data unit is sent

(b) Does not recognize beginning and end of data unit

(c) Recognize beginning and end of the data unit

(d) None of these

Q.38 Which of the following is synchronous protocol?

(a) SDLC

(b) XMODEM

(c) YMODEM

(d) BLAST

Q.39 Which of the following are sub-layers of Data Link Layer

(a) Logical Link Control, Data Link Control

(b) Data Link Control, Logical Link Control

(c) Physical Layer Control, Data Link Control

(d) Media Access Control, Logical Link Control

Q.40 Interoperatibity is the function of

(a) Network layer

(b) Presentation layer

(c) Transport layer

(d) Application layer

Q.41 Which of the following is asynchronous protocol?

(a) BLAST

(b) HDLC

(c) SDLC

(d) LAN

LEVEL–2

Q.42 In a network with 50 computer, a mesh topology would require_____ cables

(a) 1225 cables

(b) 1280 cables

(c) 50 cables

(d) 99 cable

Q.43 A voice grade telephone line carries a continue electromagnetic signal ranging between 300 Hz and 3300 Hz. What will be the wavelength of 15000 Hz, travelling through a copper wire?

(a) 333.33 m

(b) 13.33 m

(c) 13333.33 m

(d) 333.33 m

Q.44 The sign corporation of Amritsar has a fully connected mesh network consisting of ninety nine devices. Calculate the number of ports for each device

(a) 95
(b) 80
(c) 100
(d) 98

Q.45 The Shimla corporation of India has a fully connected mesh network consisting of nine devices. Calculate the total number of cable links needed

(a) 36
(b) 45
(c) 20
(d) 25

Q.46 Maximum data rate of a channel of 3000 Hz bandwidth and S/N ratio of 30 dB is

(a) 30000 bps
(b) 60000 bps
(c) 75000 bps
(d) 3000 bps

Q.47 The number of cross points needed for 10 lines in a cross point switch, which is full duplex in nature and there are no self connection is

(a) 100
(b) 50
(c) 45
(d) 90

Q.48 A terminal multiplexer has six 1200 bps terminals and 'n' 300 bps terminals connected to it. The outgoing line is 9600 bps. What is the maximum value of n?

(a) 4
(b) 8
(c) 16
(d) 28

Q.49 Characters per sec. (7 bits + 1 parity) which can be transmitted over a 2400 bps line, if the transfer is synchronous (1 start and 1 stop bit)

(a) 275
(b) 240
(c) 250
(d) 300

LEVEL–3

Q.50 Suppose BSNL telephone line has bandwidth of 6100 Hz. The signal to noise ratio is 40 dB. Then the capacity of channel would be

(a) 80,176 bps
(b) 38,821 bps
(c) 32,681 bps
(d) 81,056 bps

Q.51 When a signal travels through a transmission medium, its power becomes 100 times. Then Gain/Loss would be

(a) Gain of 80 dB
(b) Loss of 80 dB
(c) Gain of 20 dB
(d) Loss of 20 dB

Q.52 Consider a signal is measured at two different points. The power is P_1 at the first point and P_2 at the second point. If dB is 0, then

(a) P_2 is zero
(b) P_2 equals P_1
(c) P_2 is much larger than P_1
(d) P_2 is much smaller than P_1

Q.53 For a particular channel, the bandwidth is 7200 Hz. Signal strength is of 12 μW and one sided power spectrum density of white noise is 10^{-12} watt/Hz. The channel capacity would be

(a) 29.83 Kbps
(b) 77 Kbps
(c) 32.22 Kbps
(d) 69 Kbps

Q.54 Given that the channel capacity is 250 Kbps, find the white noise, present in the channel, if the signal strength is, 15 μW and bandwidth = 8000 Hz, SNR = 20000

(a) 9.375×10^{-12} watts/Hz
(b) 9.370×10^{-11} watts/Hz
(c) 9.388×10^{11} watts/Hz
(d) 9.368×10^{12} watts/Hz

Q.55 A voice grade telephone line carries a continuous electromagnetic signals ranging between 300 Hz and 3300 Hz. What is the channel capacity if the signal to noise ratio is 30 dB?

(a) 29.02 kbps
(b) 29.9 kbps
(c) 28.6 kbps
(d) 30.13 kbps

Q.56 Suppose MTNL telephone line has bandwidth of 3000 Hz (300 Hz to 3300 Hz). The signal to noise ratio is 3100. Then the capacity of channel would be

(a) 35,00 bps
(b) 34,796 bps
(c) 34,860 bps
(d) 34, 660 bps

Q.57 The wave length of red light whose frequency is 4×10^{14} Hz in air is

(a) 0.75 μm
(b) 7500 pm
(c) 400 m
(d) Data insufficient

Q.58 For certain medium if critical angle is 60° and the angle of incidence is 70°, the angle of reflection is

(a) 10°
(b) 60°
(c) 70°
(d) 130°

Q.59 When a signal travels through a transmission medium, its power becomes one fifth. The power

(a) Loss of 7 dB
(b) Gain of 7 dB
(c) Loss of 5 dB
(d) Gain of 5 dB

Q.60 For a particular optic cable if the propagation speed is 2×10^8 m/s and distance of 2000 m, then propagation time would be

(a) 10 μsec
(b) 100 μsec
(c) 0.1 μsec
(d) 0.001 μsec

Q.61 For a particular channel, the bandwidth is 3600 Hz. Signal strength is 12 μW and two sided power spectral density of white noise is 2×10^{-12} watt/Hz. The channel capacity would be

(a) 81 Kbps
(b) 40 Kbps
(c) 35 Kbps
(d) 42 Kbps

Linked Questions 62 & 63:

Q.62 A certain telecom company 'A' has a line bandwidth of 8000 Hz. The signal to noise ratio is 35 dB. The capacity of the channel would be

(a) 40860.42 bps
(b) 28001.099 bps
(c) 93017.64 bps
(d) 80000 bps

Q.63 Another telecom company 'B' has channel capacity 30% more than that of company A. What will be its SNR?

(a) 48.66
(b) 45.50
(c) 24.81
(d) 30.35

GATE QUESTIONS

Q.64 Which of the following is Not true with respect to a transparent bridge and a router?

[GATE 2004]

[1-Mark]

(a) Both bridge and router selectively forward data packets
(b) A bridge uses IP addresses while 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

Q.65 How many 8 bit characters can be transmitted per second over a 9600 baud serial communication link using asynchronous mode of transmission with one start bit, eight data bits, two stop bits and one parity bit?

[GATE 2004]

[1-Mark]

(a) 600

(b) 800

(c) 876

(d) 1200

Q.66 A and B are the only two stations on an Ethernet. Each has a steady queue of frame 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 **[GATE 2004]**

[2-Marks]

(a) 0.5

(b) 0.625

(c) 0.75

(d) 1.0

Q.67 Which one of the following statements is FALSE? **[IT-GATE 2004]**

[1 Mark]

(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.

Q.68 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

[IT-GATE 2004]

[2-Marks]

(a) I and III

(b) I, II and III

(c) II and IV

(d) I, II, III and IV

At a time only one code word of a given data word is allowed

Q.69 Consider the three commands: PROMPT, HEAD and RCPT.

Which of the following options indicate a correct association of these commands with protocols where these are used? **[IT-GATE 2005]**

[1 Mark]

(a) HTTP, SMTP, FTP

(b) FTP, HTTP, SMTP

(c) HTTP, FTP, SMTP

(d) SMTP, HTTP, FTP

Q.70 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? **[IT-GATE 2005]**

[2-Marks]

(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

Q.71 For which one of the following reasons does internet protocol (IP) use the time to live (TTL) field in the IP datagram header? **[GATE 2006]**

[1-Mark]

(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

Q.72 There are n stations in a 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? **[GATE 2007]**

[2-Marks]

(a) $np(1-p)^{n-1}$

(b) $(1-p)^{n-1}$

(c) $p(1-p)^{n-1}$

(d) $1-(1-p)^{n-1}$

Q.73 In a token ring network the transmission speed is 10^7 bps and the propagation speed is 200 meters per μs. The 1-bit delay in this network is equivalent to : **[GATE 2007]**

[2-Marks]

(a) 500 meters of cable

(b) 200 meters of cable

(c) 20 meters of cable

(d) 50 meters of cable

ANSWER KEY

1	c	2	b	3	c	4	a	5	c
6	a	7	a	8	a	9	c	10	a
11	b	12	d	13	a	14	b	15	d
16	a	17	c	18	b	19	b	20	c
21	b	22	c	23	d	24	c	25	d
26	d	27	a	28	d	29	d	30	a
31	d	32	a	33	a	34	c	35	c
36	c	37	c	38	a	39	d	40	b
41	a	42	a	43	c	44	d	45	a
46	a	47	c	48	b	49	d	50	d
51	c	52	b	53	b	54	a	55	b
56	b	57	a	58	c	59	a	60	c
61	d	62	c	63	b	64	b	65	b
66	b	67	b	68	b	69	b	70	d
71	c	72	a	73	c				

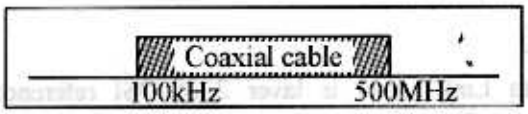
SOLUTIONS

S.1 (c)

In primary secondary, one device controls traffic and the other must transmit through it. **Star and tree** are more convenient for primary secondary.

S.2 (b)

Frequency range for coaxial cable is



S.3 (c)

Of the choices listed for coax cabling, long distance is the best answer.

S.4 (a)

The Network News Transfer Protocol (NNTP) is an internet application protocol used for **transporting usenet news articles** between news servers and for reading and posting articles by end user client applications.

S.5 (c)

For a particular incident ray when the angle of refraction is 90 degrees, then that particular incident angle is critical angle. Hence **critical angle is same as incident angle when angle of refraction is 90 degrees.**

S.6 (a)

Standardized ISDN channels are:

(i) A–4 KHz analog telephone channel

(ii) **B–64 Kbps digital PCM channel for voice or data**

(iii) C–8 or 16 Kbps digital channel

(iv) D – 16 or 64 Kbps digital channel for out of band signaling

(v) E–64 Kbps digital channel for internal ISDN signaling

(vi) H–Hybrid channel of 384–1536 or 1920 Kbps digital channel

S.7 (a)

X.21 is physical layer protocol that allows physical, electrical and procedural interface between the host and the network.

S.8 (a)

Voice band frequency ranges from **0 to 3 kHz.**

S.9 (c)

In **mesh topology** all nodes are connected to another node. It is fully connected network. In this topology the network can still operate when one node breaks down, so the network is reliable.

S.10 (a)

In a **mesh topology**, every device has a dedicated point to point link to every other device. So, if we have n nodes, then we need to connect to n–1 nodes.

S.11 (b)

A **tree topology** is a variation of star topology. Tree topology consists of multiple hub, one is primary hub and remaining are secondary hubs.

S.13 (a)

In fiber optics infra-red waves are signal source.

S.14 (b)

The virtual terminal (TELNET) protocol **allow a user on one machine to log onto a distance machine and work there.**

S.15 (d)

Principles of ISDN:

(i) Support of voice and non-voice application using a limited set of standard facilities

(ii) Support for switched and non-switched application

(iii) Reliance on 64 kbps connection

(iv) Intelligence in the network

(v) Layered protocol architecture

(vi) Variety of configuration

S.16 (a)

Fiber optic cabling transmit at faster speeds than copper cabling, is very resistant to interference, and carries signals as light waves.

S.17 (c)

Advantages of layered approach to protocols are:

(i) Interoperability
(ii) Greater Compatibility
(iii) Better Flexibility
(iv) Increased Life Expectancy
(v) Scalability
(vi) Mobility
(vii) Cost Effective Quality
(viii) Task Segmentation
(ix) Reduced Debugging Time
(x) Rapid Application Development (RAD)

S.22 (c)

The network layer performs network routing functions, and might also perform fragmentation and reassembly, and report delivery errors.

S.23 (d)

In a bounded medium, the signals are confined to the medium and do not leave it (except for smaller leakage amount). A pair of wires, **coaxial cable, waveguide and optical fiber** are examples of bounded media.

S.24 (c)

Wavelength divison multiplexing (WDM) is a technology which multiplexes multiple optical carrier signals on a single **optical fiber by using different wavelengths** (colour) of laser light to carry different signals.

S.31 (d)

The purpose of front end processor is to off-load from the host computer the work of managing the peripheral devices, transmitting and receiving messages, packet assembly and disassembly, error detection and error correction.

S.37 (c)

In asynchronous transmission, the receiver does not need to know exactly when a data unit is sent, it only needs to **recognize the beginning and end of the data unit.**

S.38 (a)

Asynchronous protocols:

XMODEM, YMODEM, ZMODEM, BLAST, KERMIT

Synchronous protocols:

SDLC, HDLC

S.39 (d)

Data Link Layer is layer 2 of OSI reference model. This layer is divided into two sub-layers:

1. **Logical Link Control (LLC) sub-layer**
2. **Media Access Control (MAC) sub-layer**

The LLC sub-layer handles error control, flow control, framing, and MAC sub-layer is used for addressing.

The MAC sub-layer is the lower of the two sub-layers of the Data Link layer.

MAC sub-layer handles access to shared media, such as a Token passing of Ethernet.

S.40 (b)

Presentation layer provides the necessary translation of data needed for transmission and at receiver changing that format into the one that is understood by the receiver. Thus ensures interoperability among communicating devices.

S.41 (a)

Asynchronous protocols:

XMODEM, YMODEM, ZMODEM, **BLAST**, KERMIT

Synchronous protocols:

SDLC, HDLC

S.42 (a)

Mesh topology requires $\frac{N(N-1)}{2}$ cables

$N = 50$

$\therefore \frac{50(50-1)}{2} = 50 \times \frac{49}{2} =$ **1225 cables**

S.43 (c)

Wave length = C/F

$\therefore \lambda = \frac{2}{3} \times 3 \times 10^8 \div 15000$

Note that C is the speed of light in the copper wire.

$\therefore \lambda$ = **13333.33 m**

S.44 (d)

Number of ports per device = n – 1

where n is the number of devices

∴ Number of ports per device = 99 – 1 = **98**

S.45 (a)

The formula for the number of links for a fully connected mesh is n (n–1)/2, where n is the number of devices.

Number of links = n(n – 1)/2 = 9(9 – 1)/2 = **36**

S.46 (a)

As per Shannon's theorem

Maximum data rate= H $\log_2$ (1 + S/N)

= 3000 $\log_2$ (1 + 1000),

where 1 dB = 10 $\log_{10}$ S/N

= 3000 × $\log_2$ (1001)

= 3000 × 10 = **30000 bps.**

S.47 (c)

As all lines are full-duplex and there are no self connections, only the cross points above the diagonal are needed. Hence formula for the number of cross points needed is $\frac{n(n-1)}{2}$

So, $\frac{10(10-1)}{2} = \frac{90}{2}$ = **45**

S.48 (b)

There are 6 1200 bps terminals and n 300 pbs terminals

hence 6 × 1200 + n × 300 = 9600

∴ **n = 8**

S.49 (d)

Start and stop bits are not needed in synchronous transfer of data. So, it is

$\frac{2400}{8}$ = **300**

S.50 (d)

It is given

$\therefore 10\log_{10} \frac{S}{N} = 40$ dB

$\frac{S}{N} = 10^4 = 10{,}000$

∴ Capacity of channel

$C = B\log_2\left(1+\frac{S}{N}\right)$

= 6100$\log_2$ (1+10,000)

= 6100 × 13.288

= **81,056 bps**

S.51 (c)

$\text{Power gain/loss} = \frac{\text{tranmitted power}}{\text{received power}}$

If transmitted power = P

then received power = 100 P

$\therefore$ Power gain/loss = $10 \log_{10} \frac{P}{100P}$

= –10 $\log_{10}$ 100

= –10 $\log_{10}$ 10^2

= –20 dB

It will be a gain of 20dB.

S.52 (b)

We know

$dB = 10\log_{10} \frac{P_1}{P_2}$

$$0 = 10\log_{10}\frac{P_1}{P_2}$$

$$10\log_{10}\frac{P_1}{P_2} = 0$$

$$\frac{P_1}{P_2} = 10^0$$

$$\frac{P_1}{P_2} = 1$$

$$\mathbf{P_1 = P_2}$$

S.53 (b)

It is given

$B = 7200$ Hz

$S = 12\ \mu W$

$\eta = 10^{-12}$ Watt/Hz

We know

$N = \eta B$

$= 7.2$ nW

Also, $\frac{S}{N} = \frac{12\times10^{-6}}{7.2\times10^{-9}} = \frac{10000}{6}$

There capacity of channel is

$$C = B\log_2\left(1+\frac{S}{N}\right)$$

$$C = 7200\log_2\left(1+\frac{10000}{6}\right)$$

$$= 7200\ \log_2\left(\frac{10006}{6}\right) = \mathbf{77\ kbps}$$

S.54 (a)

$$SNR = \frac{\text{signal strength}}{\text{noise power}}$$

$$\therefore \text{noise power} = \frac{15\mu w}{20000} = \frac{15\times10^{-6}}{20000}$$

$$= 7.5 \times 10^{-10} = 75\times10^{-9}$$

Now, noise power $= \eta \times B$

where

$\eta = ?$

B = channel bandwidth

$75 \times 10^{-9} = 8000 \times \eta$

$$\therefore \eta = \frac{75\times10^{-9}}{8000}$$

$$= \mathbf{9.375\times10^{-12}\ watts/Hz}$$

S.55 (b)

Signal range = 300 Hz to 3300 Hz

$\therefore$ Bandwidth = 3300 – 300 = 3000Hz

SNR = 30 dB

Now dB $= 10\log_{10}(S/N)$

$\therefore$ SNR = 1000

Now $C = B\log_2(1+SNR)$

$\therefore \quad C = 3000 \times \log_2(1001)$

$$= \mathbf{29.9\ Kbps}$$

S.56 (b)

Capacity of channel can be calculated as

$$C = B\log_2\left(1+\frac{S}{N}\right)$$

$= 3000\ \log_2(1 + 3100)$

$= 3000\ \log_2(3101)$

$= 3000 \times 11.598$

$= 34.796$ kbps

$\approx$ **34796 bps**

S.57 (a)

If we represent wavelength by λ, propagation speed by c, and frequency by f, then

$$\lambda = \frac{c}{f}$$

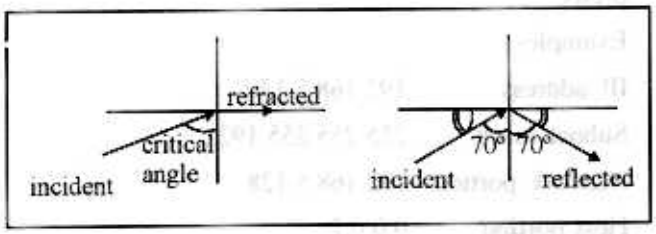
$$\therefore \lambda = \frac{3\times10^8}{4\times10^{14}}$$

$$= 0.75 \times 10^{-6}\ m = \mathbf{0.75\ \mu m}$$

S.58 (c)

When angle of incidence (critical angle =60°) is 70°, angle of refraction is 90°. Now if increase incidence angle beyond critical angle, the ray get

reflected inside the medium. Thus angle of reflection will be same as angle of incidence.



Note: When we increase angle incidence beyond critical angle, total internal reflection take place.

S.59 (a)

$$\text{Power gain/loss} = 10\log_{10}\frac{\text{transmiteted power}}{\text{received power}}$$

If transmitted power = P

then received power = $\frac{P}{5}$

$$\therefore \text{Power gain/Loss} = 10\log_{10}\frac{P}{P/5}$$

$$= 10\log_{10} 5$$

$$= 6.98 \text{ dB}$$

$$= 7 \text{ dB}$$

Thus loss of 7 dB.

S.60 (c)

$$\text{Propagation time} = \frac{\text{Distance}}{\text{Propagation speed}}$$

$$= \frac{2000\text{m}}{2\times10^{8}\text{m/s}}$$

$$= 1000 \times 10^{-8} \text{ sec}$$

$$= 10^{-5} \text{ sec}$$

$$= \mathbf{0.1\ \mu sec}$$

S.61 (d)

It is given

B = 3600

S = 12 μW

$2\eta = 2\times10^{-12}$ watt/Hz

$\therefore \eta = 10^{-12}$ watt/Hz

We know

$N = \eta B$

$= 3.6$ nW

Also, $\frac{S}{N} = \frac{12\times10^{-6}}{3.6\times10^{-9}} = \frac{120\times10^{3}}{36} = \frac{10000}{3}$

The capacity of channel is

$$C = B\log_2\left(1+\frac{S}{N}\right)$$

$$= 3600\log_2\left(1+\frac{10000}{3}\right)$$

$$= 3600\log_2\left(\frac{10003}{3}\right)$$

$$= 42.13 \text{ Kbps} \approx \mathbf{42\ kbps}$$

S.62 (c)

$$\text{SNR} = 35 \text{ dB} = 10\log_{10}\frac{S}{N}$$

$$\therefore \log_{10}\frac{S}{N} = 3.5$$

$$\therefore \frac{S}{N} = 3162.28$$

$\therefore$ Channel capacity

$C = B \log_2 (1+S/N)$

$= 8000\log_2 (1+3162.28)$

$= \mathbf{93017.64\ bps}$

S.63 (b)

Channel capacity of company 'B' is 30% more than that 'A'

$\therefore$ channel capacity of $p_0 = 93017.64 + 93017.64 \times \frac{30}{100} = 120922.93$ bps

$C = B\log_2(1+S/N)$

$\therefore 120922.23 = 8000 \log_2 (1+SNR)$

$\therefore \log_2 (1+SNR) = 15.115$

$\therefore (1+SNR) = 35486.92$

$\therefore SNR = 35485.92$

Now, SNR in dB = $10 \log_{10} S/N$

$= \mathbf{45.50\ dB}$

S.64 (b)

Choice (b) is not true.

A bridge operates at layer 2 (Data Link Layer) so it uses MAC address while router operates at layer 3 (Network Layer) so it uses IP addresses.

S.65 (b)

Total number of bits = 1 + 8 + 2 + 1 = 12

Modulation Rate = 9600 baud

Number of bits (8 bit character) transmitted

$$= \frac{9600}{12\text{bits}} = \mathbf{800}$$

S.66 (b)

There are two conditions when A will win the first back off (0,1). In second back off there are four conditions (0,1,2,3) [2x2–1=4–1=3]. If A choose in first then required probability.

$$= \frac{1}{2}\cdot\frac{3}{4}+\frac{1}{2}\cdot\frac{1}{2}$$

$$= \frac{3}{8}+\frac{1}{4}$$

$$= \frac{5}{4} = \mathbf{0.625}$$

S.67 (b)

Packet switching results in more variation in delay than circuit switching.

S.68 (b)

Data bits are of 3 bit. So possible data code words are 000, 001, 010, 011, 100, 101, 110, 111

So possible code words, are I, II and III.

IV is not possible because its data word is equal to II[nd] data word

S.69 (b)

The correct association of commands are

Command		Protocol
PROMPT	–	FTP
HEAD	–	HTTP
RCPT	–	SMTP

S.70 (d)

Three subnets with hosts

S1 → 100

S2 → 50

S3 → 50

Subnetting is the process of division of a computer network into group of computers that have common, designated IP address routing prefix.

Example-

IP address	192.168.5.130
Subnet mask	255.255.255.192
Network portion	192.168.5.128
Host portion	0.0.0.2

So using this concept required work can be done by option (d) subnet addressing.

S.72 (a)

If there are n stations in a slotted LAN, each station attempts to transmit with a probability p in each time slot and therefore acquires the medium. This is just the binomial probability distribution that one station attempts to transmit and the others do not. Let the event is denoted by P(E).

$$P(E) = {}^{n}C_1 P^1(1-p)^{n-1} = \frac{\lfloor n}{\lfloor 1 \ \lfloor n-1}p(1-P)^{n-1}$$

$$= \frac{n\lfloor n-1}{\lfloor n-1}p(1-P)^{n-1} = \mathbf{np\ (1-p)^{n-1}}$$

S.73 (c)

$R = 10^7$ bps

$B = 1$

$V = 200\text{m}/\mu\text{s}$. $d = ?$

$B = R \times d/v$

$$d = \frac{Bv}{R} = \frac{1\times 200}{10^7\times 10^{-6}}$$

$= \mathbf{20}$ **meters of cable**

○ ○ ○

10.2 THE DATA LINK LAYER

LEVEL–1

Q.1 Token bus implements

(a) IEEE 802.2 standard

(b) IEEE 802.3 standard

(c) IEEE 802.4 standard

(d) None of these

Q.2 HDLC does not support

(a) Balanced multipoint

(b) Half duplex

(c) Full duplex

(d) Multipoint link

Q.3 MSB bit of SSAP is control field of a PDU indicate

(a) Whether SSAP is an individual or group address

(b) Whether PDU is a command or response PDU

(c) Whether PDU is a primary or second device

(d) Whether SSAP is data or control information

Q.4 A switch segments a network, with a 12 plot switch, _____ collision domains and _____ broadcast domains.

(a) 1, 12

(b) 12, 12

(c) 1, 1

(d) 12, 1

Q.5 Which of the following are valid PPP authentication method?

(i) LCP

(ii) PAP

(iii) CHAP

(iv) MD5

(a) (ii) and (iii)

(b) (ii) and (iv)

(c) (iv)

(d) All of these

Q.6 What is the first thing a bridge does when it receives a frame containing a source MAC address it has not heard before?

(a) It forwards the frame out of the ports, except the one on which the frame arrived

(b) It adds the source and destination MAC address to the MAC table, associated with the incoming interface

(c) It adds the source MAC address to its MAC table

(d) It checks the frame for loops

Q.7 What will come at (1) and (2) in the table below:

	NRM	ARM	ABM
Station Type	Primary and Secondary	Primary and Secondary	(1)
Initiation	Primary	(2)	Any

(a) primary and secondary, primary

(b) primary, primary

(c) primary and secondary either

(d) combined, either

Q.8 Let s be the average number of new frames generated per frame time. If s>1, then (nearly)

(a) Frame not at all collide

(b) Every frame will suffer collision

(c) Maximum utilization of channel

(d) No change in throughput

Q.9 Which out of the following is false?

(a) Hardware feature of 10 base 2 is thick coaxial cable

(b) 10 base 5 uses Manchester coding

(c) Hardware feature of 10 base 2 is thin co-axial cable

(d) Hardware feature of 10 base 5 is thick co-axial cable

Q.10 A packet switching network

(a) Is free

(b) Can reduce the cost of using an information utility

(c) Allows communications channel to be shared among more than one user

(d) Both (b) and (c)

Q.11 FDDI is a

(a) Ring network

(b) Star network

(c) Mesh network

(d) Tree based network

Q.12 A hub in network is

(a) A multipoint signal repeater or concentrator

(b) A multiplug like device to allow many computers to be connected

(c) The server which serves every node

(d) The central power supply

Q.13 ALOHA

(a) Is used for channel allocation problem

(b) Is used for data transfer

(c) Is used for buffering

(d) None of these

Q.14 Pure ALOHA

(a) Does not require global time synchronization

(b) Does require global time synchronization

(c) Both (a) and (b)

(d) None of these

Q.15 Slotted ALOHA

(a) Divide time into discrete intervals

(b) Require global time synchronization

(c) Both (a) and (b)

(d) None of these

Q.16 Which of the following is a type of coax cabling transmission method?

(a) Baseband

(b) Broadband

(c) CSMA/CD

(d) Both (a) and (b)

Q.17 Even-parity checking function

(a) Passes data unit with even number of 1's

(b) Passes data unit with odd number of 1's

(c) Passes data unit with even number of 0's

(d) Passes data unit with odd number of 0's

Q.18 The LLC (Logical Link Control) standard format is based on

(a) BLAST

(b) ZMODEM

(c) SDLC

(d) HDLC

Q.19 What is a MAC?

(a) It is the network layer address of a NIC that can not be modified

(b) It is the network layer address of a NIC that can be modified

(c) It is the Data Link Layer address of a NIC that can not be modified

(d) It is the Data Link Layer address of a NIC that can be modified

Q.20 Which access methodology does token ring employ?

(a) Token passing

(b) Modified token passing

(c) CSMA/CD

(d) Any of the above

Q.21 Which of the following are the tasks performed by Data link layer:

(a) Frame synchronization

(b) Flow control

(c) Error control

(d) All of the above

Q.22 HDLC is a

(a) Bit-oriented protocol

(b) Character-oriented protocol

(c) Byte-oriented protocol

(d) Count-oriented protocol

Q.23 In HDLC protocol, polling and selecting are functions of the

(a) I-frame

(b) U-frame

(c) S-frame

(d) (a) and (b)

Q.24 The simultaneous transmission of data to a number of stations is known is

(a) Bandwidth

(b) Broadcast

(c) Aloha

(d) Analog transmission

Q.25 An error-detecting code inserted as a field in a block of data to be transmitted is known as

(a) Error detecting code

(b) Frame check sequence

(c) Checksum

(d) Flow control

Q.26 Error detecting code is

(a) An error-detecting code based on a summation operation performed on the bits to be checked

(b) A check bit appended to an array of binary digits to make the sum of all the binary digits

(c) The ratio of the data units in error to the total number of data units

(d) A code in which each expression conforms to specify rules of construction, so that if certain errors occur in an expression, the resulting expression will not conform to the rules of construction and thus the presence of the error is detected

Q.27 The flag field of the HDLC frame is used for

(a) Controlling flow

(b) Synchronization

(c) Error checking

(d) All of these

Q.28 Access control field in IEEE 802.5 token ring format is used for

(a) Prioritisation

(b) Monitoring

(c) Synchronization

(d) Both (a) and (b)

Q.29 Which one of following does not contradict the use of time outs in computer networks

(a) Wastage of CPU time

(b) Wastage of bandwidth

(c) Extra load on routers

(d) All of these

Q.30 A 4 Mbps token ring network has token holding timer value of 10 msec. The longest frame size would be

(a) 400 bits

(b) 4000 bits

(c) 40,000 bits

(d) None of these

Q.31 In stop and wait ARQ, if data 1 has an error, the receiver sends which frame?

(a) NAK0

(b) NAK1

(c) NAK2

(d) NAK

Q.32 In which ARQ, when a NAK is received, all frames sent since the last frame acknowledged are retransmitted

(a) Stop and wait

(b) Go back n

(c) Selective repeat

(d) (a) and (b)

Q.33 Which of the following are non polling system?

(a) TDMA

(b) Stop and wait

(c) Xon/Xoff

(d) Both (a) and (c)

Q.34 The secondary device in a multipoint configuration sends data in response to which of the following event?

(a) An ACK

(b) An ENQ

(c) A poll

(d) A sel

Q.35 In sliding window flow control, if the window size is 63, what is the range of sequence numbers?

(a) 0 to 63

(b) 0 to 64

(c) 1 to 63

(d) 1 to 64

Q.36 For a sliding window of size n–1 (n sequence numbers), the maximum number of frames sent but unacknowledged?

(a) 0

(b) n–1

(c) n

(d) n+1

Q.37 Which one of the following protocols describes the process of a TCP/ IP host learning a remote host's MAC address?

(a) ARP

(b) SLARP

(c) RARP

(d) IARP

Q.38 The Hamming distance between 001111 and 010011 is

(a) 1

(b) 2

(c) 3

(d) 4

LEVEL–2

Common Data For Questions 39 to 41:

The next three questions are based on Huffman's coding for the symbol A with probability 0.3, B with 0.15, C with 0.1, D with 0.25 and E with 0.2.

Q.39 The minimum number of bits required to represent B is

(a) 1

(b) 2

(c) 3

(d) 4

Q.40 The minimum number of bits required to represent all the symbols together is

(a) 14

(b) 11

(c) 12

(d) 15

Q.41 The average code length of the given problem is

(a) 2

(b) 2.25

(c) 2.45

(d) 3

LEVEL–3

Q.42 A channel has a bit rate of 20 kbps and a propagation delay of 100 msec. For what sizes does stop and wait gives an efficiency of 50%?

(a) 2500 bits

(b) 5000 bits

(c) 1000 bits

(d) 4000 bits

Q.43 A certain population of ALOHA users manages to generate 50 requests/sec. If the time is slotted in units of 40 m sec, then channel load would be

(a) 1.25

(b) 2

(c) 1250

(d) None of these

Q.44 An image is 1024 × 768 pixels with 3 bytes/pixel. Assume the image is uncompressed. How long will it take to transmit it over a 56 kbps modem channel?

(a) 329.14 sec

(b) 325 sec

(c) 330 sec

(d) 323.58 sec

Q.45 A group of 2^n-1 routers are interconnected in a centralized binary tree, with a router at each tree node. Router i communicates with router j by sending a message to the root of the tree. The root then sends the message back down to j. Derive an approximate expression for the mean number of hops per message for large n, assuming that all router pairs are equally likely.

(a) 2n–4

(b) n–4/2

(c) 2–4/2

(d) n–4

Q.46 Consider an error free 64 kbps satellite channel used to send 512 bytes data frames in one direction, with very short ACK coming back the other ways, what is the maximum throughput for window size of one. Assume propagation time to be 270 ms.

(a) 3.99 Kbps

(b) 8.5 Kbps

(c) 6.78 Kbps

(d) Data insufficient

Q.47 If a certain population of ALOHA users manages to generate 100 requests/sec. If the time is slotted in unit of 50 msec, then the chance of success on the first attempt would be

(a) 0.5

(b) 0.4

(c) 0.3

(d) None of these

Q.48 What is the probability of exactly 5 collision followed by a success when ALOHA users generate 50 requests/sec, if time is slotted in units of 40 msec?

(a) 0.12

(b) 0.06521

(c) 0.3

(d) None of these

Q.49 A group of some station share a 56 Kbps pure ALOHA channel. Each of these stations output a 1000 bits frame on an average of one every 100 sec, even if the previous one not yet been sent. Maximum number of stations would be

(a) 1000

(b) 2000

(c) 2030

(d) 1030

Q.50 Assume that 10,000 reservation stations are competing for the use of a single slotted ALOHA channel. An average station makes 18 requests/hour with a slot of 125 μsec. Calculate the channel load.

(a) 1/160

(b) 50

(c) 1/50

(d) None of these

Q.51 CSMA/CD LAN of 1 Gbps is to be designed over 1 km cable without repeater. The minimum frame size that DLL should consider if cable support signal speed of 2,00,000 Km/sec, is

(a) 1000

(b) 5000

(c) 100000

(d) 10000

Q.52 The length of a 10 Base 5 cable is 2.5 Km and the speed of propagation in a thick coaxial cable is 60% of the speed of light. Time required by a bit to travel from beginning to the end of the network would be

(a) 55 μ sec

(b) 12 μ sec

(c) Data insufficient

(d) None of these

Q.53 A 100 km long cable runs at 1.536 Mbps. The propagation speed in the cable is 2/3 speed of light. Number of bits fit in the cable would be

(a) 500

(b) 768

(c) 307

(d) 10000

Q.54 A satellite channel of capacity of B bits/sec, the frame size L bits, and round trip propagation time of R sec uses stop and wait protocol, what is the channel utilization U?

(a) $\dfrac{\frac{L}{B}}{\frac{L}{B}+R}$

(b) $\dfrac{1}{\frac{L}{B}+R}$

(c) $\dfrac{\frac{L}{B}}{\frac{B}{L}+R}$

(d) $\dfrac{\frac{L}{B}}{\frac{L}{B}+2R}$

GATE QUESTIONS

Q.55 Consider the following statements:

I. telnet, ftp and http are application layer protocols.

II. EJB (Enterprise Java Beans) components can be deployed in J2EE (Java2 Enterprise Edition) application server.

III. If two languages conform to the Common Language Specification (CLS) of the Microsoft.NET framework, then a class defined in any one of them may be inherited in the other.

Which statements are true? **[IT-GATE 2004] [1 Mark]**

(a) I and II only

(b) II and III only

(c) I and III only

(d) I, II and III

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 **[IT-GATE 2004]**

[2-Marks]

(a) 01101011

(b) 011010110

(c) 011101100

(d) 0110101100

Q.57 In the TCP/IP protocol suite, which one of the following is NOT part of the IP header?

[IT-GATE 2004]

[2-Marks]

(a) Fragment offset

(b) Source IP address

(c) Destination IP address

(d) Destination port number

Q.58 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? **[IT-GATE 2004]**

[2-Marks]

(a) 40 bytes

(b) 80 bytes

(c) 120 bytes

(d) 160 bytes

Q.59 Suppose that the maximum transmit window size for a TCP connection is 12000 bytes. Each packet consists of 2000 bytes. At some point of time connection is in slow-start phase with a current transmit window of 4000 bytes. Subsequently, the transmitter receives two acknowledgments. Assume that no packets are lost and there are no time-outs. What is the maximum possible value of the current transmit window? **[IT-GATE 2004]**

[2-Marks]

(a) 4000 bytes

(b) 8000 bytes

(c) 10000 bytes

(d) 12000 bytes

Q.60 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?

[IT-GATE 2005]

[1 Mark]

(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

Q.61 Assume that "host1.mydomain.dom" has an IP address of 145.128.16.8. Which of the following options would be most appropriate as a subsequence of steps in performing the reverse lookup of 145.128.16.8? In the following options "NS" is an abbreviation of "nameserver"?

[IT-GATE 2005]

[2-Marks]

(a) Query a NS for the root domain and then NS for the "dom" domains

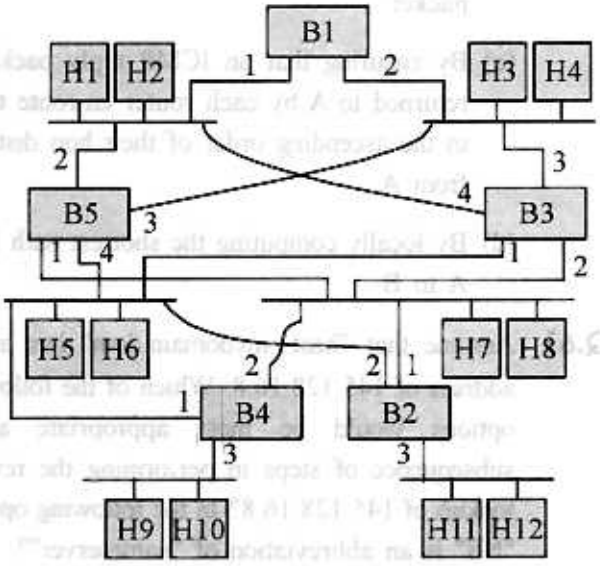
(b) Directly query a NS for "dom" and then a NS for "mydomain.dom" domains

(c) Query a NS for in-addr.arpa and then a NS for 128.145.in-addr.arpa domains

(d) Directly query a NS for 145.in-addr.arpa and then a NS for 128.145.in-addr.arpa domains

Common Data For Questions 55 & 56:

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 shortest paths from the root bridge to each bridge.



Figure

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.

Q.62 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? **[GATE 2006]**

[2-Marks]

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

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

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

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

Q.63 Consider the correct spanning tree for the previous question. Let host H1 send out a broadcast ping packet. Which of the following options represents the correct forwarding table on B3? **[GATE 2006]**

[2-Marks]

(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
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

Common Data For Questions 64 & 65:

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.64 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. **[GATE 2009]**

[2-Marks]

(a) $I = 2$

(b) $I = 3$

(c) $I = 4$

(d) $I = 5$

Q.65 Suppose that the sliding window protocol is used with the sender window size of 2^I, where I is the number of bits identified in the earlier part and acknowledgments 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). **[GATE 2009]**

[2-Marks]

(a) 16 ms

(b) 18 ms

(c) 20 ms

(d) 22 ms

Q.66 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? **[GATE 2009]**

[2-Marks]

(a) G(x) contains more than two terms

(b) G(x) does not divide $1 + x^k$, for any k not exceeding the frame length

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

(d) G (x) has an odd number of terms

ANSWER KEY

1	c	2	a	3	b	4	d	5	a
6	c	7	d	8	b	9	a	10	d
11	a	12	a	13	a	14	a	15	c
16	d	17	a	18	d	19	c	20	a
21	d	22	a	23	c	24	b	25	b
26	d	27	a	28	d	29	d	30	c
31	d	32	b	33	d	34	c	35	a
36	b	37	a	38	c	39	c	40	c
41	b	42	d	43	b	44	a	45	a
46	c	47	d	48	b	49	d	50	a
51	d	52	d	53	b	54	a	55	a
56	b	57	d	58	c	59	b	60	c
61	d	62	c	63	a	64	d	65	b
66	c								

SOLUTIONS

S.1 (c)

The **standard 802.4** describes a LAN called token bus.

S.2 (a)

HDLC does not support **balanced multipoint.**

S.3 (b)

MSB bit of the SSAP (Source Service Access Point) indicates **whether the PDU is a command or response PDU.**

S.4 (d)

Layer 2 switching creates 12 individual collision domains, but are 1 large broadcast domain.

S.5 (a)

Link Control Protocol (LCP) – Perform the negotiation.

Password Authentication Protocol (PAP) and Challenge Handshake Authentication Protocol (CHAP) – Perform the authentication.

S.6 (c)

The bridge will first create an entry in its MAC table for the new address, then forward the frame appropriately.

S.7 (d)

NRM (Normal Response Mode) is the mode in which the primary station initiates transfer to the secondary station.

ARM (Asynchronous Response Mode) is the mode in which either primary or secondary transmits to each other.

ABM (Asynchronous Balanced Mode) is the mode which uses combined stations. There is no need for permission on the part of any station in this mode.

S.8 (b)

If $s > 1$ the user is generating frames at a higher rate than the channel can handle and **nearly every frame will suffer collision.**

S.9 (a)

Option (a) is false. The right statement is:

Hardware feature of 10 base 2 coaxial cable is thin coaxial cable and **10 base 5 is thick coaxial cable.**

S.11 (a)

A FDDI network contains two rings, one as a secondary backup in case the primary ring fails. It is a ring network.

S.12 (a)

A network hub or repeater hub is a device for connecting multiple twisted pair or fiber optic ethernet devices together and making them act as a single network segment. It works at the physical layer.

S.13 (a)

ALOHA uses ground based radio broadcasting. The ALOHA **system was connected to allow radio communication between machines and solve the channel allocation problem.**

S.14 (a)

Pure ALOHA does not require global time synchronization but slotted ALOHA does.

S.15 (c)

In slotted ALOHA, the time on the channel is **divided into discrete intervals**, each interval corresponding to frame transmission time and **it also require global time synchronization.**

S.16 (d)

Baseband and broadband are the two common types of coax cabling transmission methods.

S.18 (d)

The operation and format of LLC (Logical Link Control) is based on **HDLC.**

S.19 (c)

MAC is the data link layer address of NIC that cannot be modified.

S.21 (d)

LLC sublayer of **datalink layer provides flow control, acknowledgement and error control** whereas the MAC sublayer provides framing and frame synchronization.

S.22 (a)

High-Level Data Link Conltrol (HDLC) is a bit-oriented synchronous data link layer protocol.

S.24 (b)

Broadcasting refers to a method of transferring data message to all recipients simultaneously.

S.27 (a)

The flag field of HDLC frame is an eight bit sequence with a bit pattern 01111110, that identifies both the beginning and end of the frame and serves as a synchronization pattern for the receiver.

S.28 (d)

Access Control (AC) is one byte long and include four subfields. It has the format PPPTMRRR. **The first three bits are priority field.** T denotes token bit. **The last three bits (monitor bits) are reservation field** that can be set by stations reserve access to the ring.

S.29 (d)

When timer goes off, some action is generally repeated. If it is truly necessary, it is ok but repeating it unnecessarily is wasteful. **A timer that goes off when it should not have used up scarce CPU time, waste bandwidth and puts extra load on routers.**

S.30 (c)

t_F = 10 m sec

In one second 4×10^6 bits are carried

Thus, in 10 msec, no of bits = $4\times10^6\times10\times10^{-3}$

= 40,000 bits

Thus, frame size is 40,000 bits.

S.31 (d)

Stop and wait ARQ (Automatic Repeat Request) is similar to stop and wait flow control protocol, but includes retransmission of data in case of lost or damaged frames.

Both data and ACK frames are numbered alternately 0 and 1. But **NAK frame, tells the sender to retransmit the frame last sent.**

S.32 (b)

In the case of go back n protocol, when a NAK is received , all the frames sent since the last frame acknowledged are retransmitted.

Go.....> Back .....> n.

S.34 (c)

Poll/select is a line discipline method.

The primary device always initiates communication with either a poll or select (SEL) frame. In this point the secondary device sends data in response to a poll frame event.

S.35 (a)

In sliding window flow control the window size is 63, **the range of sequence numbers are 0 to 63** {0.....63}.

S.36 (b)

In sliding window protocol, the window size is n–1, **then its maximum capacity is n–1.**

S.37 (a)

Address Resolution Protocol (ARP) maps a know logical address (IP address) to a physical address (MAC address).

When a host wants to send traffic to a host that isn't on the local segment, the first thing it does is ARP for its default gateway. It sends out a message that says something like: "I know my gateway is 192.168.1.1 but I don't know the MAC address. I checked my ARP cache and didn't see an entry that mapped 192.168.1.1 to a MAC address . can someone tell me who this is ?"

IARP (Inverse Address Resolution Protocol) is what frame relay uses to map a Data Link Connection Identifier (DLDI) to an IP address.

SLARP (Serial Line Address Resolution Protocol) is used when a router attempts to request an IP address for a serial interface.

RARP (Reverse Address Resolution Protocol) is the exact opposite of ARP (mapping a known MAC address to an unknown IP address). This was used by "diskless" workstations to get an IP address. It is some what similar to DHCP.

S.38 (c)

The hamming distance between two strings of equal length is the number of positions at which the corresponding symbols are different.

S.39 (c)

The Huffman code for A will have 2 digits, **B-3 digits**, C-3 digits, D-2 digits and E-2 digits. This can be obtained by constructing the binary tree corresponding to the given probabilities.

S.41 (b)

Average code length is the sum of product of the length and probability of the occurrence of the symbols. Here it is, $2 \times 0.3 + 3 \times 0.15 + 3 \times 0.1 + 2 \times 0.25 + 2 \times 0.2 = \mathbf{2.25}$.

S.42 (d)

Data rate = 20 kbps

t_p = 100 msec

Efficiency = 50%

Frame size = L

20×10^3 bits are transmitted in 1 sec

Also, L bits are transmitted in t_f sec

$\therefore t_f = \dfrac{L}{20 \times 10^3}$

For stop and wait,

Channel utilization $U = \dfrac{1}{1+2A}$

Where $A = \dfrac{t_p}{t_f}$

$$0.5 = \frac{1}{1+2\left(\frac{100\times10^{-3}}{L/20\times10^3}\right)} = \frac{1}{1+2\left(\frac{2000}{L}\right)}$$

$\therefore$ **L = 4000 bits.**

S.43 (b)

No. of request = 50/sec

Slot time = 40 msec

No. of slots per second $= \dfrac{1}{40\,\text{msec}} = 25$

$$\therefore \quad \text{channel load} = \frac{\text{No.of request/sec}}{\text{No.of slots/sec}}$$

$$= \frac{50}{25} = 2$$

$\therefore$ **channel load = 2**

S.44 (a)

Total size of the image in bits

$= 1024 \times 768 \times 3 \times 8 = 18874368$ bits

Data rate = 56 kbps

$= 56 \times 1024$ bps

$\therefore$ time to transmit the image

$$= \frac{\text{image size in bits}}{\text{transfer rate}}$$

$$= \frac{18874368}{56\times1024} = \mathbf{329.14\ sec}$$

S.45 (a)

The mean router path is twice THE MEAN ROUTER–ROOT PATH.

Let the levels of the tree with the root as 1 and the deepest level as n.

The path from the root to level n requires (n–1) hops, and 0.50 of the routers are at this level.

The path from the root to level (n–1) has 0.25 of the routers, and a length of (n–2) hops

$\therefore$ Mean path length

$\ell = 0.5(n-1) + 0.25(n-2) + 0.125(n-3) + \ldots$

$$= \sum_{i=1}^{\infty} n(0.5)i - \sum_{i=1}^{\infty} i(0.5)i$$

The expression reduces to $\ell = n - 2$

$\therefore$ **mean number of hops/msg = 2n – 4**

S.46 (c)

For sliding window,

Data rate = 64 kbps

Frame size L = 512 bytes

= 512 × 8 bits

= 4096 bits

t_p = 270 msec

W = 1

$$t_F = \frac{\text{Frame size}}{\text{Data rate}} = \frac{4096}{64\times10^3} = 64 \text{ msec}$$

$$\text{Throughput} = \frac{W.L.}{t_f + 2t_p} = \frac{4096}{64 + 2\times270}$$

$$= \frac{4096}{64+2\times270} = \textbf{6.78 Kbps}$$

S.47 (d)

$$\text{No. of slots per second} = \frac{1}{50\,\text{msec}}$$

$$= 20$$

$$\therefore \text{ Channel load} = \frac{\text{No. of request/sec}}{\text{No. of slots/sec}}$$

$$= \frac{100}{20} = 5$$

we know, Poission Distribution,

$$P_k = \frac{G^k . e^{-G}}{K!}$$

For the success on the first attempt,

K = 0

$$\therefore P_0 = e^{-G} = e^{-5} = \textbf{6.73×10}^{-3}$$

S.48 (b)

$$\text{No. of slots per second} = \frac{1}{40 \text{ msec}} = 25$$

$$\text{channel load} = \frac{\text{No.of request/sec}}{\text{No.of slots/sec}}$$

$$= \frac{50}{25}$$

$$= 2$$

Now, probability of a transmission requiring exactly K attempts is

$P_K = e^{-G} (1-e^{-G})^{K-1}$

we have K = 6 (Five collisions followed by success) and G = 2

$P_6 = e^{-2} (1-e^{-2})^5 = 0.1353 (1-0.1353)^5$

= **0.06521**

S.49 (d)

$$\text{No. of output bits every sec} = \frac{1000}{100}$$

=10 bits/sec

Thus each station outputs 10 bits/sec.

If we have N stations, then total number of bits transmitted by all N stations in one second would be 10 N bits.

Usable bandwidth = Efficiency × Data rate

= 18.4% × 56 kbps

= 10.3 kbps

∵ Efficiency of pure ALOHA is 18.4%

∴ 10 N = 10300

N = 1030 bps

S.50 (a)

$$\text{Each station makes} = \frac{18}{3600} \text{ requests/sec.}$$

$$\therefore \text{ Total no. of request} = \frac{18}{3600}\times10000$$

= 50 request/sec.

Slot time = 125 μsec

$$\text{No. of slots} = \frac{1}{125\mu\text{sec}}$$

= 8000/sec.

∴ Total channel load,

$$G = \frac{\text{No.of request/sec}}{\text{No.of slots/sec}}$$

$$= \frac{50}{8000}$$

$$\mathbf{G = \frac{1}{160}}$$

S.51 (d)

Data rate = 1 Gbps = 10^9 bps

Cable length = 1 km

Single speed = 200,000 km/sec

= 2×10^8 m/sec

For CSMA/CD Ethernet LAN,

$t_f \geq 2\ t_p$

$t_{Fmin} = 2\ t_p$

Signal in 1 sec travels 2×10^8 m

Signal in t_p travels 1000 m

$\therefore \quad t_p = \frac{1000}{2\times10^8} = 5\mu sec$

$\therefore \quad t_{Fmin} = 2 \times 5\ \mu sec = 10\ \mu sec$

$$t_f = \frac{\text{Frame size}}{\text{Data rate}}$$

$\therefore$ Frame size = Data rate $\times\ t_F$

= $10^9 \times 10\times10^{-6}$ = **10,000 bits**

S.52 (d)

10 Base 5 is thick coaxial cable

cable length = 2500 m

Signal speed = 60% $\times$ (3×10^8)

= 1.8×10^8 m/s.

In one second signal travels 1.8×10^8 m

Thus in t_p second signal travels 2500 m

$$\therefore \quad t_p = \frac{2500}{1.8\times10^8} = \textbf{13.89 } \mu\textbf{sec}$$

S.53 (b)

Cable length = 100 km

Data rate = 1.536 Mbps

$$\text{Signal speed} = \frac{2}{3}\times3\times10^8 \text{m/s}$$

= 2×10^8 m/sec

In one second signal travels 2×10^8 m

In t_p second signal travels 100×10^3 m

$$\therefore \quad t_p = \frac{100\times10^3}{2\times10^8} = 500\,\mu sec$$

In one second 1.536×10^6 bits are carried in the cable.

Thus we need to find out number of bits that fit into the cable in 500 μ sec.

$\therefore$ No. of bits in the cable

= $1.536 \times 10^6 \times 500\times10^{-6}$

= **768 bits**

S.54 (a)

Data rate = B bits/ sec

Frame size = L bits

$2\ t_p$ = R sec

$$\therefore\ t_p = \frac{R}{2} \text{sec}$$

For stop and wait method,

$$\text{Channel utilization } U = \frac{t_F}{t_F + 2t_p}$$

For finding t_F:

B bits are transmitted in 1 second

L bits are transmitted in t_F second

$$\therefore\ t_F = \frac{L}{B}$$

$$\therefore\ U = \frac{\frac{L}{B}}{\frac{L}{B}+R}$$

S.56 (b)

As bit stuffing is used and delimiter flag is given by 0111, so in stuffing it will put zero (0) after two consecutive 0's. Hence, 01110110 will be transmitted as **011010110**

S.57 (d)

Destination port number is not the part of the IP header.

S.58 (c)

Total payload to be transmitted is 2100 bytes in the first n/w payload size is 1200 bytes. So 2100 bytes will be carried in 2 frames

$1200 + 900 = 2100$

and given that 20 bytes IP overhead is for one frames so now total bytes

$2100 + 2 \times 20 = 2140$

Now this payload of 2140 byte is carried of size 400 bytes frame in second n/w

So total frame in second n/w will be constructed

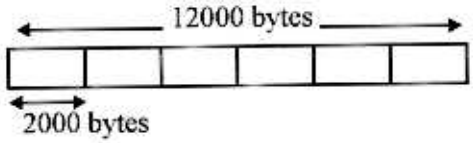
$400 \times 5 + 140 = 2140$ bytes

$\downarrow \quad \downarrow$

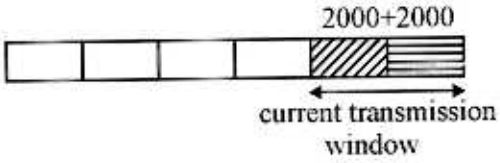
$5 + 1 = 6$ frames

The IP overhead of one frame is 20 byte so total IP overhead for 6 frames is $20 \times 6 =$ **120 bytes**

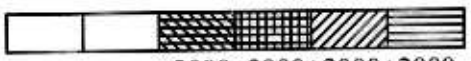
S.59 (b)



window is of 6 packets



Now two acknowledgment has been received window size will be increased by two packets



Now current transmission window size is **8000 bytes.**

S.60 (c)

Trace-route reports by ensuring that an ICMP reply packet is returned to Host A by each router en-route to Host B, in the ascending order of their hop distance from A

S.61 (d)

Reverse DNS lookup is the determination of domain name that is associated with a given IP address using the Domain name system (DNS) of the internet.

Address record for "host1.mydomain.dom" points to the IP address 145.128.168. In pointer records of the reverse database, this IP address is stored as the domain name 8.16.128.145.in-addr.arpa pointing back to its designated host name "host1.mydomain.dom".

S.62 (c)

For the given connection of LANs by bridges the depth first traversal is B1, B5, B2, B3, B4

The traversal method uses the procedure as:

(i) Visit the root.

(ii) Traverse the left subtree.

(iii) Traverse the right subtree.

Note: Favour is given to the port having lower iandex value.

S.63 (a)

The forwarding table for B_3 is

Hosts	Port
H_1, H_2, H_3, H_4	3
H_5, H_6, H_9, H_{10}	1
H_7, H_8, H_{11}, H_{12}	2

S.64 (d)

The link is a Duplex hence we need not wait for twice the propagation time for sending the frame belonging to next window. If the sender window is of size N.

Transmitting 10^6 bits require = 1 sec

$$\therefore \text{ N} \times 1000 \text{ bit require} = \frac{1}{10^6} \text{N} \times 10^3$$

$$= \text{N} \times 10^{-3} \text{ sec}$$

$$= \text{N msec}$$

Therefore

N msec = 25 msec

N = 25

$\therefore$ **Minimum no. of bits required is 5 to represent sequence number distinctly.**

S.65 (b)

Time taken to send 10^6 bits = 1 sec

$\therefore$ Time taken to send 25 frames = 32 msec (1 frame = 1000 bits)

Time taken for the first frame to be acknowledged = 25 × 2 = 50 ms. Then waiting time = 50 – 32 = **18 ms.**

S.66 (c)

The polynomial generator used for CRC checking must satisfy at least two conditions

1. It should be not divisible by x
2. It should be divisible by 1 + x

Therefore (1+x) is a factor of G(x).

10.3 NETWORK LAYER

LEVEL–1

Q.1 What addressing information is shipped with every network interface card?

(a) The internet protocol (IP) address

(b) The physical (MAC) address

(c) The address resolution protocol (ARP) address

(d) All of these

Q.2 What phrase best defines a hub?

(a) A hub is a multiport repeater.

(b) A hub is a device that routes at the internet layer of the TCP/IP suite.

(c) A hub is a device that routes at the datalink sublayer of the network access layer of the TCP/IP suite.

(d) None of the above

Q.3 Which of the following statements are true about routers and bridges?

(a) Bridges connect two networks at the transport layer

(b) Bridges are type of inexpensive routers

(c) Routers are improved bridges

(d) Routers connect two networks at the network layer

Q.4 Most network empty devices for routing services. Routers work at which of the following OSI layer?

(a) Transport

(b) Network

(c) Presentation

(d) Application

Q.5 IGRP stands for

(a) Interior Gateway Routing Protocol

(b) Internal Gateway Routing Protocol

(c) Internet Gigabit Routing Protocol

(d) Interior Gigabit Routing Protocol

Q.6 Which one of the following is true?

(i) Transmission is a physical movement of information

(ii) Communication means the meaningful exchange of information between two communication entities.

(a) (i)

(b) (ii)

(c) Both (i) and (ii)

(d) Neither (i) nor (ii)

Q.7 Which of the following is true about IGMP?

(i) The objective of each host in using IGMP is to make itself known as a member of a group with a given multicast address to all routers on the LAN

(ii) The group address field of the IGMP message and the destination address field the encapsulating IP header are the same

(iii) To maintain a valid current list of active group addresses. A multicast router periodically issues an IGMP query message sent in an IP datagram with an all hosts multicast address

(iv) ICMPv6 includes all the functionality of ICMPv4 and IGMP

(a) Only (iv)

(b) Only (i) and (ii)

(c) All of the above

(d) None of the above

Q.8 Communication via circuit switching involves three phase which are

(a) Circuit establishment, Data transfer, Circuit disconnect

(b) Circuit making, Data compression, Circuit disconnect

(c) Circuit transfer, Data Compression, Circuit disconnect

(d) Circuit establishment, Data compression, Circuit disconnect

Q.9 Your primary concern is LAN security. You want to subnet your internal network with a device that provides security and stability. Which of the following devices do you choose to meet these needs?

(a) Static router

(b) Dynamic router

(c) Static switch

(d) Dynamic switch

Q.10 Which one of the following are connectionless?

(a) Frame Relay

(b) ATM

(c) SMDS

(d) None of these

Q.11 You manage a company network and the network budget. You want to minimize costs, but desire to prevent hackers from sniffing your local area network (LAN). Which of the following devices would you recommend to meet your goals?

(a) Hub

(b) Switch

(c) Router

(d) Bridge

Q.12 What is a router?

(a) A hardware device that connects dissimilar networks, such as Cat 5 cabling and FDDI

(b) A network host that reads the source and destination addresses in the packet header and makes decisions about where to forward the packet

(c) A network host that can forward LAN based email messages onto the internet, after repackaging them into the SMTP format

(d) A software system that can translate between dissimilar networks such as Ethernet and Token ring

Q.13 SLIP is

(a) Protocol used for transmission of IP datagrams across a serial line

(b) Signal line information protocol

(c) Protocol used to exchange information between the routers

(d) Protocol used to exchange information between the layers

Q.14 In virtual circuit approach a route is established _____ are sent

(a) after packets

(b) before packets

(c) after data

(d) before data

Q.15 What is the difference between DTE and DCE devices?

(a) DTE does the clocking, DCE goes according to that clocking

(b) DCE does the clocking, DTE goes according to that clocking

(c) DTE devices are capable of routing, DCE are not

(d) DCE devices are capable of routing, DTE are not.

Q.16 The network layer provides following two related services to make end to end delivery possible

(i) Switching

(ii) Initialization

(iii) Disconnect

(iv) Routing

(a) Both (i) and (iv)

(b) Only (ii)

(c) Both (i) and (iii)

(d) Only (i)

Q.17 Which of the following statement is incorrect?

(i) A repeater is a regenerator, not an amplifier.

(ii) A repeater must be placed so that a signal reaches it before any noise changes the meaning of any of its bits.

(iii) A repeater placed on the line before the legibility of the signal becomes lost can still read the signal well enough to determine the intended voltages and replicate them in their original form.

(a) (i), (ii) and (iii)

(b) (i) and (iii)

(c) (i) and (ii)

(d) None of these

Q.18 Which of the following statements are true?

(i) Routing protocols update the routing tables of a router

(ii) Routing protocols determine the path of a packet through a network

(iii) Routing protocols are assigned to a router interface and determine the method of packet delivery

(a) (i) and (ii)

(b) (ii) and (iii)

(c) (i), (ii) and (iii)

(d) None of the above

Q.19 The subnet broadcast address, and valid host range for 172.16 10.33 and 255.255.255.224 is:

(a) 172.16.10.32, 172.16.10.63, 172.16.10.33 through 10.62

(b) 172.16.10.32, 172.16.10.65, 172.16.10.33 through 10.62

(c) 172.16.10.32, 172.16.10.65, 172.16.10.32 through 10.65

(d) 172.16.10.32, 172.16.10.63, 172.16.10.32 through 10.63

Q.20 Which of the following functionality must be implemented by a transport protocol over and above the network protocol?

(a) Recovery from packet losses

(b) End to end connectivity

(c) Packet delivery in the correct order

(d) None of above

Q.21 At which layer of the OSI reference model will you find the protocols necessary to assemble packets of data into a coherent message?

(a) At the session layer

(b) At the transport layer

(c) At the datalink layer

(d) At the presentation layer

Q.22 What is the most dominant LAN technology?

(a) Ethernet

(b) Asynchronous Transfer Mode

(c) Token Ring

(d) Token Bus

Q.23 X 25 standard specifies a

(a) Technique for start/stop data

(b) Technique for dial access

(c) DTE/DCE interface

(d) Data bit rate

Q.24 On a digital circuit, the absence of a transmitted signal

(a) has no effect on equipment

(b) occurs when a DTE has no data transmit

(c) is compensated by the transmission of bipolar violations to maintain equipment clocking

(b) occurs only in some fixed time interval

Q.25 The _____ measures the number of lost or garbled messages as a fraction of the total sent in the sampling period.

(a) Residual Error rate

(b) Transfer failure probability

(c) Connection release failure probability

(d) Connection establishment failure probability

LEVEL–2

Q.26 You have an IP of 156.233.42.56 with subnet mask of 7 bits. How many hosts and subnets are possible?

(a) 126 hosts and 510 subnets

(b) 128 subnets and 512 hosts

(c) 510 hosts and 126 subnets

(d) None of the above

Q.27 You have a class C 192.168.10.0/28 network. How many usable subnets and hosts do you have?

(a) 16 subnets, 16 hosts

(b) 14 subnets, 14 hosts

(c) 20 subnets, 6 hosts

(d) 50 subnets, 2 hosts

Q.28 ICMP's address mask request and address mask reply message

(a) are useful in an environment that includes subnets

(b) allows a host to learn the address mask for the LAN to which it connects

(c) Both (a) and (b)

(d) None of the above

Q.29 Which of the following could be a unicast?

(a) 10.3.1.27/30

(b) 255.255.255.255

(c) 172.16.128.255/18

(d) 192.168.10.48/29

Q.30 What valid host range is the IP address 172.16.10.22 255.255.255.240 a part of?

(a) 172.16.10.20 through 172.16.10.22

(b) 172.16.10.1 through 172.16.10.255

(c) 172.16.10.17 through 172.16.10.30

(d) None of the above

Q.31 If the routing table has a static RIP, and an IGRP route to the same network, which route will be used to route packets by default?

(a) Any route

(b) RIP route

(c) Static route

(d) IGRP route

Q.32 You have a network 192.168.10.0/24. How many subnets and hosts are available?

(a) 10 subnet with 10 hosts

(b) 1 subnet with 254 hosts

(c) 1 subnet with 1 host

(d) 254 subnets with 254 hosts

Q.33 Which of the following assertion 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 forwarded 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 tables in the routers on the way

Q.34 Match the following:

Group I		Group II	
P.	SMTP	1.	Application layer
Q.	BGP	2.	Transport layer
R.	TCP	3.	Data link layer
S.	PPP	4.	Network layer
		5.	Physical layer

(a) P-2,Q-1,R-3,S-5

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

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

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

Q.35 For stop-and-wait flow control, for n data packets are sent, the number of acknowledgments needed are

(a) n

(b) 2n

(c) n – 1

(d) n + 1

Q.36 Which of the following addresses does not belong to the same network (no subnetting)?

(i) 123.4.6.2

(ii) 123.4.78.9

(iii) 132.14.56.12

(iv) 123.4.0.0

(a) Only (i)

(b) Only (i) and (ii)

(c) Only (iii)

(d) Only (i),(ii) and (iv)

GATE QUESTIONS

Q.37 Which one of the following statements is FALSE? **[IT-GATE 2004] [1 Mark]**

(a) TCP guarantees a minimum communication rate

(b) TCP ensure in-order delivery

(c) TCP reacts to congestion by reducing sender window size

(d) TCP employs retransmission to compensate for packet loss

Q.38 Which one of the following statement is FALSE? **[IT-GATE 2004] [1 Mark]**

(a) HTTP runs over TCP

(b) HTTP describes the structure of web pages

(c) HTTP allows information to be stored in a URL

(d) HTTP can be used test the validity of a hypertext link

Q.39 In TCP, a unique sequence number is assigned to each **[IT-GATE 2004] [1 Mark]**

(a) byte

(b) word

(c) segment

(d) message

Q.40 Which of the following statements is TRUE about CSMA/CD **[IT-GATE 2005] [1 Mark]**

(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

Q.41 A network with CSMA/CD protocol in the MAC layer is running at 1 Gbps 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. **[IT-GATE 2005]**

[2-Marks]

(a) 10000 bits
(b) 10000 bytes
(c) 5000 bits
(d) 5000 bytes

Q.42 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: **[IT-GATE 2005]**

[2-Marks]

(a) 01110
(b) 01011
(c) 10101
(d) 10110

Q.43 Suppose that two parties A and B wish to setup a common secret key (D-H key) between themselves using the Diffie-Hellman key exchange technique. They agree on 7 as the modulus and 3 as the primitive root. Party A chooses 2 and party B chooses 5 as their respective secrets. Their D-H key is: **[IT-GATE 2005]**

[2-Marks]

(a) 3
(b) 4
(c) 5
(d) 6

Q.44 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 **[GATE 2005]**

[2-Marks]

(a) 4
(b) 6
(c) 7
(d) 9

Q.45 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 **[GATE 2005]**

[2-Marks]

(a) 94
(b) 416
(c) 464
(d) 512

Q.46 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 5^{th} 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? **[GATE 2006]**

[2-Marks]

(a) 12
(b) 14
(c) 16
(d) 18

Q.47 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? **[GATE 2006]**

[2-Marks]

(a) 20
(b) 40
(c) 160
(d) 320

Q.48 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: **[GATE 2007]**

[2-Marks]

(a) 11001001000
(b) 11001001011
(c) 11001010
(d) 110010010011

Q.49 The distance between two stations M and N is L kilometers. All frames are K bits long. The propagation delay per kilometer is t seconds Let R bits/second be the channel capacity. Assuming that 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: **[GATE 2007]**

[2-Marks]

(a) $\left[\log_2 \frac{2LtR + 2K}{K}\right]$

(b) $\left[\log_2 \frac{2LtR}{K}\right]$

(c) $\left[\log_2 \frac{2LtR + K}{K}\right]$

(d) $\left[\log_2 \frac{2LtR + K}{2K}\right]$

ANSWER KEY

1	b	2	a	3	d	4	b	5	a
6	c	7	c	8	a	9	a	10	c
11	b	12	b	13	a	14	b	15	b
16	a	17	d	18	a	19	a	20	b
21	b	22	a	23	c	24	c	25	a
26	c	27	b	28	c	29	c	30	c
31	c	32	b	33	d	34	b	35	a
36	c	37	a	38	b	39	d	40	c
41	a	42	a	43	b	44	d	45	d
46	c	47	b	48	b	49	b		

SOLUTIONS

S.1 (b)

A network interface card, network adapter, network interface controller (NIC) or LAN adapter is a computer hardware component designed to allow computers to communicate over a computer network and provides physical access to a networking medium and provides a low-level addressing system, through the use of MAC addresses.

S.2 (a)

Option (b) simply defines a router.

Option (c) simply defines a switch.

S.3 (d)

Bridge connects two network at the Data link layer and **router connect two networks at the Network layer.**

S.4 (b)

Routers work at the **Network layer.**

S.5 (a)

IGRP is Interior Gateway Routing Protocol.

S.8 (a)

Circuit establishment, Data transfer, Circuit disconnect. In Circuit Switching networks the connection provides for transmission at constant data rate.

S.10 (c)

ATM's and frame Relys are connection oriented, unreliable protocol whereas **SMDS (Switched Multimegabit Data service) is a connectionless system.**

S.11 (b)

A **switch** will meet your goals for this situation.

S.12 (b)

Some routers also perform gateway functions.

S.13 (a)

SLIP (Serial Line Interface Protocol) is a very simple protocol used for transmission of IP datagrams across a serial line.

S.14 (b)

In virtual circuit approach a route is established **before packets are sent**.

S.15 (b)

DCE (Data Circuit-terminating Equipment) does the clocking, DTE (Data Terminal Equipment) goes according to that clocking.

S.16 (a)

Both Switching and Routing.

S.17 (d)

(i), (ii) and (iii) are correct statement about the repeater.

S.19 (a)

Here,

256 – 224 = 32, 64

In the fourth oclet, the host address is 33, that is between 32 and 64, so the host is in the 32 subnet, which has a broadcast address of 63 and the valid host range is 33–62. Remember that the subnet is 10.32, because the third octet is part of the subent address.

S.20 (b)

The transport protocol provides an **end to end** connectivity that shields network layer protocol from the details of the intervening network or networks. A transport protocol can be either connection oriented such as TCP, or connectionless such as UDP.

S.21 (b)

The session layer is responsible for node to node communication.

The datalink layer is responsible for logical link control and medium access control.

The presentation layer is responsible for the delivery and formatting of inforamtion to the application layer.

The transport layer is responsible for encapsulating application data blocks into data units, suitable for transfer to the network infrastructure for transmission to the destination host.

S.22 (a)

Token ring has less than 30% of the market share.

ATM has less than 5% of the market share.

Ethernet is by far the most commonly used local area network (LAN) technology.

S.23 (c)

The X.25 specification defines only the interface between a subscriber (DTE) and an X.25 network (DCE).

S.26 (c)

Class B network has the form N.N.H.H, the default mask is 16 bits long.

There is additional 7 bits to the default subnet mask. The total number of bits in subnet are 16 + 7 = 23.

This leaves us with 32 – 23 = 9 bits for assigning to hosts.

7 bits of subnet mask corresponds to $(2^7 - 2)$ = **126 subnets.**

9 bits belonging to host addresses correspond to $(2^9 - 2) = 512 - 2 =$ **510 hosts.**

S.27 (b)

You must know that / 28 is 2555.255.225.240. 256–240 = 16. Subtracting 2 from this number form all subnet bits and host bits on/off, so the answer is **14 subnets with 14 hosts each.**

S.28 (c)

The host broadcast an address mask request on the LAN. The router on the LAN responds with address mask reply message that contains the address mask.

S.29 (c)

A unicast is a broadcast that is forwarded to a specific host. Only option (c) is a valid host, the rest are broadcast addresses. 172.16.128.255/18 is 255.255.192.0. The valid networks are 64.0 and 128.0, where the broadcast address for the 172.16.128.0 subnet is 172.16.191.255

So the valid hosts are 128.1 through 191.254.172.161.128.255 is a valid host and is a unicast.

S.30 (c)

This is a class B network address with 12 bits of subnetting 8 in the third octet and 4 in the fourth octet. The subnet in the third octet is 10, and the subnets in the fourth octet are 256–240–16,32,48 etc. Since the fourth octet is using 22, the host is in the 16 subnet, and since the next subnet is 32, the broadcast address for the 16 subnet is 31. The valid host range is the numbers in between, 17–30.

S.31 (c)

Administrative distance is the first criterion that a router uses to determine which routing protocol to use if two protocols provide route information for the same destination. The smaller the administrative distance value, the more reliable the protocol.

Static routes have an administrative distance of 1 by default. Unless that distance changed, the router will always use that route over any other found route. **IGRP's administrative distance = 100 while that of RIP is 120.**

S.32 (b)

192.168.10.0/24 is a class C network using a default mask. This provides a simple **single network with 254 hosts.**

S.33 (d)

Consider each choice separately

Choice (a): It is possible for a computer to have multiple IP addresses specify the network connection not to a host computer so if a host computer moves from one network to another, its IP address must change. In the network the IP address for a computer is unique but when we move the host computer from one network to another network its IP address must be changed.

Choice (b): IP packets from the same source to the same destination can take different routes in network. In packet switching network the routes are determined by routing algorithms. It may be possible that different network follows different routing algorithm so the statement is true.

Choice (c): IP ensures that a packet is discarded if it is unable to reach its destination within a given number of hops so statement is true.

Choice (d): The packet source cannot set the route of an outgoing packet, the route is determined only by the routing tables in the routers on the way. The usual IP routing algorithm employs an Internet routing table on each machine (computer) that stores information about possible destination and how to reach them. Because both hosts (computer) and routers route datagrams both have IP routing tables so the statement is false.

S.34 (b)

P. SMTP = Application layer Protocol

Q. BGP = Network Layer protocol

R. TCP = Transport Layer protocol

S. PPP = Data Link Layer Protocol

S.35 (a)

Stop- and-wait flow control is the simplest form of flow control where a sender transmits a data frame. After receiving the frame, the receiver indicates its willingness to accept another frame by sending back an ACK frame acknowledging the frame just received. The sender must wait until it receives the ACK frame before sending the next data frame. Therefore when n data

packets are sent, the number of acknowledgments needed are equal to the data packets sent i.e. n.

S.36 (c)

For class 'A' the range of IP address is from 0.0.0.0 to 127.255.255.255, with first octet defining the network that is 123, is the net id. The remaining 3 octets are defined the host ids.

While 132.14.56.12 belongs to class B 123.4.6.2, 123.4.78.9 and 123.4.0.0 belong to the same network i.e. network A.

S.37 (a)

TCP does not guarantees a minimum communication rate.

S.38 (b)

HTTP stands for Hyper Text Transfer Protocol and **does not contain any information about the structure of web pages.**

S.39 (d)

In TCP, a unique sequence number assigned to each **message.**

S.40 (c)

The CSMA/CD is not suitable for a high propagation delay network because frame size depends on twice the largest propagation delay between any two stations in LAN.

So if frame size increase propagation delay increases and in this case a single station may transmit data most of time and increase waiting time for other station that is far. Thus channel utilization decreases.

S.41 (a)

Round trip time for covering 2000 m is

$$= \frac{2\times 1000}{2\times 10^8} = 1000\times 10^{-8} = 10\mu\text{sec}$$

bits transmit over 1 Gbps link with 10 μs

If 1 bit take 1 nsec = 10^{-9} sec

then, 10,000 bits takes 10 μs.

S.42 (a)

Polynomial $D = X^5 + X^4 + X^2 + 1$

$= 110101$

$M = 1010001101$

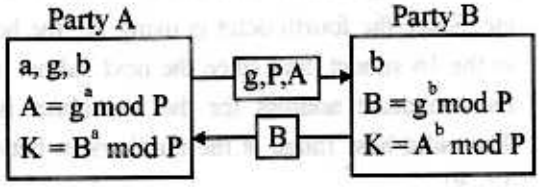
Cyclic redundancy check

$$\begin{array}{r} 110101 \overline{)1010001101 00000} \\ 110101 \\ \hline \times 111011 \\ 110101 \\ \hline \times 111010 \\ 110101 \\ \hline \times 111110 \\ 110101 \\ \hline \times 101100 \\ 110101 \\ \hline \times 110010 \\ 110101 \\ \hline \times 01110 \end{array}$$

So CRC check bits → 01110

S.43 (b)

Diffic-Hellman key exchange technique work as given below



where p is prime and g is primitive root of p.

$\because$ p = 7, g = 3

party A choose a = 2,

party B choose b = 5

Then $A = 3^2 \bmod 7 = 2$ (at party A)

$B = 3^5 \bmod 7 = 5$ (at party B)

$K = 5^2 \bmod 7 = 4$ (at party A)

$K = 2^5 \bmod 7 = 4$ (at party B)

So their D-H key is = 4

S.44 (d)

Let S denotes the source station and D denotes the destination station x and y are two intermediate nodes between S and D.

S x y D

Message size = 24 bytes, header (control

information) = 3 bytes consider the first choice (a).

Packet size = 4 then message size = 4–3=1 byte so it requires 24 packeets each containing 3 byte header so the transmission time for header overhead is increased. Consider the second, third and fourth choices.

(b) Packet size = 6 then message size = 6–3=3 byte (require 8 packets)

(c) Packet size = 7 then message size 7–3=4 byte (require 6 packets)

(d) Packet size = 9 then message size = 9 –3 = 6 bytes (require 4 packets)

So, 4 packet is the optimal message size and 9 is the optimal packet size.

S.45 (d)

Propagation delay = 46.4 μsec.

$= 46.4 \times 10^{-6}$ sec.

Channel rate = 10 Mbps

$= 10 \times 10^{6}$ bps

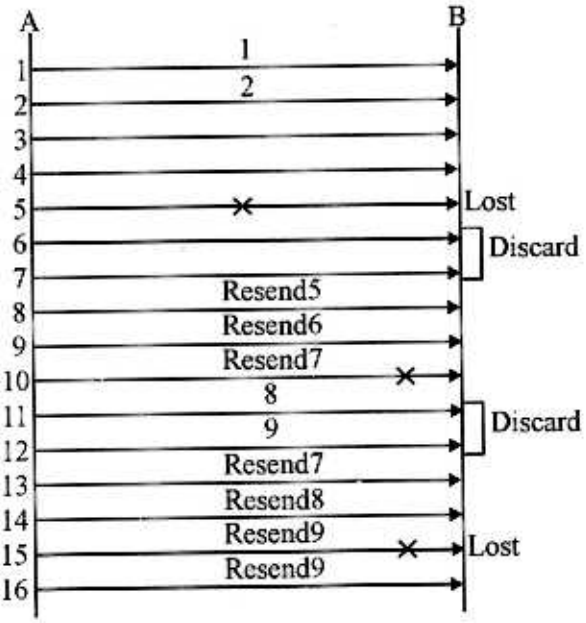
Frame size $= 46.4 \times 10^{-6} \times 10 \times 10^{6}$

= 464 bits.

But actual frame size = 464 + 48 bit jamming signal

= **512**

S.46 (c)



S.47 (b)

Given round trip delay $t = 80$ ms

$= 80 \times 10^{-3}$ sec

$R = 128$ kbps

$= 128 \times 10^{3}$ bps

$L = Rt$

$= 128 \times 10^{3} \times 80 \times 10^{-3}$

So, optional window size $= n$

$$= \frac{128 \times 80}{32 \times 8}$$

$$= \frac{10240}{256}$$

$$n = 40$$

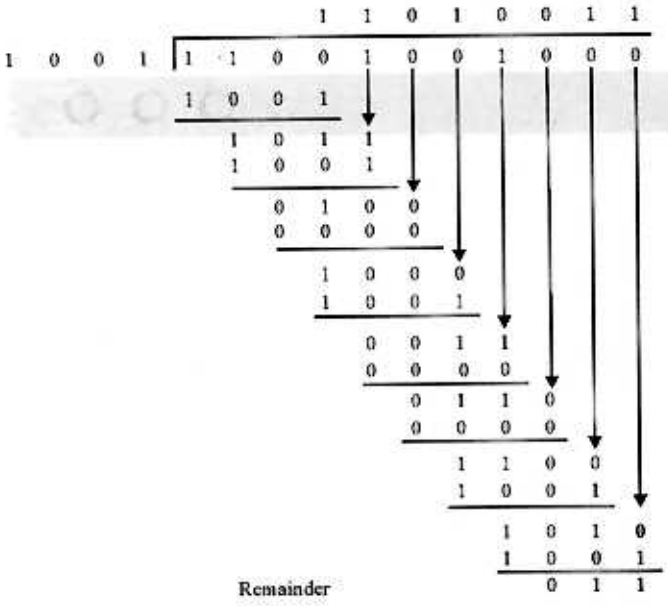
S.48 (b)

Frame : 11001001

Generator: $x^3 + 1 = 1001$

Message after 3 zero bits are appended:

11001001000



Transmitted frame : 11001001011

S.49 (b)

Frame size = K bits long

Propagation delay = t sec/km

Channel capacity = R bit/sec

Distance between station = L kms.

Total propagation delay = Lt sec.

Roundtrip time = 2 × Lt = 2 Lt sec.

Number of bits transmitted in roundtrip = 2LtR bits.

$$\text{Number of frames} = \frac{2LtR}{K}$$

Let the number of bits in sequent number of frames be b.

So, $$2^b = \frac{2LtR}{K}$$

$$b = \left[\log_2 \frac{2LtR}{K}\right]$$

10.4 TRANSPORT LAYER

LEVEL–1

Q.1 You have been using a network monitor or protocol analyzer to monitor Internet packets. One of the message sent has an IP header protocol field value of "1". What does this value classify?

(a) UDP

(b) ICMP

(c) IGMP

(d) TCP

Q.2 A network layer protocol defined by TCP/IP is

(a) TCP

(b) UDP

(c) IP

(d) None of these

Q.3 The file transfer protocol (FTP) requires a reliable transport service. Which protocol of the TCP/IP suite does it use?

(a) Transmission Control Protocol (TCP)

(b) User Datagram Protocol (UDP)

(c) Telnet

(d) All of the above

Q.4 Transport layer is responsible for

(a) Node to Node delivery

(b) End to End delivery

(c) Station of Station delivery

(d) Hosts to Hosts delivery

Q.5 Which of the following statements are correct?

(a) TCP is connection oriented and UDP is connectionless

(b) UDP is connection oriented and TCP is connectionless

(c) Both TCP and UDP are connection oriented

(d) Both TCP and UDP are connectionless

Q.6 Your routing table is reaching a large size. What could you do to decrease the size of your routing table?

(a) Implement summarization

(b) Add more memory to your routers

(c) Switch to a different routing protocol

(d) Replace your routers with a more powerful ones

Q.7 ICMP stands for

(a) Internet Control Message Protocol

(b) Internet Connection Message Protocol

(c) IP Control Message Protocol

(d) IP Connection Metro Protocol

Q.8 Connection establishment delay is

(a) The amount of time elapsing between a transport connection being requested and the conformation being received by the user of the transport service

(b) The maximum establishment delay time

(c) The time between a message being sent by the transport user on the source machine and it being received by the transport user on the destination machine

(d) None of the above

Q.9 Consider the IP address 128.252.144.84. What is the network id and what is the node id? Assume classfull networking

(a) 0.0.0.0 and 128.252.144.84

(b) 128.0.0.0 and 252.144.84

(c) 128.252.0.0 and 144.84

(d) 128.252.144.0 and 144.84

Q.10 Default subnet mask for class A, B, and C?

(a) 0.255.255.255, 0.0255.255, 255.255.0.0

(b) 255.0.0.0, 255.255.0.0, 255.255.255.0

(c) 255.255.255.0, 255.255.0.0, 255.0.0.0

(d) 0.0.0.0, 0.0.0.255, 0.0.255.255

Q.11 You see the following subnet addresses; What is the subnet mask?

128.252.4.0

128.252.8.0

128.252.12.0

128.252.16.0

(a) 255.255.255.0

(b) 255.255.192.0

(c) 255.255.240.0

(d) 255.255.252.0

Q.12 Which of the following is most resistant to electrical and noise interference?

(a) Fiber

(b) UDP

(c) Coax

(d) STP

Q.13 Which of the following is the most expensive to install and terminate?

(a) Coaxial cable

(b) Fiber optic

(c) Category 4 UTP

(d) Category 5 UTP

Q.14 Bit stuffing is

(a) inserting a "0" in flag stream to avoid ambiguity

(b) inserting a '0' in user data stream to differentiate it with a flag

(c) appending a nibble to the flag sequence

(d) appending a nibble to the user data stream

Q.15 Pick the correct statements about flooding

(a) It is a type of isolated routing

(b) It is a method in which every incoming packet is sent out on every outgoing line except the one by which it arrived

(c) Selective flooding is a type in which the packet are sent to those lines that are going approximately in the right direction

(d) All of the above

Q.16 You have been using a network monitor or protocol analyzer to monitor ethernet packets. One of the messages sent has an IP header protocol field value of "6". What does this value classify?

(a) UDP

(b) ICMP

(c) IGMP

(d) TCP

Q.17 Which of the following network classes is reserved for multicast addressed only?

(a) Class A

(b) Class B

(c) Class C

(d) Class D

Q.18 The following are the steps toward encapsulation. Put them in order

1. User input 2. data 3. frame 4. segment 5. datagram 6. bits

(a) 1–4–2–5–3–6

(b) 1–2–3–4–5–6

(c) 1–2–3–5–4–6

(d) 1–2–4–5–3–6

Q.19 Which of the following can transmit data at speeds of up to 16 Mbps?

(a) Category 1 UTP

(b) Category 2 UTP

(c) Category 3 UTP

(d) Category 4 UTP

Q.20 Why can the original SNMP cause greater network overhead?

(a) Because it uses the user data protocol (UDP)

(b) Because it allows remote configuration

(c) Because it cannot automatically provide information to a management information base

(d) Any of the above

Q.21 Which routing protocols would you recommend using in the displayed network?

(i) IGRP

(ii) OSRF

(iii) RIP

(iv) EIGRP

(a) Only (i)

(b) (ii) and (iv)

(c) Only (ii)

(d) Only (iv)

Q.22 Which statement most correctly describes what happens on an IP over Ethernet network when one host sends data to another host?

(a) Actual communication is between IP addresses

(b) Actual communication is from IP address on the sender to MAC address on the receiver

(c) Actual communication is between physical addresses

(d) None of these

Q.23 Which of the followings NOT a function of the Transport Layer?

(a) Provides the ability to send unacknowledged packets

(b) Can issue a "not ready" indicator

(c) Segments can be placed back into their correct sequence at the destination

(d) Provides routing services

Q.24 Where is the active configuration file of the router stored?

(a) In NVRAM

(b) In RAM

(c) In ROM

(d) On a TFTP server

Q.25 The parameter which gives the probability of the transport layer, itself spontaneously terminating a connection due to internal problems is called

(a) protection

(b) resilience

(c) option negotiation

(d) transfer failure

LEVEL–2

Q.26 Which of the following devices discriminates between multicast and unicast packets?

(a) Multicast switch

(b) Bicast switch

(c) Multicast router

(d) Bicast router

Q.27 What is the broadcast address for the subnet that IP address 192.168.26.8, 255.255.255.248 is a member of ?

(a) 192.168.26.25

(b) 192.168.26.255

(c) 192.168.26.15

(d) 192.168.26.0

Q.28 You have class B network with a 12 bit subnet. How many subnets and how many hosts per subnet are available?

(a) 14, 14

(b) 14, 4094

(c) 4096, 14

(d) 4094,14

Q.29 Which addresses can be given to devices in network 131.107.0.0 with a standard class B subnet mask?

(i) 131.107.0.255

(ii) 131.107.0.1

(iii) 131.107.1.0

(iv) 131.107.0.0

(a) Only (i)

(b) Only (iii)

(c) Only (ii)

(d) (i) and (iii)

Q.30 Your previous Network Administrator had submitted your network into many subnets. Only info you have is that one of the hosts IP was 200.252.144.33 and the mask was 255.255.255.240. Which class network is it?

How many bits are being subnetted?

What is the broadcast address?

(a) B, 28, 200.252.144.47

(b) C, 20, 200.252.144.47

(c) C, 28, 200.252.144.47

(d) C, 28, 255.255.255.32

Q.31 You want to make an access list where you will block a range of IP addresses (128.252.0.0) to (128.252.240.0).

What mask would you use?

(a) 0.0.7.255

(b) 0.0.15.255

(c) 0.0.31.255

(d) 0.0.63.255

Q.32 You have a class B network 172.16.0.0. You use 11 bits for subnetting. Which of the following is a correct range of IP addresses that belong to the same network?

(a) 255.255.8.1 to 255.255.14.254

(b) 255.255.255.9 to 255.255.255.14

(c) 255.255.17.1 to 255.255.22.254

(d) 255.255.17.0 to 255.255.22.255

Q.33 In a network that has maximum packet size of 129 bytes, a maximum packet lifetime of 30 second and an 8 bit packet sequence number, what is maximum rate per connection?

(a) 1700

(b) 1579

(c) 8806

(d) None of these

Q.34 Given the IP address 130.113.64.17/24, which statement is true?

(a) 130.113.64.0 is the network number

(b) 130.113.0.0 is the network number

(c) 130.0.0.0 is the network number

(d) 255.255.0.0 is the subnet mask

GATE QUESTIONS

Q.35 The subnet mask for a particular network is 255.255.31.0. Which of the followings pairs of IP addresses could belong to this network?

[GATE 2003]

[2-Marks]

(a) 172.57.88.62 and 172.56.87.233

(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

Q.36 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 packets 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? **[GATE 2003]**

[2-Marks]

(a) 7.69×10^6 bps

(b) 11.11×10^6 bps

(c) 12.33×10^6 bps

(d) 15.00×10^6 bps

Q.37 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? **[GATE 2003]**

[2-Marks]

(a) 50 bytes

(b) 100 bytes

(c) 200 bytes

(d) None of the above

Q.38 The routing table of a router is shown below:

On which interfaces will the router forward packets addressed to destinations 128.75.43.16 and 192.12.17.10 respectively? **[GATE 2004]**

[2-Marks]

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	255.255.255.255	Eth3
Default		Eth2

(a) Eth1 and Eth2

(b) Eth0 and Eth2

(c) Eth0 and Eth3

(d) Eth1 and Eth3

Q.39 Choose the best matching between Group 1 and Group 2. **[GATE 2004]**

[1-Mark]

Group I		Group II	
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.	Allow end to end communication between two processes
		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-1

Common Data For Questions 40 & 41:

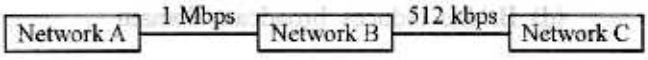
Consider three IP networks A, B and C. Host H_A in network A sends messages each containing 180 bytes of application data to a host H_c in network C. The TCP layer prefixes a 20 byte header to the message. This passes through an intermediate network B. The maximum packet size, including 20 byte IP header, in each network is

A : 1000 bytes

B : 100 bytes

C : 1000 bytes

The network 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.40 Assuming that the packets are correctly delivered, how many bytes, including header, are delivered to the IP layer at the destination for one application message, in the best case? Consider only data packets. **[GATE 2004]**

[2-Marks]

(a) 200

(b) 220

(c) 240

(d) 260

Q.41 What is the rate at which application data is transferred to host H_c? Ignore errors, acknowledgments, and other overheads. **[GATE 2004]**

[2-Marks]

(a) 325.5 Kbps

(b) 354.5 Kbps

(c) 409.6 Kbps

(d) 512.0 Kbps

Q.42 A sender is employing public key cryptography to send a secret message to a receiver. Which one of the following statements is TRUE? **[IT-GATE 2004]**

[1 Mark]

(a) Sender encrypts using receiver's public key

(b) Sender encrypts using this own public key

(c) Receiver decrypts using sender's public key

(d) Receiver decrypts using his own public key

Q.43 Which of the following statements is FALSE regarding a bridge **[IT-GATE 2005]**

[1 Mark]

(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

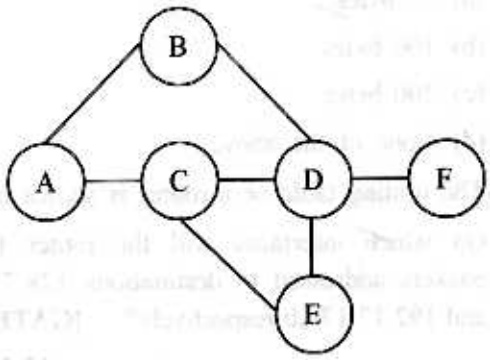
Statement for Linked Answer Questions 44(i) and 44(ii):

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 updation 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 ∞.

(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.44 (i) For the graph given above, possible routing tables for various nodes after they stabilized, are shown in the following options. Identity the correct table? **[IT-GATE 2005]**

[2-Marks]

(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	3
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

Q.44 (ii) 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:

[IT-GATE 2005]

[2-Marks]

(a) > 100 but finite

(b) ∞

(c) 3

(d) >3 and ≤100

Q.45 An organization has a class B network and wishes to form subnets for 64 departments. The subnet mask would be **[GATE 2005]**

[1-Mark]

(a) 255.255.0.0

(b) 255.255.64.0

(c) 255.255.128.0

(d) 255.255.252.0

Q.46 Packets of the same session may be routed through different paths in : **[GATE2005]**

[1-Mark]

(a) TCP, but not UDP

(b) TCP and UDP

(c) UDP, but not TCP

(d) Neither TCP nor UDP

Q.47 The Address Resolution Protocol (ARP) is used for : **[GATE 2005]**

[1-Mark]

(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

Q.48 The maximum window size for data transmission using the selective reject protocol with n bit frame sequence number is:

[GATE 2005]

[1-Mark]

(a) 2^n

(b) 2^{n-1}

(c) 2^n-1

(d) 2^n-2

Q.49 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? **[GATE 2005]**

(a) For shortest path routing between LANs

(b) For avoiding loops in the routing paths

(c) For fault tolerance

(d) For minimizing collisions

Q.50 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? **[GATE 2006]**

[2-Marks]

(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 network

Q.51 In ethernet when Manchester encoding is used, the bit rate is : **[GATE 2007]**

[1-Mark]

(a) Half the baud rate

(b) Twice the baud rate

(c) Same as the baud rate

(d) None of the above

Q.52 Which one of the following uses UDP as the transport protocol? **[GATE 2007]**

[1-Mark]

(a) HTTP

(b) Telnet

(c) DNS

(d) SMTP

Q.53 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? **[GATE 2007]**

[2-Marks]

(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.54 In the slow start phase of the TCP congestion control algorithm, the size of the congestion window **[GATE 2008]**

[2-Marks]

(a) Does not increase

(b) Increases linearly

(c) Increases quadratically

(d) Increases exponentially

Q.55 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? **[GATE 2008]**

[2-Marks]

(a) 1022

(b) 1023

(c) 2046

(d) 2047

Q.56 A computer on a 10 Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 2 Mbps. It is initially filled to capacity with 16 Megabits. What is the maximum duration for which the computer can transmit at the full 10 Mbps? **[GATE 2008]**

[2-Marks]

(a) 1 6 seconds

(b) 2 seconds

(c) 5 seconds

(d) 8 seconds

Q.57 A client process P needs to make a TCP connection to a server process S. Consider the following situation: the server process S executes a socket ( ), a bind ( ), and a listen ( ) system call in that order, following which it is preempted. Subsequently, the client process P executes a socket ( ) system call followed by connect ( ) system call to connect to the server process S. The server process has not executed any accept ( ) system call. Which one of the following events could take place.? **[GATE 2008]**

[2-Marks]

(a) connect ( ) system call returns successfully

(b) connect ( ) system call blocks

(c) connect ( ) system call returns an error

(d) connect ( ) system call results in a core dump

Q.58 What is the maximum size of data that the application layer can pass on to the TCP layer below? **[GATE 2008]**

[1-Mark]

(a) Any size

(b) 2^{16} bytes size of TCP header

(c) 2^{16} bytes

(d) 1500 bytes

Q.59 While opening a TCP connection, the initial sequence number is to be derived using a time of day (ToD) clock that keeps running even when the host is down. The low order 32 bits of the counter of the ToD clock is to be used for the initial sequence numbers. The clock counter increments once per millisecond. The maximum packet lifetime is given to be 64s.

Which one of the choices given below is closest to the minimum permissible rate at which sequence numbers used for packets of a connection can increase? **[GATE 2009]**

[2-Marks]

(a) 0.015/s

(b) 0.064/s

(c) 0.135/s

(d) 0.327/s

ANSWER KEY

1	b	2	c	3	a	4	b	5	a
6	a	7	a	8	a	9	c	10	b
11	d	12	a	13	b	14	b	15	d
16	d	17	d	18	d	19	d	20	c
21	b	22	c	23	d	24	b	25	b
26	c	27	c	28	d	29	d	30	c
31	b	32	c	33	c	34	a	35	c
36	b	37	c	38	c	39	a	40	d
41	b	42	a	43	d	44(i)	c	44(ii)	b
45	b	46	b	47	d	48	b	49	b
50	c	51	b	52	c	53	c	54	d
55	c	56	b	57	c	58	b	59	b

SOLUTIONS

S.1 (b)

The IP header protocol field value of 1 = ICMP; 2=IGMP; 6=TCP; and 17=UDP.

S.2 (c)

At the network layer the main protocol defined by TCP/IP is **Internet Protocol (IP)**.

S.3 (a)

UDP is an unreliable, connectionless protocol. Telnet is a terminal emulator.

S.4 (b)

The transport layer is responsible **for source to destination (end to end) delivery of the entire message**. Protocol at this layer overseas the delivery of data from an application program on one device to an application program on another device.

S.6 (a)

Summarization enables groups of IP addresses to be grouped together and represented with a single entry in the routing table.

S.7 (a)

ICMP is Internet Control Message Protocol.

S.8 (a)

The amount of time elapsing between a transport connection being requested and the conformation being received by the user of the transport service.

S.9 (c)

Class B network with 128.252.0.0 network id and 144.84 node id.

S.10 (b)

Default subnet masks for class A, class B, and class C network are

IP Address Class	Total no. of bit for Network ID/Host ID	Default Subnet Mark			
		First octet	Second octet	Third octet	Fourth octet
Class A	8/24	11111111 (255)	00000000 (0)	00000000 (0)	00000000 (0)
Class B	16/16	11111111 (255)	11111111 (255)	00000000 (0)	00000000 (0)
Class C	24/8	11111111 (255)	11111111 (255)	11111111 (255)	00000000 (0)

S.12 (a)

Fiber is most resistant to electrical and noise interference.

S.13 (b)

Fiber optic cable is the most reliable cable type, but it is also the most expensive to install and terminate.

S.14 (b)

Bit stuffing is required when there is a flag of bits to represent one of the incidents, like start of frame, end of frame, etc. If the same flag of bits appear in the data stream, a zero can be inserted. The receiver deletes this zero from the data stream.

S.16 (d)

The IP header protocol field value of 6 = TCP; 1=ICMP; 2=IGMP; and 17 = UDP.

S.17 (d)

Class D networks are reserved for multicast addresses. Class A, B and C networks contain assignable addresses, and Class E networks are reserved for future and experimental use as well as for broadcasts.

S.18 (d)

User input – data – segment – datagram – frame – bits.

S.19 (d)

Category 4 UTP is used in token ring networks and can transmit data at speeds of up to 16 Mbps.

S.21 (b)

The OSPF and EIGRP routing protocols are classless routing protocols and will support the displayed network.

A classless routing protocol transports the network mask value with the identified network address to support network that use more than one mask. The network displayed is using three different masks for the component networks. A 26- bit mask, or 255.255.255.192; a 28- bit mask or 255.255.255.240; and a 30-bit mask, or 255.255.255.252 are all used when configuring the devices in the exhibit. Variable Length Subnet Masking (VLSM) enables us to make efficient use of the assigned address space. For example, a 30-bit mask is considered the most efficient mask for the use on point to point WAN interfaces. A point to point WAN interface requires a maximum of two IP addresses. The 30-bit mask provides a maximum of two IP host addresses assigned in the subnet. Therefore, the host addresses are wasted.

S.22 (c)

In a TCP/IP network, logical addressing using IP addresses is used to identify the source or host IP address and the final destination IP address. But an IP packet may (and most likely will) traverse the internetwork by passing through many different Data link technologies. The IP packet may originate on an Ethernet segment, pass through a Frame Relay, ATM, HDLC, and PPP segment on the way to the destination.

Each Data Link protocol will use the MAC address of the next hop router to build the destination MAC address in the associated header. This is the process of routing.

One of the sub components of the Data Link Layer (Layer2) is the MAC sublayer. The MAC sublayer protocols deal with the Media Access Control (MAC) address of the sending and receiving networking nodes.

Take a look at the components of a 802.3 Frame below:

|Preamble| DA | SA | Length | Data | FCS |

If we look at the data in both the Destination Address (DA) and the Source Address (SA) fields, we would see MAC addresses of the nodes involved in the data transmission.

S.23 (d)

The transport Layer is responsible for setting up and defining how two nodes will communicate. Since the transport Layer resides above the Network Layer, it is tasked with assembling and disassembling segments and preparing them for disassembling over the network infrastructure. It is at the Transport Layer that most of the network error detaction and error correction takes place.

In addition, the Transport Layer can "speak" both reliably (TCP–a connection oriented protocol) and unreliability (UDP-a connectionless protocol).

The Transport Layer...

- ... can issue a "not ready" indicator (TCP)
- ... arranges segments back into their proper order at the destination
- ... can provide the ability to send unacknowledged packets
- ... can provide a connectionless services (UDP)

Routing services are provided by routers, which operate at the Network Layer, not the Transport Layer.

S.24 (b)

The active configuration file is called "running config" and is stored in RAM. Routers have the following types of memory installed.

Random Access Memory (RAM), volatile memory that stores running config, routing table and any information that is dynamic in nature.

Read Only Memory (ROM), permanent memory that contains the basic instruction set that reboot, which is a limited feature BIOS.

ROM Monitor (ROMMON), which is used for password recovery.

Flash Memory-non volatile memory, that can serve as a storage area for config files and the full BIOS image files. Routers can run the BIOS from Flash.

NVRAM- Non Volatile RAM is where the start-up config file is saved. This memory area has battery backup to preserve its contents.

Routers can boot from a TFTP server, **but the active configuration file is stored in the local RAM.**

S.25 (b)

Resilience – Probability of TPL terminating a connection.

S.26 (c)

A multicast router discriminates between multicast and unicast packets and informs switching devices what to do with the multicast packets.

S.27 (c)

The broadcast address is the address in which the host portion of the address is all 1s. This address can be easily found by subtracting one from the next subnet address.

In this case, our mask of 255.255.255.248 tells us that subnets occur at multiples of 8. We are given one 192.168.26.8.255.255.255.248 subnet, which makes the next subnet 192.168.26.16. If we subtract 1 from 16 we get 15. The broadcast address for our subnet is **192.168.26.15**.

S.28 (d)

Even through your parent subnet is of Class B, your network nodes extend beyond the Class B/ Class C border (24th bit) because you are using 12 bit subnets. Basically, you are taking this big network and spliting it into many little subnetworks.

Number of subnets = $2^{12} - 2 = 4096 - 2 =$ **4094 subnets**

Number of hosts per subnet = $2^4 - 2 =$ **14 hosts**

S.29 (d)

The IP address given, 131.107.0.0, is a Class B network which has a default subnet mask of 255.255.0.0. The subnet mask used in this problem is 255.255.0.0, which means that we have 16 network bits (/16) total and 16 host bits. Therefore, this network is not subnetted.

If we convert this subnet mask to binary, we would have the binary number:

11111111.11111111.00000000.00000000

To determine the number of subnets, use the $2^N - 2$ formula on the number of subnet bits(0). This yields zero subnets.

To calculate the range of host addresses per network, use the $2^N - 2$ formula on the number of host bits(16). This yields:

65536 – 2 = 65534 (hosts per subnet)

The IP address in the question, 131.107.0.0, would therefore fall in the range between 131.107.0.0 and 131.107.255.255. There are 65534 usable IP addresses in this range. We cannot use the first, 131.107.0.0, because this is the network number itself. This number cannot be assigned to a host. The last number in this subnet is 131.107.255.255, but this cannot be assigned to a host because this is the broadcast for the network. That leaves us with the first usable IP address of 131.107.0.1, and all addresses between it and the broadcast are valid. The highest host number then would be 131.107.255.254.

S.30 (c)

We see that the first byte is 200. That puts it in class C.

Mask's last byte 240 (128+64+32+16), that 4 bits N = 4 that subnetted bits = 8 + 8 + 8 + 4 = **28**
There should be 14 (2^4–2) hosts in the subnet.

The highest IP in the subnet will be 200.252.144.33 + 13 = 200.252.144.46

The broadcast address is always 1 higher than the highest IP so it is **200.252.144.47**

S.31 (b)

Spread the last 2 bytes out:

00000000.00000000

11110000.00000000

We want to say in the access list is that, we don't care about the last 12 bits. Insert 1's in those 12 bits → 00001111.11111111→**15.255**

S.32 (c)

If we are using 11 bits for subnetting, we have 5 Networking bits and 11 node bits

From the subnetting formulas above:

M = 5, N = 11

The first range = 255.255.X.1 to 255.255.Y.254
where $X = 2^{(N-8)}+1$ and $Y = 2^{(N-8-1)}-2$

For the next ranges, just add $2^{(N-8)}$ at each end of the range

The first range = 255.255.9.1 to 255.255.14.254
$2^{(N-8)} = 2^3 = 8$

The second range = **255.255.17.1** to **255.255.22.254** so on and so forth.

S.33 (c)

Maximum numbers of packets that can be transmitted in 30 sec = $2^8 = 256$

Data size = 256 × 129 bytes
= 256 × 129 x 8 bits

In 30sec, (256×129x8) bits are transmitted.

∴ in one second number of bits transmitted

$$= \frac{256 \times 129 \times 8}{30}$$

= **8806.4 bps.**

S.34 (a)

The network layer (Layer 3) handles network addressing and decides the best path through a network. Layer 3 of the Open Systems Interconnect (OSI) model defines the network or logical addressing of packets. At this layer, segments are converted to datagrams or packets. Internet Protocol (IP) addresses are 32 bits long and are divided into four octets (divisions of 8 bits each). They consist of two parts.

- The Network Portion
- The Host Portion

Subnet mask tell us what portion of the IP address is the Network and which part is the Host address. For example

130.113.64.17

255.255.255.0

In binary, the mask would look like this:

11111111.11111111.11111111.00000000

Wherever there are 1s in the subnet mask, the corresponding bits in the IP address are the network portion of the address. Wherever there are binary 0s in the subnet mask, the corresponding bits in the IP address are the host portion of the address.

If we are given a subnet mask of 255.255.255.0 and an IP address of 130.113.64.17, the network portion (based on the mask) would be 130.113.64 and the host portion would be 17. Therefore, the network's IP address is **130.113.64.0** because a host of 0 indicates that this is the network's address.

S.35 (c)

The subnet mask is

255. 255. 31. 0

The given subnet mask belongs to class B network because first two octet are all one's which specify the physical network connection and the fourth octet specify the host computer. The lowest address of class B network is 128.0.0.0 and the highest address is 191.255.0.0 so **191.203.31.87 and 191.234.31.88** belongs to class B network.

S.36 (b)

Given

Window size $n = 5$ packets

Packet size $= 1000$ byte

Total packet size $= 5 \times 1000$

$= 5000$ bytes

Total time = Transmission time + Propagation Time

$= 5 \times 50 + 200\ \mu s$

$= 250 + 100\ \mu s$

$= 450\ \mu s$

$= 450 \times 10^{-6}$ sec

Maximum achievable throughput

$$= \frac{\text{Total Size}}{\text{Total Time}}$$

$$= \frac{5000}{450 \times 10^{-6}}$$

$$= \frac{5000 \times 10^{6}}{450}$$

$$= \mathbf{11.11 \times 10^{6}\ bps}$$

S.37 (c)

In CSMA/CD the minimum frame size

$= 2 * z *$ data rate (Bandwidth)

$\therefore$ $d = 2$ km $= 2 \times 10^{3}$ m

$v = 2 \times 10^{8}$ m/sec.

Data rate $= 10^{7}$ bps

$$z = \frac{d}{v} = \frac{2 \times 10^{3} m}{2 \times 10^{8} m/sec}$$

$= 10^{-5}$ sec

$\therefore$ Minimum packet size $= 2 * 10^{-5} * 10^{7}$

$= 2 * 10^{2}$

$= \mathbf{200\ byte}$

S.38 (c)

Solution for IP address : 128.75.43.16

10000000.01010011.00101011.00010000
11111111.11111111.11111111.00000000
10000000.01010011.00101011.0000000

i.e. 128.75.43.0 i.e Eth0

Solution for IP address 192.12.17.5 is Eth3.

S.39 (a)

P. Data Link Layer

1. Ensures reliable transport of data over a physical point to point link. Reliable means error correction and detection done by data link layer

Q. Network layer

4. Routes data from one network node to the next according to routing algorithm.

R. Transport layer

3. Allows end to end communication between two process with the help of TCP and UDP protocol.

S.40 (d)

Network A sends a message of size 180 byte. Network B having the maximum packet size limit is 100 byte including 20 byte header. So the possible combination of sending packet from network A to C is

Header		Header		Header	
20	80	20	80	20	40

So the packet size = 100 + 100 + 60

= **260 byte.**

S.41 (b)

Apply Nyquist Theorem =

$$C = 2W\log_2 M$$

For H_c = **354.5 kbps**

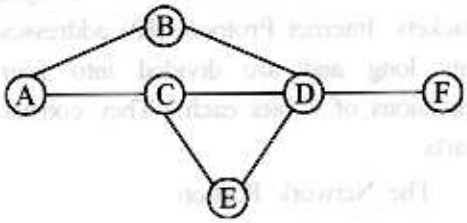
S.42 (a)

A sender is employing public key cryptography to send a secret message to a receiver, **sender encrypts using receiver's public key.**

S.43 (d)

A Bridge divides a network in segments, whenever a station broadcasts data, then it is received by all stations of the network. It doen't matter on which segment they are.

S.44(i) (c)



From the given information and graph the routing table at router B is

Note	Next router	Cost
A	A	1
B	–	–
C	C	1
D	D	1
E	C	2
F	D	2

S.44(ii) (b)

When a node goes down then it broadcast a message to inform all other nodes to update its reachable to infinite.

So after time (t + 100) **the cost for node a will be ∞.**

S.45 (b)

In a class B network initial two octets are all 1's but the third octet specifies the physical network for subnet of 64 department of 2^6 so initial 6 bits of third octets are 1s.

S.46 (b)

TCP and UDP are not network layer protocols. TCP and UDP both are transport layer protocols. Routing packets from source to destination is done by network layer and depends on routing algorithm so there is no interface of TCP and UDP at network layer.

S.47 (d)

The Address Resolution Protocol (ARP), allows a host to find out the MAC (Physical) address for a given target IP address.

S.48 (b)

In case of the selective Reject Protocol

the maximum window size $= \frac{2^n}{2} = 2^{n-1}$

S.49 (b)

The spanning tree approach is a mechanism in which bridge automatically develop a routing table and update that table in response to changing topology. The algorithm consists of three mechanisms: 1. Frame Forwarding 2. Address Learning 3. **Loop resolution**

S.50 (c)

The two computer C_1 and C_2 are configured as follows:

	C_1	C_2
IP Address	203.197.2.53	203.197.75.201
AND		AND
Netmask		

255.255.128.0	255.255.192.0
203.197.0.0	203.197.64.0
Network address	Network address

203.197.2.53→203.197.00000010.00111001

255.255.192.0→255.255.11000000.00000000

203.197.0.0	203.197.0.0

203.197.75.201

255.255.128.0

203.192.0.0

∴ C_1 assumes C_2 is on same network but C_2 assumes C_1 is on different network.

S.51 (b)

In Manchester encoding system, two voltage levels are used for binary 0 and 1. So No. of different signal elements

M = 4 (2 for 0 and 2 for 1)

D is the modulation rate

R is the bit rate

$$D = \frac{R}{\log_2 M}$$

$$D = \frac{R}{\log_2 4}$$

$$D = \frac{R}{2}$$

$$R = 2D$$

S.52 (c)

Domain Name System (DNS) map a name onto an IP address, an application program calls a library procedure called the resolver passing it the name as a parameter. The resolver sends UDP packet to a DNS server, which then looks up the name and return the IP address to resolver, which then returns it to caller. So, DNS uses transport layer protocol UDP.

HTTP uses TCP port 80

SMTP uses TCP port 25

Telnet uses TCP

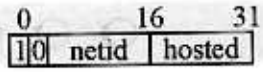
S.53 (c)

The class B is defined as follows

Maximum number of subnet = $2^6 - 2 = 64 - 2 = \mathbf{62}$

Maximum number of hosts in each subnet

$= 2^{16-6} = 2^{10} = \mathbf{1022}$



S.54 (d)

In the slow start (additive) phase of the TCP congestion control algorithm, **the size of congestion window increases exponentially**. TCP acts the window size as follows, allowed-window = min (receiver_advertisment, congestion window)

In slow start (additive) phase whenever starting traffic on a new connection or increasing traffic after a period of congestion, start the congestion window at the size of a single segment and increases the congestion window by one segment each time an acknowledgment arrives.

S.55 (c)

11111111 1111111 11111000 00000000

So the host per subnet = 2^{11}= 2048–2 = **2046**

S.56 (b)

Data transfer rate of token bucket = 10 Mbps

Initially filled to capacity 16 Megabits

Let the maximum duration is t sec.

So, $16 + 2t = 10 \times t$

$t = 2$ sec.

S.57 (c)

Connect ( ) system call returns an error.

As there is no accept( ) at server side, the connect( ) at client could not get anything that can respond to its requests, so error occurs.

S.58 (b)

The maximum size of the data that the application layer can pass on to the TCP layer is 2^{16} bytes size of TCP header.

SESSION, PRESENTATION AND APPLICATION LAYER

10.5

LEVEL–1

Q.1 Non-Repudiation is

(a) Confidentiality of the message

(b) Proof that received message came from a specified sender

(c) Security of the message sent

(d) None of these

Q.2 Symmetric encryption algorithm is same as

(a) Secret key encryption algorithm

(b) Public key encryption algorithm

(c) RSA algorithm

(d) None of these

Q.3 Encryption/ Decryption provide the network with

(a) Authentication

(b) Integrity

(c) Non-repudiation

(d) Privacy

Q.4 Symmetric encryption involves the use of

(a) One key

(b) Two key

(c) Non-repudiation

(d) All of the above

Q.5 Public key encryption makes use of

(a) One key

(b) Two key

(c) Hash functions

(d) All of the above

Q.6 The secret key in secret key encryption is used for

(a) Encryption

(b) Decryption

(c) (a) and (b)

(d) None of these

Q.7 The public key in public key encryption is used for

(a) Encryption

(b) Decryption

(c) Hashing

(d) (a) and (b)

Q.8 The private key in public key encryption is used for

(a) Encryption

(b) Decryption

(c) Hashing

(d) (a) and (b)

Q.9 Digital signature can provide the network with
(a) Authentication
(b) Integrity
(c) Non repudiation
(d) All of the above

Q.10 We have a combination of secret key encryption and public key encryption. Here public key is used to encrypt
(a) Message
(b) Private key
(c) Secret key
(d) None of these

Q.11 In the digital signature techniques, the sender of the message use which key to create ciphertext
(a) Its own secret key
(b) Its own private key
(c) Its own public key
(d) The receiver's private key

Q.12 What is the primary purpose of an FTP server?
(a) Simplify storage of files
(b) Allow for backup storage of files
(c) Report security violations of files
(d) Facilitate transfer of files

Q.13 Your small company is growing and has decided to host a web page and dedicate a server for email. What protocol is used to support email traffic?
(a) ARP
(b) DNS
(c) SMTP
(d) FTP

Q.14 Which of the following is frequently used to send and receive text based files and messages, including router configurations and ACL information?
(a) File Transfer Protocols (FTP)
(b) Trivial File Transfer Protocol (TFTP)
(c) Fast File Transfer Protocol (FFTP)
(d) Trivial Transport Protocol (TTP)

Q.15 Which layer deals with conversion of formats (UNIX-DOS, EBCDIC-ASCII etc)?
(a) Presentation
(b) Session
(c) Transport
(d) Application

Q.16 Which of the following is one of the most important tasks to perform when hardening a DNS server?
(a) FTP server
(b) DNS server
(c) NNTP server
(d) File and Print server

Q.17 Which layer deals with

Group I		Group II	
(i)	File system transfer	A.	Transport
(ii)	Virtual terminals emulation	B.	Presentation
(iii)	Inter-process communication	C.	Session
		D.	Application

(a) (i) – C, (ii) – A, (iii) – B
(b) (i) – A, (ii) – C, (iii) – B
(c) (i) – D, (ii) – A, (iii) – B
(d) (i) – D, (ii) – A, (iii) – C

Q.18 SNMP uses which Transport layer port number to communicate?
(a) UDP port 21
(b) TCP port 21
(c) UDP port 69
(d) UDP port 161

Q.19 Which answer best describes the function of ICMP?
(a) ICMP is a distance vector routing protocol
(b) ICMP provides control and messaging capabilities
(c) ICMP provides host name to IP address resolution
(d) ICMP determines the Data Link layer address from known IP addresses

Q.20 TFTP uses which transport protocol?

(a) SPX

(b) UDP

(c) ICMP

(d) TCP

Q.21 In a broad sense, a railway track is an example of

(a) simplex

(b) half-duplex

(c) full-duplex

(d) all of the above

LEVEL–2

Q.22 If plaintext and ciphertext both have the same number of As, Bs, Cs and so on. This is

(a) Monoalphabetic substitution

(b) Transpositional substitution

(c) Rotational substitution

(d) Both (b) and (c)

Q.23 If there are N people in the world and are using secret key encryption/decryption for privacy purpose, then number of secret keys required will be

(a) N(N+1)/2

(b) N(N–1)/2

(c) N/2

(d) (N–1)

Q.24 How can split horizon be best described?

(a) It is calculation in a router that limits the maximum size of a packet that a particular interface can route

(b) It is a feature of a router that helps prevent routing loops by preventing routing updates from including information about routes to remote networks that were learned through the interface when the update is being sent from

(c) It is a feature of routers to help reduce the convergence time

(d) All of the above

Q.25 Polyalphabetic substitution of the given plaintext DEAR FRIEND would be

(a) READ DNEIRF

(b) EGDV IULHQG

(c) EGDV LYQNXO

(d) EGDV KYQNXO

Q.26 What are the benefits of LAN segmentation?

(i) A decrease in WAN costs

(ii) An increase in collision domains

(iii) Fewer network addresses

(iv) An increase in bandwidth per user

(a) Only (i)

(b) (ii) and (iv)

(c) Only (v)

(d) All of the above

LEVEL–3

Q.27 If you are using RSA algorithm for data security such that P = 7 and q=11, then the legal value of encryption key would be

(a) 12

(b) 15

(c) 60

(d) 17

Q.28 In RSA algorithm if P is 7 and q is 11, then what could be the possible value of decryption key if encryption key is 13?

(a) 13

(b) 37

(c) 23

(d) 40

Q.29 For RSA algorithm, if the value of P is 5 and q is 11, find the value of decryption key if the value of encryption key is 27

(a) 40

(b) 27

(c) 3

(d) None of these

Q.30 For an RSA algorithm if p = 5, q = 11 and encryption key is 3, then encryption of "a,b,c,d,e,f,g,h,i,j" would give

(a) 1,2,3,4,5,6,7,8,9,10

(b) 4,5,6,7,9,10,11,12,13

(c) 1,8,27,9,15,10,14,10,17,13

(d) 1,8,27,9,15,51,13,17,14,10

Q.31 Consider the following plaintext

GOOD MORNING

Suppose this text is transpositional encrypted with key

1	2	3	4	5	6	7	8	9	10	11	12
12	5	6	4	3	11	2	9	10	1	7	8

Then the ciphertext would be

(a) G MDONONIGOR

(b) GNINROM DOOG

(c) DOOG GNINROM

(d) None of these

GATE QUESTIONS

Q.32 A subnet has been assigned a subnet mask of 255.255.255.192. What is the maximum number of hosts that can belong this subnet?

[IT-GATE 2004]

[1 Mark]

(a) 14

(b) 30

(c) 62

(d) 126

Q.33 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:

[IT-GATE 2004]

[1 Mark]

(a) the subnet to which the host belongs

(b) the Department network

(c) the University network

(d) the Internet

Q.34 A serial transmission T1 uses 8 information bits, 2 start bits, 1 stop bit and 1 parity bit for each character. A synchronous transmission T2 uses 3 eight bit sync characters followed by 30 eight bit information characters. If the bit rate is 1200 bits/second in both cases, what are the transfer rates of T1 and T2? **[IT-GATE 2004]**

[2-Marks]

(a) 100 characters/sec, 153 characters/sec

(b) 80 characters/sec, 136 characters/sec

(c) 100 characters/sec, 136 characters/sec

(d) 80 characters/sec, 153 characters/sec

Q.35 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:

[IT-GATE 2004]

[2-Marks]

(a) min(M, N)

(b) max(M, N)

(c) M + N

(d) MN

Q.36 A 25 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 bytes long, what is the maximum data rate possible?

[IT-GATE 2004]

[2-Marks]

(a) 5 Kbps

(b) 10 Kbps

(c) 15 Kbps

(d) 20 Kbps

Q.37 Count to infinity is a problem associated with

[IT-GATE 2005]

[1 Mark]

(a) link state routing protocol

(b) distance vector routing protocol

(c) DNS while resolving host name

(d) TCP for congestion control

Q.38 In the RSA public key cryptosystem, the private and public keys are (e,n) and (d,n) respectively, where n=p*q and p and q are large primes. Besides, n is public and p and q are private. Let M be an integer such that 0<M<n and (n) and $\phi(n)=(p-1)(q-1)$. Now consider the following equations

I. $M' = M^e \bmod n$

$M = (M')^d \bmod n$

II. $ed \equiv 1 \bmod n$

III. $ed \equiv 1 \bmod \phi(n)$

IV. $M = M^e \bmod \phi(n)$

$M = (M')^d \bmod \phi(n)$

Which of the above equations correctly represent RSA cryptosystem? **[Gate 2009]**

[2-Marks]

(a) I and II

(b) I and III

(c) II and IV

(d) III and IV

ANSWER KEY

1	b	2	a	3	d	4	a	5	b
6	c	7	a	8	b	9	d	10	c
11	b	12	d	13	c	14	b	15	a
16	c	17	d	18	d	19	b	20	b
21	b	22	b	23	b	24	b	25	c
26	b	27	d	28	b	29	c	30	d
31	a	32	c	33	a	34	c	35	b
36	d	37	b	38	b				

SOLUTIONS

S.1 (b)

Non repudiation means that a receiver must be able to prove that a received message came from a specific sender. The sender must not be able to deny sending a message that he actually did send.

S.2 (a)

Secret key encryption algorithm are often referred to as symmetric encryption algorithm because the same key can be used in bidirectional communication.

S.3 (d)

Privacy means that the sender and the receiver expect confidentiality. The transmitted message should make sense to only the intended receiver. The message should be unintelligible to others. This could be made possible by encryption and decryption of message.

S.4 (a)

Symmetric or secret key encryption uses the same key for sender and receiver.

S.5 (b)

In public key encryption, there are two key: a private key and a public key. The private key is kept by the receiver. The public key is announced to the public.

S.6 (c)

Secret key encryption uses the same key for sender and receiver. Thus for encryption and decryption same key will be used that is the secret key.

S.7 (a)

In public key encryption, the public key is used to encrypt the message.

S.9 (d)

Digital signature provide the network with following aspects:

(i) authentication

(ii) integrity

(iii) non-repudiation

S.10 (c)

To have the advantage of both secret key and public key encryption, we can encrypt the secret key using the public key and encrypt the message using the secret key.

S.11 (b)

The sender of the message uses its own private key for creating ciphertext.

S.12 (d)

The primary purpose of an FTP server is to facilitate file transfers.

S.13 (c)

Simple Mail Transfer Protocol (SMTP) is used to support email traffic.

S.14 (b)

Trivial File Transfer Protocol (TFTP) defines message format and the method to store and forward mail throughout the Internet to servers that provide message storage for incoming mail.

S.15 (a)

Presentation layer do format conversion i.e., translation.

S.16 (c)

A Network News Transfer Protocol (NNTP) server, which runs on port 119, allows for a high volume of group network traffic and is a potential source for malicious code or Denial of Service (DoS) attacks.

S.18 (d)

Simple Network Management Protocol (SNMP) is an application layer passive protocol that handle Management Information Block (MIB) queries by sending out User Datagram Protocol

(UDP) responses. The requester interrogates the SNMP capable Router (a string called an OID), and the router responds with the information requested.

The following is a partial list of well known ports:

Port 21 – FTP, which uses TCP

Port 23 – Telnet, which uses TCP

Port 25 – SMTP, which uses TCP

Port 53 – DNS, which uses UDP

Port 69 – TFTP, which uses UDP

Port 80 – HTTP, which uses TCP

Port 161 – SNMP, which uses UDP

S.19 (b)

ICMP (Internet Control Message Protocol) provides control and messaging capabilities. Internet Control Message Protocol (ICMP) is used to help manage and control the operation of a TCP/IP network. It provides a wide variety of information about the health and operational status of a network. The ICMP messages are inside an IP packet, with no Transport layer header at all, so it is truly just an extension of the TCP/IP Network Layer.

S.20 (b)

Trivial File Transfer Protocol (TFTP) uses the connectionless transport protocol, User Datagram Protocol (UDP), which uses port 69.

S.22 (b)

In transpositional encryption, characters retain their plaintext form but change their positions to create the ciphertext.

Rotational encryption is a bit level encryption so though the number of bits will remain same after rotation but their meaning will not be same. It may happen 'A' after rotation of bits change to some other alphabet though both have same numbers of one's.

S.23 (b)

In secret key encryption/ decryption, each pair of users must have a secret key. Thus for N user in the world, number of secret keys required will be

$$(N-1) + (N-2) + (N-3) + \ldots\ldots + 2 + 1$$

$$= \frac{(N-1)N}{2}$$

S.24 (b)

This technique attempts to prevent routing loops from occurring by eliminating the source of an update from the list of routers that will receive the update. Split horizon is designed to fix the "counting to infinity" problem. This is best described by an example.

Router-A tells Router-B that its route to network 1 has failed at about the same time that Router-B advertises a valid path to network 1. If routing update information crosses paths, a never ending cycle of updates begins with one router saying the link is up and the next router says it's down. Then both routers accepts the update from each other and announce the opposite information back to each other. This would go back and forth for an infinity of cycles if not managed. Split horizon provides the procedure to prevent this problem.

Split horizon is a feature of router, not bridges or switches. Preventing a bridge from sending frames to a network segment that does not contain the destination host is exactly what switches are supposed to do. A bridge looks up the destination address in its bridge table and forwards it to the proper segment. This is standard bridge/switch operation and has nothing to do with Split horizon.

Split horizon is not a calculation in a router that limits the maximum size of a packet that particular interface can route. The maximum packet size that a router interface can route is called the Maximum Transmission Unit (MTU).

Split horizon is not designed to help reduce convergence time. Convergence time is a general term that describes the length of time it takes form routers to completely update routing tables.

S.25 (c)

Find the position of the character in the text and use that value as the key.

∴ DEAR FRIEND "would **EGDV LYQNXO**

S.26 (b)

When a Local Area Network (LAN) is segmented, each segment becomes a separate collision domain. With multiple collision domains, fewer users are in each one, and therefore have less competition for the bandwidth on that segment.

By segmenting, you are creating smaller (not larger) shared media segments. Since you have not reduced the total number of users, you do not have fewer addresses.

Segmenting a network requires additional hardware, such as bridges, switches or routers and if anything, increased LAN costs, but has no effect on Wide Area Network (WAN) costs.

S.27 (d)

$p = 7$ $q = 11$

$\therefore N = p*q = 77$

let $Z = (p-1)*(q-1) = 6 \times 10 = 60$

Factors of Z are

$60 = 2x2x3x5$

Encryption key should be selected such that it is not a factor $(p-1)*(q-1)$

∴ possible values of encryption key would be {7,11,13,17,23,....}

S.28 (b)

We have

$p = 7$

$q = 11$

$k_e = 13$

Also

(k_e*k_d) Mod$(p-1)(q-1) = 1$

$13k_d$ Mod $(6x10) = 1$

$$60 \overline{)\begin{array}{c} K \\ \hline 13k_d \\ \hline 1 \end{array}}$$

$\therefore \quad 13k_d = (60xk) + 1$

$$\therefore k_d = \frac{(60xk)+1}{13}$$

K	K_d
1	$K_d = \frac{61}{13}$
2	$k_d = \frac{121}{13}$
.	.
.	.
.	.
.	.
8	$\mathbf{k_d = \frac{481}{13} = 37}$

S.29 (c)

We have

(k_e*k_d)Mod $(p-1)$ $(q-1) = 1$

$(27*k_d)$ Mod $(5-1)$ $(11-1) = 1$

$27\ k_d$ Mod $40 = 1$

$$40 \overline{)\begin{array}{c} K \\ \hline 27k_d \\ \hline 1 \end{array}}$$

$\therefore 27\ k_d = 40\ K + 1$

$$k_d = \frac{(40*k)+1}{27}$$

k	k_d
1	$k_d = \frac{41}{27}$
2	$k_d = \frac{81}{27} = 3$

S.30 (d)

Message

Encoded

	a	b	c	d	e	f	g	h	i	j
Message	1	2	3	4	5	6	7	8	9	10

Encryption algorithm:

$c = p^{ke} \bmod (p*q)$

$= p^3 \bmod (5x11)$

$= P^3 \bmod 55$

P	C
1	$1^3 MOD55 = 1$
2	$2^3 MOD55 = 8$
3	$3^3 MOD55 = 27$
4	$4^3 MOD55 = 9$
5	$5^3 MOD55 = 15$
6	$6^3 MOD55 = 51$
7	$7^3 MOD55 = 13$
8	$8^3 MOD55 = 17$
9	$9^3 MOD55 = 14$
10	$10^3 MOD55 = 10$

Thus encryption message would be:

1,8,27,9,15,51,13,17,14,10

S.31 (a)

1	2	3	4	5	6	7	8	9	10	11	12
G	O	O	D		M	O	R	N	I	N	G

Based on the key, encrypted (ciphertext) message would be.

1	2	3	4	5	6	7	8	9	10	11	12
12	5	6	4	3	11	2	9	10	1	7	8
G		**M**	**D**	**O**	**N**	**O**	**N**	**I**	**G**	**O**	**R**

S.32 (c)

The given subnet mask is of class E, which can take value upto 255.255.255.255

So no. of host being to this subnet

$= 254 - 192 = \mathbf{62}$

S.34 (c)

Given:

T1: Character size = (8 + 2 + 1 + 1) = 12 bits

Transfer rate = **100 characters/sec.**

T2: Sync characters = 24 bits

Information characters = 240 bits

So, for 1 bit/second = $\frac{24}{240}$

i.e., 1200 bits/second = $\frac{24}{240} \times 1200 = 120$

$\therefore$ Character transmitted = $\frac{1200-120}{8}$

$= 135 \approx$ **136 characters/sec.**

S.35 (b)

Transmitted window size = N

Receiver's window size = M

Minimum numbers required to execute correct operation of ARQ scheme is maximum of these two which is **max (M, N).**

S.36 (d)

Maximum data rate possible = speed of satellite transmission rate

= **20 Kbps**

S.37 (b)

Count to infinity problem is associated with distance vector routing protocol. The core of the count to infinity problem is that if A tells B that it has a path somewhere, there is no way for B to know if the path has B as a part of it.

S.38 (b)

I and III equations correctly represent RSA cryptosystem.

Cypher text can be find out as,

$$M' = M^e \bmod n$$

Plain text can be recovered as,

$$M = (M')^d \bmod n$$

Relationship between private and public key is,

$$ed \equiv 1 \bmod \phi(n).$$

UNIT–11

WEB TECHNOLOGY

UNIT–11

WEB TECHNOLOGY

11.1 HTML

LEVEL–1

Q.1 Markup tags tell the web browser
(a) how to display message box on page
(b) how to display the page
(c) how to organize the page
(d) none of the above

Q.2 Which of the following creates push button?
(a) INPUT
(b) RESET
(c) RADIO
(d) CHECK BOX

Q.3 Which of these tags are all <table> tags?
(a) <table><tr><td>
(b) <thead><body><tr>
(c) <table><tr><tt>
(d) <table><head><foot>

Q.4 In HTML, which of the following attributes of text control allow to limit the maximum character:
(a) Maxlength
(b) Size
(c) Length
(d) None of the above

Q.5 Choose the correct HTML to left align the content inside a table cell
(a) <td left align>
(b) <td align = "left">
(c) <td ralign = "left">
(d) <tdleft>

Q.6 In HTML, which of the following creates a push-button:
(a) <button type = reset>
(b) <button type = submit>
(c) <input type = button>
(d) All of the above

Q.7 How can we open a link in a new browser window?
(a) <a href = "url" target = "open">
(b) <a href = "url" new>
(c) <a href = "url" target = "blank">
(d) <a href = "url" target = "new">

Q.8 In HTML, which of the following can be considered a container?
(a) <BODY>
(b) <INPUT>
(c) <VALUE>
(d) <SELECT>

Q.9 In HTML, how can we make an e-mail link?

(a) <a href="admin@geniuspublications.com">

(b) <a href="mailto:admin@geniuspublications.com">

(c) <mail>admin@geniuspublications.com</mail>

(d) <mailhref+"admin@geniuspublications.com">

Q.10 Which of the following is not an attribute of the <FORM> tag

(a) SUBMIT

(b) ON SUMBIT

(c) ACTION

(d) METHOD

Q.11 What is the correct HTML syntax for adding a background colour?

(a) <body by = "orange">

(b) <body bgcolour = "orange">

(c) <body colour = "orange">

(d) <background> "range" </background>

Q.12 The <INPUT> is

(a) UnFormatted tag

(b) Empty tag

(c) Format tag

(d) None of the above

Q.13 Main container for <TR>, <TD> and <TH> is

(a) <CAPTION>

(b) <DATA>

(c) <GROUP>

(d) <TABLE>

Q.14 The <DT> tag is designed to fit a single line of our web page but the <DR> tag will

(a) Accept a request

(b) Accept a word

(c) Accept a full paragraph

(d) Accept a line of text

Q.15 From which tag the descriptive list starts?

(a) <DS>

(b) <DL>

(c) <DD>

(d) <LL>

Q.16 www is based on the model

(a) 3-tier

(b) client-server

(c) Local-server

(d) none of these

Q.17 The correct HTML tag for the largest heading is

(a) <h1>

(b) <heading>

(c) <h6>

(d) <head>

Q.18 The tag used to create a hypertext relationship between current document and another URL is

(a) <LINK>

(b) <A>

(c) <ISINDEX>

(d) None of these

Q.19 The web standard allows programmers on many different computer platforms to dispersed format and display the information server. These programs are called

(a) Internet Explorer

(b) HTML

(c) Web Browser

(d) None of these

Q.20 The attribute of <form> are tag

(a) ACTION

(b) METHOD

(c) Both (a) and (b)

(d) None of the above

Q.21 The attribute define the relationship between the current document and the HREF'ed URL

(a) REV

(b) URL

(c) REL

(d) None of these

Q.22 Which tag creates a number/order list?

(a) <UL>

(b) <OT>

(c) <OL>

(d) None of these

Q.23 The <DIR> tag can have only

(a) 12 characters

(b) 18 characters

(c) 22 characters

(d) 24 characters

Q.24 The MIME text file is saved with

(a) HTML extension

(b) HMT extension

(c) THM extension

(d) None of these

Q.25 <Base> tag is designed to appear only between

(a) <TITLE>

(b) <HEAD>

(c) <BODY>

(d) <FORM>

LEVEL–2

Q.26 What is the correct HTML form making a hyperlink?

(a) geniuspublications

(b) geniuspublications

(c) <a>http://www.geniuspublications.com

(d) geniuspublications

Q.27 Method used to send the data is stored in an environment variable on the web server is

(a) POST

(b) REQUEST

(c) GET

(d) CONTENT-LENGTH

Q.28 Which of the following will display the line with more thickness?

(a) cannot be determined

(b) <Hr size = 10>

(c) <HR size = 10 noshade>

(d) both (b) and (c) will display line with same thickness

Q.29 How many basic types of bullets are supported by HTML 4, although not all browsers supports all three.

(a) Two

(b) Three

(c) Four

(d) Five

LEVEL–3

Q.30 State whether the following statement are T/F.

I. The <IMG> tag does not support an ending tag.

II. The alt attribute in the <IMG> tag is used to describe the height of the image.

(a) False, False

(b) False, True

(c) True, False

(d) True, True

Q.31 A HTML form is to be designed to enable purchase of office stationary. Required items are to be selected (checked). Credit card details are to be entered and then the submit button is to be pressed. Which one of the following options would be appropriate for sending the data to the server. Assume that security is handled in a way that is transparent to the form design.

(a) Only GET

(b) Only POST

(c) Either of GET or POST

(d) Neither GET nor POST

GATE QUESTIONS

Q.32 Given below are several usages of the anchor tag in HTML. **[IT–GATE 2004]**

[2–Marks]

I. <A HREF=http://www.gate.ac.in/HTML/BASIC/testpage.html>TestMe</A>

II. <A HREF="/BASIC/testpage.html">Test Me</A>

III. <A HREF="testpage.html">Test Me</A>

IV. <A HREF="testpage.html#test">TestMe</A>

Which of the above are valid?

(a) I and II only

(b) I and III only

(c) I, II and III only

(d) I, II, III, and IV

Q.33 The diagram that helps in understanding and representing user requirements for a software project using UML (Unified Modeling Language) is: **[IT-GATE 2004]**

[1 Mark]

(a) Entity Relationship Diagram

(b) Deployment Diagram

(c) Data Flow Diagram

(d) Use Case Diagram

Q.34 Given below is an excerpt of an xml specification.

```
<!DOCTYPE library SYSTEM "library.dtd">
<Book>
<title> GATE 2005 </title>
<type value = "BROCHURE"/>
<accno>10237623786</accno>
</Book>
<Book>
<type value = "FICTION"/>
<accno>0024154807</accno>
</Book>
```

Given below are several possible excerpts from "library.dtd". For which excerpt would the above specification be valid? **[IT-GATE 2005]**

[2-Marks]

(a) <!ELEMENT Book (title+, type, accno)>

<!ELEMENT title (#PCDATA)>

<!ELEMENT type EMPTY>

<!ATTLIST type value (BROCHURE/FICTION/TECHNICAL)>

<!ELEMENT accno (#PCDATA)>

(b) <!ELEMENT Book (title?, type, accno)>

<!ELEMENT title (#PCDATA)>

<!ELEMENT type ATTLIST>

<!ATTLIST type value (BROCHURE/FICTION/TECHNICAL)>

<!ELEMENT accno value (#PCDATA)>

(c) <!ELEMENT Book (title*, type, accno)>

<!ELEMENT title (#PCDATA)>

<!ELEMENT type ATTLIST>

<!ATTLIST type value (BROCHURE/FICTION/TECHNICAL)>

<!ELEMENT accno (#PCDATA)>

(d) <!ELEMENT Book (title?, type, accno)>

<!ELEMENT title (#PCDATA)>

<!ELEMENT type EMPTY>

<!ATTLIST type value (BROCHURE/FICTION/TECHNICAL)>

<!ELEMENT accno (#PCDATA)>

ANSWER KEY

1	b	2	b	3	a	4	a	5	b
6	d	7	c	8	b	9	b	10	a
11	b	12	b	13	d	14	c	15	b
16	b	17	a	18	a	19	c	20	c
21	a	22	c	23	d	24	a	25	b
26	b	27	d	28	c	29	b	30	c
31	b	32	d	33	a	34	a		

SOLUTIONS

S.1 (b)

A "markup tag" is the fundamental characteristic of HTML. Every markup tag is a command placed between "wickets" or "angle brackets" – a left bracket (<) and a right bracket (>). Markup tags are not revealed by a web browser; they are invisible and tell the web brouser **how to display the file or page**.

S.21 (b)

REV describes the reverse relationship, how the other resource views the current document. E.g.-

<LINK HREF="index.html" REL=HOME REV=CHILD>

S.22 (b)

The <OL> tag defines the start of an ordered list.

The <UL> tag defines an unordered list.

<OT> tag does not exist in html language.

S.23 (d)

The <DIR> tag defines a directory list.

Content of the LI element of the DIR list is usually less than 20 characters in length. These may be arranged in columns across the page, each column typically as **24 characters wide**.

S.28 (c)

Normally, a browser displays a horizontal rule in some form of 3–dimensional shading. This shading varies from browser to browser; some show it as depressed, some raised, some as an outline. Using **noshade** forces the horizontal rule to appear as a thick line with no additional highlighting. Again, this appearance can vary among browsers. Some use black for the rule and others use shades of gray.

S.29 (b)

Three basic types of bullets are supported by HTML 4. If a browser doesn't recognize the attribute, the default bullet representating is used. The syntax for type attribute is,

<UL type = bullet Type>

In this attribute, bullet Type is one of these values: circle, square, or disc.

S.30 (c)

<IMG> tag is a single resource element (one tag for one image). Hence an **ending tag is not supported**.

Browsers don't images for a variety of reason. Supplying a value for alt ensure that the user has some idea of what's supposed to be going on with that big blank space. The alt attribute is vital for interoperability with speech–based and text–only user agents. The alt attribute can provide a brief description of what the image is. For text-only browsers, it's the only indication that the user is missing any content.

S.31 (b)

'GET' means that form data is to be encoded (by a browser) into a URL, while the latter means that the form data is to appear within a message body. But the specifications also give the usage

recommendation that the "GET" method should be used when the form processing is "idempotent". As a simplification, we might say that "GET" is basically for just getting (retrieving) data whereas **"POST" may involve anything, like storing or updating data, or ordering a product, or sending E-mail**.

S.33 (a)

Entity relationship diagram used for understanding and representing user requirements for a software project using unified modeling language.

S.34 (a)

There is user defined tags for a book. we can use these tags to prepare a book.

In (a) <!ELEMENT Book (title +,type,accno)>

<!ELEMENT title (#PCDATA)>

<!ELEMENT type EMPTY>

<!ATTLIST type value (BROCHURE/ FICTION/TECHNICAL)>

<!ELEMENT accno (#PCDATA)>

there is correct use of the defined tags in XML.

11.2 XML

LEVEL–1

Q.1 Which character is used while defining a namespace prefix.

(a) #

(b) :

(c) .

(d) -

Q.2 What is the main building blocks of all XML documents?

(a) Entity References, Namespaces

(b) Elements, Attributes

(c) Comments, Character Data

(d) Processing Instructions, CDATA Sections

Q.3 XPointer specification essentially extends you which specification.

(a) XHTML

(b) XL Link

(c) XPath

(d) XReference

Q.4 Which are the core technologies of Web Services architecture.

(a) M-POST

(b) POST

(c) GET

(d) Both (a) and (b)

Q.5 What is character encoding?

(a) There is no term, as such called character encoding

(b) Method used to represent character in a number

(c) It is a one-to-one mapping between a set of characters and the corresponding numbers to represent those characters

(d) Method used to represent the number in a character code digitally

Q.6 What is XSLT

(a) It is used for session tracking in XML

(b) It is an extensible stylesheet language and is used for formatting

(c) It is an extended stylesheet language and is used for formatting

(d) None of these

Q.7 XSL is →

(a) extended stylesheet language

(b) extensible solution language

(c) a language which is not used in XML

(d) an XML based language to create style sheets

Q.8 DOM is

(a) DOM is coding style

(b) Document Model, a specification

(c) Document Object Model, a parser

(d) None of these

Q.9 DTD's are
(a) a part of Name spaces
(b) document type definition in XML
(c) ways to create templates for out does type
(d) None of these

Q.10 Can XML be used as a database?
(a) XML is not a database, it is language
(b) No, it can't be
(c) Yes, it can be
(d) None of these

Q.11 MSXML is
(a) used for interacting with XML
(b) XML parser that ships with IE5.0
(c) a Microsoft language
(d) None of these

Q.12 SOAP over HTTP supports following Request types:
(a) GET
(b) POST
(c) M-POST
(d) Both (b) and (c)

Q.13 If an XML document uses internal as well as external DTD subsets, and both subsets have declaration for the same element type or entity, which subset will have the precedence?
(a) External
(b) Internal
(c) Cannot be determined
(d) None of these.

Q.14 What is one of the better-known early implementation of XML-based communication protocol.
(a) SOAP
(b) RemoteXML
(c) XML-RPC
(d) None of the above

Q.15 What is XML?
(a) Like SGML, Extended Markup Language
(b) Superset of SGML, Extendable Markup Language
(c) Subset of SGML, Extensible Markup Language
(d) None of these

Q.16 What is a namespace in XML
(a) Distinguishes one XML vocabulary from another
(b) It is an interface language
(c) It is a querying language
(d) None of the above.

Q.17 Which of the following protocols is used for accessing web services.
(a) SOAP
(b) WSDL
(c) UDDI
(d) None of these

LEVEL–2

Q.18 White spaces in XML
(a) includes space between two double quotes
(b) includes only spaces
(c) includes things like space characters, new line and tabs
(d) none of these

Q.19 XPATH is used for which purpose-
(a) to store the IP address of the server
(b) to address the server
(c) to address documents by specifying a location path
(d) None of these

Q.20 To load an XML document with Microsoft XML Parser version 1.0 (that shipped with Internet Explorer 4.0):
(a) Use load method.
(b) Update the UDL property.
(c) This version did not supported loading XML documents.
(d) Either (a) or (b)

Q.21 What are two popular parsing API's.
(a) CSS and XSL
(b) DOM and SAX
(c) DTS and Schemas
(d) XML and XSLT

Q.22 Which is a document that describes how the data will be exchanged, and acts as a kind of contract between the sender and the receiver.

(a) Schema
(b) DTD
(c) XSLT Stylesheet
(d) Both (a) and (b)

Q.23 XML Schema divides data types into two main categories: they are–

(a) Simple, Complex
(b) Machine-Dependent, Machine-Independent
(c) Standard, Custom
(d) String, Number

LEVEL–3

Q.24 Which of the following is true/false:

I. The Header sub-element inside the Envelope element in a SOAP Message, is optional; and if present, can appear any where inside the Envelope element.

II. The following is a well-formed XML document:

```
<?xml version ="1.0?>
<Data>
<Name>Andy</Name>
<Title>Sr. Java Developer</Title>
<Location Coast=west>California</Location>
<DateOfJoin>4/4/2003</DateOfJoin>
</Data>
```

(a) True, True
(b) True, False
(c) False, False
(d) False, True

Q.25 If you were to process a huge XML document (about 150 MB) to read it and insert the records into the database, and there are limited memory resources, which parsing API would you use:

(a) DOM
(b) SAX
(c) Either (a) or (b)
(d) None of these

Q.26 Consider the following XML fragment:

```
<BankDetails Country="UK"xmlns="http://www.SomeBankOrgWebsite/Sample">
</BankDetails>
```

Which of the following is true?

(a) Only attribute BankDetails is in http://www.SomeBankOrgWebsite/Sample Namespace.
(b) Only attribute Country is in http://www.SomeBankOrgWebsite/Sample Namespace.
(c) Neither Element Bank Details nor attribute Country is in http://www. Some BankOrg WebSite/Sample ... espace.
(d) Element BankDetails and attributes Country both are in http://

GATE QUESTIONS

Q.27 Consider an XML file called intro.xml and a document type definition (DTD) file intro.dtd as follows:

intro.xml

```
<?xml version = "1.0"?>
<!DOCTYPE myMessage SYSTEM "intro.dtd">
<myMessage>
    <message?>Welcome to XML</message>
</myMessage>
```

intro.dtd

```
<!ELEMENTmyMessage(message)>
<!ELEMENTmessage(#PCDATA)>
```

A validating parser will classify intro.xml as

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(a) Well formed and validated
(b) Well formed but not validated
(c) Validated but not well formed
(d) Neither validated not well formed

ANSWER KEY

1	b	2	b	3	c	4	d	5	d
6	b	7	d	8	c	9	b	10	c
11	b	12	d	13	b	14	c	15	c
16	a	17	a	18	c	19	c	20	b
21	b	22	b	23	a	24	c	25	b
26	a	27	a						

SOLUTIONS

S.1 (b)

The **colon character** (:) is used while defining a namespace prefix.

S.2 (b)

Building blocks of XML documents are:

→ **Elements**

→ Tags

→ **Attributes**

→ Entities

→ PCDATA

→ CDATA

S.3 (c)

X pointer is based on the XML path language (X path), supports addressing into the internal structures of XML decuments.

The correct answer is **XPath**.

S.5 (d)

A character encoding system consists of a code that pairs each character from a given repertoire with something else, such as a sequence of natural numbers, octets or electrical pulses, in order to facilitate the transmission of data.

S.8 (c)

The Document object model (DOM) is a cross–platform and language–independent convention for representing and interacting with objects in HTML, XHTML and XML documents.

S.9 (b)

A Document type Definition (DTD) defines the legal building blocks of an XML document. It defines the document structure with a list of legal elements and attributes.

S.10 (c)

Two major classes of XML database exist:

1. **XML-enabled:** These map all XML to a traditional database (such as a relational database), accepting XML as input and rendering XML as output. This term implies that the database does the conversion itself (as opposed to relying on middleware).
2. **Native XML (NXD):** The internal model of such databases depends on XML and uses XML documents as the fundamental unit of storage, which are, however, not necessarily stored in the form of text files.

S.14 (c)

XML–RPC is a remote procedure call protocol which uses XML to encode its calls and HTTP as a transport mechanism. As new functionality was introduced, the standard evolved into what is now SOAP.

S.15 (c)

XML (Extensible Markup Language) is a highly functional subset of SGML. Its purpose is to specify an SGML subset that works very well for delivering SGML information over. SGML (Standard Generalized Markup Language).

S.16 (a)

XML namespaces are used for providing uniquely named elements and attributes in an XML document.

S.17 (a)

Once a web service is created and published, the calling applications (clients) should have some means to access it. For this purpose, many protocols can be used. However, the most popular of them is a specialized protocol, called as **Simple Object Access Protocol (SOAP)**. Web Service Definition Language (WSDL) defines a common binding mechanism. Universal Description Discovery and integration (UDDI) protocol is a directory model for web services.

S.19 (c)

XPath, the XML Path Language, is a query language for **selecting nodes from an XML document**. In addition, XPath may be used to compute values (e.g., strings, numbers, or Boolean values) from the content of an XML document.

S.21 (b)

DOM (Document Object Model) and SAX (Simple API for XML) are the two popular API's for XML parsing. DOM loads the entire XML documents in the memory and allows random read/write access to the document. SAX is an event-based streamin, push API that reads the input XML character stream character by character, generates the event and pushes them to the application.

S.22 (d)

Document Type Definition (sometimes also called Data Type Definitions or DTD) or XML Schema can be used to describe the structure of the XML document. The XML documents can then be validated against the DTD or the schema to ensure the correct predefined structure. And hence the sender and receiver can define a DTD or a schema to formalize the data being exchanged (in XML format).

S.23 (a)

XML Schema divides data types into two main categories: **Simple and Complex**. Elements that may contain attributes or other elements are complex Types. Attributes values and elements that contain only text contents are simple Types.

S.24 (c)

I. Header is optional, but if present, should be the first child under envelope.

II. The value of coast attribute within the location element must be enclosed within a single or double quotes.

S.25 (b)

SAX (Simple API for XML parsing), unlike DOM (Document Object Model), does not load the entire document in the memory, and as we do not need to write back to the XML document, and as we do not need the random access to the XML document, **SAX is the best parsing API that can be used here in this scenario**.

S.26 (a)

Attributes do not inherit the default namespace. In order to make the attribute country also part

of http://www.SomeBankOrgWebSite/Sample namespace, it is requrired to use the namespace prefix as below:

```
<uk:BankDetails uk:Country="UK"
xmlns:uk="http://
www.SomeBankOrgWebSite/Sample">
```

S.27 (a)

Well-formed and validated.

11.3

ASP

LEVEL–1

Q.1 Is there more than one global.asa file?

(a) cannot be determined

(b) there is no global.asa file

(c) no, there is only a single global.asa file

(d) yes, there are two global.asa file

Q.2 Where does ASP code execute?

(a) reportedly somewhere in Washington State

(b) on any machine it wants to

(c) in the client's browser

(d) on the web server

Q.3 What are the tags in ASP?

(a) { }

(b) <% %>

(c) <? ?>

(d) < >

Q.4 Redirect is a method of Request or Response object

(a) Response

(b) Request

(c) Both (a) and (b) above

(d) None of these

Q.5 What does query string do in ASP?

(a) It is appended to the URL with a question mark'?'

(b) It contains the information that is passed to the server in the form of name/value pair

(c) both (a) and (b)

(d) none of the above

Q.6 In ASP, what does Response.Clear do?

(a) It will only erase the information that has been added to the HTML output stream since the last call to Response Flush.

(b) It sends any buffered output to the client immediately and causes the server to stop processing the script

(c) It simply erases any already-buffered HTML

(d) It sends any previously buffered output to the client immediately but continues processing the script

Q.7 In ASP, what is the default value for recordset's cursor Type property?

(a) adOpenKeyset

(b) adOpenDynamic

(c) adOpenStatic

(d) adOpenForward only

Q.8 When does the application object end?

(a) The default time is 10 minutes

(b) When the webserver stops

(c) When the user leaves the site

(d) None of these

Q.9 In Java, what is the range of values that can be assigned to a variable of type byte

(a) 2^7 through $2^7 - 1$.

(b) 0 through $2^8 - 1$

(c) 0 through $2^{16} - 1$

(d) It depends on the underlying hardware

Q.10 In ASP what does the Response.ExpiresAbsolute property do?

(a) Sets the date and/or time at which page cached on the browser expires

(b) Specifies the number of minutes before a page cached on a browser expires

(c) Specifies the URL of the page, which the browser needs to fetch, in case the session expires

(d) None of the above.

Q.11 In ASP, which of the following method is used to end the current user session and destroy the current session object immediately.

(a) Session.Exit

(b) Session.End

(c) Session.Abandon.

(d) Session.Terminate

Q.12 In ASP, the default value for timeout property of the session object is

(a) 40 minutes.

(b) 30 minutes

(c) 20 minutes

(d) 10 minutes

Q.13 In ASP, when is an application object created:

(a) It is created when the ASP DLL is loaded in response to the first request for an ASP page

(b) It is created for each new visitor when they first request an ASP page from the site

(c) It is created when the administrator logs on to the web server

(d) None of these.

Q.14 In ASP, the FileSystemObject provides access to the computer's file system. Which of the following is the correct syntax for creating an instance of the FileSystemObject:

(a) Set objFSO = Server.CreateObject ("Scripting.FileSystemObject")

(b) Set objFSO = Server.CreateObject ("FileSystemObject")

(c) Set objFSO = Server.CReate ("FileSystemObject")

(d) None of the above.

Q.15 What does the following, ASP line, do:

Set conPubs = Server.CreateObject ("ADODB.Connection")

(a) Simply creates a connection object

(b) Opens a connection with the data store

(c) Creates a recordset object

(d) None of the above.

Q.16 In ASP, what does Request.ServerVariable ("REMOTE_ADDR") do?

(a) Contains the IP address of the client that issued the HTTP request

(b) Contains the IP address of the web server

(c) Contains the IP address of the ISP server

(d) None of the above.

Q.17 In ASP, what does the BinaryRead method do?

(a) Reads the file opened in Binary mode

(b) Can be used for raw bytes submitted when a form posted

(c) Retrieves count bytes of data from the client request when the data is sent to the server as part of a POST request.

(d) Reads the ASP page and outputs the result

Q.18 Which type of collection of the Request object contains value from HTML form fields.

(a) Cookies

(b) QueryString

(c) ServerVariables

(d) None of these

Q.19 How many objects are there in ASP 7.0?

(a) 10 objects.

(b) 5 objects.

(c) 6 objects.

(d) 7 objects.

LEVEL–2

Q.20 Among the following which one returns the number of form variables in the incoming form.

(a) Request.QueryString.Item ( )

(b) Request.QueryString.Key ( )

(c) Request.QueryString.Count ( )

(d) None of these

Q.21 ASP runs on

(a) Java Web Server

(b) Apache

(c) ASP server

(d) Internet Information Server (IIS)

Q.22 Find the odd man out in context with the protocols in TCP/IP model.

ICMP, IP, ARP, TCP

(a) TCP

(b) IP

(c) ARP

(d) ICMP

Q.23 Which of the following is the correct code to tell the web server that the programming language Java Script.

(a) <%@ Application.Language = Java Script %>

(b) <% Application.Language = Java Script %>

(c) <% @ Language = "Java Script" %>

(d) <% Language = Java Script %>

Q.24 Which is only client–side scripting technology

(a) VBScript

(b) Common Gateway Interface (CGI)

(c) Java Servlets and Server Pages (JSP)

(d) Active Server Pages (ASP)

Q.25 What is the object that is used for sending mails?

(a) Request

(b) NewMail

(c) Response

(d) RDO

ANSWER KEY

1	c	2	d	3	b	4	a	5	c
6	a	7	d	8	c	9	a	10	a
11	c	12	c	13	a	14	a	15	a
16	a	17	c	18	d	19	d	20	d
21	d	22	a	23	c	24	a	25	b

SOLUTIONS

S.1 (c)

The Global.asa file is an optional file that can contain declarations of objects, variables and methods that can be accessed by every page in an ASP application.

The Global.asa file must be stored in the root directory of the ASP application and **each application can have only one Global.asa file**.

S.7 (d)

The CursorType property sets or returns the cursor type to use when opening a Recordset object. This property can take a Cursor Type Enum value. Default is **adOpenForwardOnly**.

S.19 (d)

There are seven built in objects in ASP 7.0

They are

Application Objects

ASPError Objects

Request Objects

Response Objects
Server Object
Session Object and
Context Objects

S.20 (d)

Request.QueryCount ( ) returns the number of form variables in the incoming form.

If we give Request.QueryString.Key ( ) a number less than the number of incoming form variables, the request object gives us the name of a field.

If we put field name in Request.QueryString.Iten ( ), we get the value of that field.

S.21 (d)

ASP runs only on Microsoft's Web Server, the name of which is **Internet Information Server** (IIS). It cannot execute on other operating system or Web server such as Apache and Java Web Server without additional libraries.

S.22 (a)

ICMP, IP and ARP are protocols in the network layer, whereas **TCP** is a protocol in the Transport layer.

S.23 (c)

The code **<%@ Language = Java Script %>** tells the web server that the programming language is java script. Because, IIS, the Microsoft Web Server, often assumes that ASP programs will be written in VBScript, it's always a good idea to tell IIS if we are using some other language.

S.24 (a)

Active server pages, JSP and common gateway interface are typically examples of server-side scripting. **VBScript** and JavaScript are popular languages used for client-side scripting.

S.25 (b)

We know that the ASP environment provides built-in objects that make it easy to get things done. This is true with email, as well. A technology called "CDONTS" does most of the work required to take of things. CDONTS stands for Collaboration Data Objects for IIS, so we might have to make sure that we have a file called Cdonts.dll installed on our system.

CDONTS can be used to create an object called a **"NewMail Object"**.

For example:

1. mail_ob = Server.CreateObject ("CDONTS.NewMail");
2. mail_ob.sent ("sender@vcp.com", recipient @vcp.com, "subject", "body");

The above two lines creates an object and use it to sent a message. The first line creates a NewMail Object called mail_ob using the Server.CreateObject() method. The next line applies the sent( ) method to the mail_ob object and passes it four parameters:

(i) a from address
(ii) a to address
(iii) a subject
(iv) a body

11.4

.NET

LEVEL–1

Q.1 Which is a set of formal specification of the type system implemented by the CLR.

(a) Common Language Specification

(b) Common Type System

(c) Both (a) and (b) combined

(d) None of these

Q.2 What type of server is the next-generation software that provides the infrastructure and tools for building successful commerce communities.

(a) Application Center Server 2000

(b) Biz talk Server 2000

(c) Exchange Server 2000

(d) SQL Server 2000

Q.3 CLR stands for

(a) Code Language Runtime

(b) Code Language Resources

(c) Common Language Runtime

(d) Common Language Resources

Q.4 What is a set of constructs and constraints that act as a guide for library and complier developers.

(a) Common Language Specification

(b) Common Language System

(c) Common Type System

(d) None of these

Q.5 What do enterprise beans use to communicate with the EJB container to get runtime context information?

(a) A JNDI ENC context

(b) The javax.ejb.EJBContext provided by the container

(c) A javx.ejb.EJBHome object provided by the container

(d) A javax.ejb.EJBMetaData object provided by the container

LEVEL–2

Q.6 Which of the following can be considered as the smallest unit of reuse and deployment for the .NET Framework.

(a) DLL

(b) Assembly

(c) Managed module

(d) Byte code

Q.7 When a programmer decides to leave the memory management decisions to the CLR, it is called

(a) managed code, programmed code

(b) unmanaged code, programmed code

(c) managed code, unmanaged code

(d) unmanaged code, managed code

Q.8 Which of the following is not included in the .NET Enterprise Server Suite

SQL Server 2000, Commerce Server 2000,

Host Integration Server – 2000

(a) Host Integration Server – 2000

(b) Commerce Server 2000

(c) SQL Server 2000

(d) None of these

Q.9 Assemblies have code in the form of

(a) Assembly Language

(b) Intermediate Language

(c) Byte code

(d) None of these

GATE QUESTIONS

Q.10 Which of the following objects can be used in expressions and scriplets in JSP (Java Server Pages) without explicitly declaring them?

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[1 Mark]

(a) session and request only

(b) request and response only

(c) response and session only

(d) session, request and response

ANSWER KEY

1	b	2	b	3	c	4	[illegible]	5	b
6	c	7	c	8	d	9	b	10	[illegible]

SOLUTIONS

S.1 (b)

Common Type System is a set of formal specification of the type system implemented by the CLR (Common Language Runtime). It specifies how types are defined. The possible members of a type can be described as: Field, Method, Properties and Events.

S.2 (b)

Biz Talk Server 2000 is the next generation software that provides the infrastructure and tools for building successful e-commerce communities. The core of Biz Talk Server offers business document routing, transformation, and a rules-based tracking infrastructure.

S.3 (c)

In simple terms, the **Common Language Runtime (CLR)** is an environment for programs to execute. CLR handle issues such as memory management and inter process communication.

S.4 (a)

Common Language Specification (CLS) is a set of constructs and constraints that act as a guide for library and compiler developers. It allows library to be fully usable from any language supporting the CLS, and for those languages to interpolate with each other.

S.6 (c)

Actually CLR does not work with modules. It works with Assemblies. An assembly is nothing but logical grouping of managed modules and resource files. **Managed modules** and resource files can be considered as the smallest unit of reuse and deployment for the .NET framework.

S.7 (c)

When we create a new object in Java, we need not worry about freeing its memory when the object is no longer required. However, when we create an object in C++, it is always recommended that we release that object from the memory when it is no longer required. Otherwise, the program may crash unexpectedly or behave abnormally. CLR now allows C++ programmers to stop worrying about this issue. When a programmer decides to leave the memory management decisions (e.g., cleaning up variables no longer in use, etc) to the CLR, it is called **managed code** in the .NET terminology. Thus, in managed code, one cannot use pointers, unlike their extensive use in the C/C++ programming languages. However, to somehow maintain compatibility with the older C/C++ code, if needed, the programmer is free to choose to perform the memory management action himself. In such cases, the CLR does not perform any cleaning up, and is not responsible for handling pointer exceptions. Such a program is called **unmanaged code**.

S.8 (d)

All of the given servers are included in the .NET Enterprise Server Suite.

S.9 (b)

Assemblies have code in the form of **Intermediate Language (IL)**. This is also referred to as Microsoft Intermediate Language (MSIL). IL is a CPU independent machine language created by Mircosoft. Like any other machine language, IL can also be written in Assembly Language.

S.10 (a)

The session and request objects can be used in expression and scriplcts in JSP without explicitly declaring them.

11.5 SOFTWARE PROCESS MODELS

LEVEL–1

Q.1 Which of the following is wrong about JSP forward and JSP redirect methods?
(a) Redirect executes on client
(b) Forward executes on server
(c) Redirect is faster than forward
(d) Forward is faster than redirect

Q.2 J Script is which type of JavaScript
(a) the Sun Microsystems version
(b) the Microsoft's version
(c) another name
(d) same

Q.3 Java Server Pages are processed by?
(a) The asp.dll component
(b) JSP Container
(c) Web Server
(d) IIS

Q.4 Which of the following defines the Java code within a JSP?
(a) Between <JAVA> and </JAVA>
(b) Between <SCRIPT> and </SCRIPT>
(c) Between <!-- and -->
(d) Between <% and %>

Q.5 Unlike Java servlets (or JSP) on applet life cycle is
(a) start-init-destroy
(b) start-init-stop-destroy
(c) init-start-stop-destroy
(d) init-start-destroy

Q.6 Which of the following in JSP has XML like syntax?
(a) Action elements
(b) Scripting elements
(c) Directives
(d) None of these

Q.7 Where does the <JSP : forward> executes?
(a) on remote database server
(b) on server
(c) on client
(d) all of the above

Q.8 In JSP, which of the following is not a marker interface?
(a) Http session
(b) Cloneable
(c) Single thread model
(d) Serializable

Q.9 Implicit JSP variable session is an instance of
(a) Javax.httpsession
(b) Javax.servlet session
(c) Javax.servlet.http.httpsession
(d) Javax.http.session

Q.10 In JSP, variables declared in which of the following tags are public variables
(a) <% % ..... % %>
(b) <% ..... %>
(c) <% = ... %>
(d) <%! .....%>

Q.11 A bean is
(a) useful in developing reusable components
(b) has getter and setter method
(c) a Java class
(d) all of the above

Q.12 JSP lifecycle doesn't consists of which of the following methods:
(a) jspservice
(b) jspstart
(c) jspdestroy
(d) jspinit

Q.13 In EJB, Local interfaces have declarative
(a) Security only
(b) Transactions only
(c) Transactions and security
(d) Neither for performance reasons

Q.14 When a JSP is executed, of the following, what is most likely to be sent to the client?
(a) The source JSP file
(b) The source Servlet file
(c) HTML
(d) The complied Servlet file

Q.15 Which of the following is used for browsers that do not support <embed> or <object> elements
(a) <jsp : redirect>
(b) <jsp : fallback>
(c) <jsp : param>
(d) <jsp : include>

Q.16 In JSP, what is the valid value returned by dostart tag method while developing custom tag:
(a) Tag.EVAL_PAGE
(b) Tag.SKIP_BODY
(c) Tag.EVAL-BODY_INCLUDE
(d) None of these

LEVEL–2

Q.17 A client invokes a method on a stateful session bean instance deployed in the WebLogic Server. While the method execution is in progress another method call arrives on server. What will be the result.
(a) In all cases, Remote Exception is thrown
(b) The EJB container blocks the concurrent method call and allows it to proceed when the previous call has completed if the value of allow-concurrent-calls is true
(c) EJBException is thrown if the value of concurrency-strategy property is false
(d) Remote Exception is thrown if the value of concurrency-strategy property is false.

Q.18 In Java, which of the following statement is true:
(a) Object references can be converted in both method calls and assignments and the rules governing these conversions are identical.
(b) Object references can be converted in both method calls and assignments and the rules governing these conversions are different.
(c) Object references can be converted in method calls but not in assignments.
(d) Object references can be converted in assignments but not in method calls.

Q.19 Which of the following JSP lines are correct:
(a) <% = "Hello"%>
(b) <% = out.print ("Hello")%>
(c) <%Stringmystring = request.getServerName ( ) %>
(d) <%! String mystring = "Hello" %>

Q.20 A local home or component Interface for an EJB can only be used by
(a) Another EJB
(b) A web-tier client
(c) A business logic-tier client
(d) A client located in the same JavaTM Virtual Machine (JVM)

Q.21 An entity in an unidirectional relationship that is the target of a role with a CMR field

(a) must have remote home and component interfaces

(b) must have local home and component interfaces

(c) may have either local or remote interfaces, but not both

(d) may have any combination of local or remote interfaces

Q.22 Most popular freely available web server for developing JSP pager is

(a) Weblogic

(b) Tomcat

(c) java Web server

(d) Dynamo

Q.23 Which of the statements below is true for a web application using session management?

(i) The session object is Invalidated, when the session times out.

(ii) The session object is invalidated, when session Invalidate ( ) method of HttpSession is invoked.

(a) None of the above statements is true.

(b) Only statement (ii) is true.

(c) Only statement (i) is true.

(d) Both of the above statements are true.

Q.24 All JSP pages, by default take part in an HTTP session. Which of the following is true regarding the values which can be put into a session?

(a) Any Java variable (primitives, objects) can be placed into a session.

(b) Only String objects can be placed into a session.

(c) Any Java object can be placed into a session.

(d) Only JavaBeans component can be put into a session.

LEVEL–3

Q.25 The legal collection class type (s) to represent a many-valued relationship are

(a) java.util.Collection only

(b) java.util.Collection and java.util.Set

(c) java.util.List,java.util.Set, and java.util.Map

(d) java.util.Map only

Q.26 You can only specify cascade-delete on a relationship role if

(a) the other role in the relationship has a multiplicity of 'One".

(b) the role has a multiplicity of 'One'

(c) the role has a multiplicity of 'Many'

(d) the other role in the relationship does not already use cascade-delete.

Q.27 The EJB 2.0 specification introduce ejb.Select methods, These are

(a) The local home interface equivalent of a finder method

(b) Abstract methods in the bean class that call a query

(c) Methods in the components interface that call a query

(d) A method that allows the bean developer to choose between a local and remote interface

Q.28 The new EJB Query Language (EJB-QL) has three clauses: SELECT, FROM, and WHERE.

(a) Only the from clause is mandatory

(b) Only the where clause is mandatory

(c) Only the SELECT and FROM clauses are mandatory

(d) All clauses are mandatory

Q.29 Which of the following statements are true regarding MDBs (Message Driven Beans) on version 6.0 of WebLogic App Server?

(a) MDBs support concurrnet processing neither Topics nor Queues.

(b) MDBs support concurrent processing for only Queues.

(c) MDBs support concurrent processing for only Topics.

(d) MDBs support concurrent processing for both Topics and Queues.

Q.30 Which of the following statements are true regarding the identity of two EJBs?

I. Two stateful session beans are identical if their data attributes are identical.

II. Two stateful session beans are identical if their session contexts are equal.

III. Two stateless session beans are identical if they are of the same type.

IV. Two stateless session beans are identical if their session contexts are equal.

(a) III, IV

(b) II, IV

(c) I, III

(d) II, III

Q.31 Consider a shopping cart web application which uses session management, implemented using Servlet API (HttpSession interface). Whenever a new user login, his name (String type) is stored in a session using the setAttribute ( ) method of the HttpSession interface. The variable used to store the user name is "myName".

To retrieve the user name from the session, which of the following lines of code is correct, assuming request and response are arguments of type HttpServletRequest and HttpServletResponse respectively, to the service ( ) method of the servlet?

(a) String userName = response.getSession ( ).getAttribute("myName");

(b) String userName = request.getSession( ).getAttribute(myName);

(c) String userName = request.getSession( ).getAttribute("myName");

(d) None of the above

Q.32 A session bean's business method has the transaction attribute set to 'Required'. A client attempts to invoke the bean method without a transaction context. What will be the result?

(a) TransacitonRequiredException is thrown to the client.

(b) Container invokes bean methods without a transaction context.

(c) Container creates a new transaction context and invokes the bean method from within that context.

(d) None of these

Q.33 What type of enterprise bean is used to embody business objects?

(a) javax.ejb.EntityBean

(b) javax.ejb.SessionBean

(c) javarmi.Remote

(d) javax.ejb.EnterpriseBean

ANSWER KEY

1	d	2	b	3	b	4	d	5	c
6	a	7	b	8	a	9	c	10	d
11	d	12	b	13	c	14	c	15	b
16	b	17	b	18	a	19	a	20	d
21	b	22	b	23	d	24	c	25	b
26	b	27	b	28	c	29	d	30	d
31	d	32	c	33	a				

SOLUTIONS

S.1 (d)

The forward method works inside the Web container. The sendRedirect method requires a round trip to the client. So the **forward method is faster than sendRedirect.** However, using the forward method restricts us to redirect only to resource in the same Web application. The sendRedirect method, on the other hand, allows us to redirect to any URL. Conclusion: Use the forward method if it can solve our problem. Resort to the sendRedirect method only if we can't use the forward method.

S.2 (b)

J script is **microsoft's** version of the ECMAscript (or Java script) language. J script is implemented as a windows script engine of file extension is of Jscript source code file is 'js'.

S.3 (b)

A JSP page is executed in a JSP container or a JSP engine, which is installed in a web server or in a application server. When a client asks for a JSP page the engine wraps up the request and delivers it to the JSP page along with a response object. The JSP page processes the request and modifies the response object to incorporate the communication with the client. The container or the engine, on getting the response, wraps up the responses from the JSP page and delivers it to the client. The underlying layer for a JSP is actually a servlet implementation. The abstractions of the request and response are the same as the ServletRequest and ServletResponse respectively. If the protocol used is HTTP, then the corresponding objects are HttpServletRequest and HttpServletResponse.

S.8 (a)

In java language programming interfaces with no methods are known as marker interfaces. Marker interface are serializable, cloneable, single thread model, event listener. Marker interface are implemented by the classes or their super classes in order to add some functionality.

S.12 (b)

The jspInit()- The container calls the jspInit() to initialize the servlet instance. It is called before any other method, and is called only once for a servlet instance.

The jspservice()- The container calls the jspservice() for each request, passing it the request and the response objects.

The jspDestroy()- The container calls this when it decides take the instance out of service. It is the last method called in the servlet instance.

jspstart is not a method of JSP lifecycle.

S.15 (b)

The jsp:fallback tag is used to specify the message to be shown on the browser if applet is not supported by browser.

Example

```
<jsp:fallback>
    <p>Unable to load applet</p>
</jsp:fallback>
```

The jsp:fallback element provides alternate text to browsers that do not support OBJECT or EMBED.

S.17 (b)

By default, simultaneous access tc a stateful session EJB results in a RemoteException. However, we can set the allow-concurrent-calls option in the WebLogic EJB deployement descriptor to specify that a statefull session bean

instance will allow concurrent method calls. This access restriction on statefull session EJBs applies whether the EJB client is remote or internal to WebLogic Server. By default, allows-concurrent-calls is false. However, when this value is set to true, the EJB container blocks the concurrent method call and allows it to proceed when the previous call has completed.

The concurrency-strategy element determines ejLoad( ) and ejbStore( ) behavior for entity EJB instances.

S.20 (d)

Use of a local client view avoids the performance overhead of remote method invocation. To use a local client view, the enterprise bean and its client must be guaranteed to be **located on the same JVM.** By implementing a local home interface and local component interface, co-located enterprise beans can make direct local method calls on the methods of other beans and avoid the remote invocation overhead. It is thus feasible to implement fine-grained access between beans using local interfaces.

S.21 (b)

Local interfaces provide the foundation for container-managed relationships among entity beans and session beans. The bean uses the local interface to maintain its references to other beans. For example, an entity bean uses its local interfaces to maintian relationships to other entity beans. Using local interfaces, beans can also expose their state and use pass-by-reference to pass their state between related bean instances.

S.22 (b)

Tomcat is the official reference implementation of the servlet 2.2 and JSP 1.1 specifications. It can be used as a small stand-alone server for testing servlets and JSP pages, or can be integrated into the Apache Web server. However, many other servers have announced upcoming support. Tomcat, like Apache itself, is free. However, also like Apache (which is very fast, highly reliable, but a bit hard to configure and install), Tomcat requires significantly more effort to set up than do the commercial servlet engines.

S.23 (d)

The session object will become invalid in either of the following scenarios:

(i) When the session times out.

(ii) When invalidate ( ) method of the Http Session interface is invoked.

Please note that invalidate ( ) and not sessionInvalidate( ) is the method of HttpSession interface.

S.24 (c)

Any valid Java object can be stored in a session. A session object is identified by a session ID which is a unique key. Primitives can't be placed into a session. We need to wrap a primitive first (using a wrapper class, e.g., for int Integer is used to wrap the int variable) to store it into a session. The object is identified with the key "obj".

S.25 (b)

The CMR field type specifies the class of a collection-valued logical relationship field in the entity bean class. The value of the CMR field type must be either: **java.util.Collection or java.util.Set.** This field is accessed by methods whose names consists of the name of the field specified by CMR field name in which the first letter is upper-cased, prefixed by "get" or "set".

S.26 (b)

Cascade delete option specifies that, within a particular relationship, the lifetime of one or more entity beans is dependent upon the lifetime

of another entity bean. **The cascade delete option can only be specified for relationships in which the multiplicity of the first role is One.** Because an Address object should only exist when the customer that references it exists, we want to ensure that, when we delete a customer, we also delete all addresses associated to that customer. Check the option to delete bean B for AddressBean in the Customer to Address bean one-to-many relationship. Now, when the application deletes an instance of a Customer bean, the container ensures that all instances of the Address bean that are associated to the deleted Customer object are also deleted.

S.27 (b)

There are two kinds of select methods, ejb Select<METHOD> and ejb Select<METHOD>InEntity. The ejb.Select<METHOD> method is executed globally, which means it's not specific to the bean instance on which it is executed. The ejb.Select<METHOD>InEntity, is specific to the entity instance in which it is executed. Those select methods are declared as **abstract methods in the bean class** and are used in the class business methods.

S.28 (c)

The EJB QL must always contain **SELECT and FROM clauses.** The WHERE clause is optional. The FROM clause provides declarations for the identification variables based on abstract schema name, for navigating through the scheme. The SELECT clause uses these identification variables to define the return type of the query, and the WHERE clause defines the conditional query.

S.29 (d)

MDBs support concurrent processing for both Topics and Queues. Previously, only concurrent processing for Queues was supported. To ensure concurrency, change the weblogic-ejb-jar.xml deployment descriptor max-beans-in-free-pool setting to >1. If this element is set to more than one, the container will spawn as many threads as specified. WebLogic Server maintains a free pool of EJBs for every stateless session bean and message driven bean class.

The max-beans-in-free-pool element defines the size of this pool. By default, max-beans-in-free-pool no limit, the maximum number of beans is the free pool is limited only by the available memory.

S.30 (d)

The stateful session beans maintain the conversational state of the clients, they are identical when their session are equal. Two stateful session beans may have identical data attributes, but if the session contexts are different they are not identical. Since stateless beans do not retain the conversational state, they are considered identical if they are of the same type.

S.31 (d)

Choice (a) is incorrect as get Session( ) is the method of HttpServletRequest interface. Choice (b) is incorrect as the syntax used here is incorrect; the input argument to get Attribute( ) method is of String type ("myName" should be used instead of myName). Choice (c) is incorrect as the return type of getAttribute method is Object and thus explicit casting is needed for assignement to string. The correct code will be:

```
String userName = (String)request.get
Session( ).getAttribute("myName");
```

S.32 (c)

The transaction attribute defines the transactional manner in which the container invokes enterprises bean methods. This attribute is set for individual methods in a bean. Setting the transaction attribute to Required, directs the container to invoke the bean method within a transaction context. If a client invokes a bean method from within a transaction context, the container invokes the bean method within the client transaction context. It a client invokes a bean method outside of a transaction context, the container creates a new transaction context and invokes the bean method from within that context. The transaction context is passed to any enterprise bean objects or resources that are used by this bean method.

S.33 (a)

There are two types of beans Session beans and Entiry beans, where Session beans deals with business processing and **Entiry beans deals with Business data(Business Objects)**

UNIT–12

ENGINEERING MATHEMATICS

UNIT–12

ENGINEERING MATHEMATICS

12.1

MATHEMATICAL LOGIC

LEVEL–1

Common Data For Questions 1 to 5:

If p and q are two statements, then the statement of the form "if p then q" is called the conditional statement for which truth table is as :

p	q	$p \Rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

Q.1 $p \vee q$ is

(a) T, T, T, F
(b) T, F, T, F
(c) F, T, F, T
(d) F, F, F, T

Q.2 $\sim p \wedge \sim q$ is

(a) F, T, F, T
(b) T, F, T, F
(c) T, T, T, F
(d) F, F, F, T

Q.3 $\sim (p \vee q)$ is

(a) F, F, T, T
(b) T, T, F, F
(c) F, F, F, T
(d) T, F, F, F

Q.4 $p \Leftrightarrow q$ is

(a) T, T, F, F
(b) F, F, T, T
(c) T, F, F, T
(d) F, T, F, T

Q.5 $p \wedge q$ is

(a) T, F, T, F
(b) F, T, F, T
(c) T, T, T, T
(d) T, F, F, F

Statement for Linked Q6 & Q7:

Given statements are

p : $5 \times 7 = 35$

q : Earth revolves around the sun

r : $\cos 45^0 \frac{1}{2}$

Q.6 Which one of the following is true?

(a) $p \wedge q$ has truth value 'true'
(b) $p \wedge r$ has truth value 'true'
(c) $q \wedge r$ has truth value 'true'
(d) None of these

Q.7 The negation for the truth value of the correct answer of Q.6 is

(a) True

(b) False

(c) Both (a) and (b)

(d) None of these

Statement for Linked Q8 to Q11:

If the statement p has the truth values T, T, F, F and the corresponding truth value for q are T, F, T, F.

Q.8 For the given statement the negation of p and q are respectively

(a) {T, T, F, F} , {T, T, F, F}

(b) {F, F, T, T} , {F, T, F, T}

(c) {F, T, F, T} , {T, F, T, F}

(d) None of these

Q.9 The truth value for the disjunction of the correct answer of Q.8 is

(a) {F, T, T, T}

(b) {T, F, F, F}

(c) {T, T, F, F}

(d) {F, F, T, T}

Q.10 The truth value of the negation of the correct answer of Q.9 is

(a) {F, F, T, T}

(b) {T, T, T, T}

(c) {T, F, F, F}

(d) {T, T, F, F}

Q.11 The truth value for the conjunction of the correct answer of Q.8 is

(a) {F, F, F, T}

(b) {T, F, T, F}

(c) {F, T, F, T}

(d) {T, T, T, T}

Q.12 Which of the following is the inverse of the statement.

"If I drink then I do not eat."

(a) If I drink then I do not eat

(b) If I do not drink then I eat

(c) If I do not drink then I do not eat

(d) none of these

Q.13 In propositional logic which one of the following is equivalent to $p \rightarrow q$?

(a) $\sim p \rightarrow q$

(b) $\sim p \wedge q$

(c) $\sim p \vee q$

(d) $p \rightarrow \sim q$

Q.14 Let A is a tautology and B be any other formula then $(A \vee B)$ is

(a) A tautology

(b) A contradiction

(c) Well formed formula

(d) none of the above

Q.15 Which of the following is the contrapositive of the statement :

A quadrilateral is a square only if it is both a rectangle and a rhombus.

(a) If a rectangle is not a rhombus it is not a square

(b) If a rhombus is not a rectangle it is not a square

(c) If a quardrilateral is neither a rectangle nor a rhombus then it is not a square.

(d) None of these

Q.16 For a conditional statement $p \Rightarrow q$, which of the following is incorrect

(a) Converse of the inverse is its contrapositive

(b) Contrapositive of the converse is its inverse

(c) Inverse of the contrapositive is its converse

(d) None of these

Q.17 Let A = {1, 2 3, 4, 5} which of the following is false

(a) $(\exists x \in A) : (x + 3 \leq 10)$

(b) $(\forall x \in A) : (x + 3 \leq 10)$

(c) $(\exists x \in A) : (x + 3 \leq 6)$

(d) $(\forall x \in A) : (x + 3 < 8)$

Q.18 Which of the following is equivalent to $p \Rightarrow q$

(a) $\sim xp \wedge q$

(b) $p \vee \sim q$

(c) $\sim xp \vee q$

(d) $p \wedge \sim q$

Q.19 Which of the following is NOT equivalent to $p \wedge q \Rightarrow r$

(a) $q \wedge \sim r \Rightarrow \sim p$

(b) $p \wedge \sim r \Rightarrow \sim q$

(c) $\sim p \vee \sim q \Rightarrow \sim r$

(d) $\sim p \wedge \sim q \Rightarrow \sim r$

Q.20 Which one of the following propositional forms is a tautology ?

(a) $p \wedge \neg q$

(b) $p \Rightarrow (p \vee q)$

(c) $p \Rightarrow (p \wedge q)$

(d) $(p \vee q) \Rightarrow (p \wedge q)$

Q.21 Which of the following is correct ?

(a) $P \rightarrow (Q \rightarrow R) \Leftrightarrow (P \wedge Q) \wedge R$

(b) $P \rightarrow (Q \rightarrow R) \Leftrightarrow (P \wedge Q) \vee R$

(c) $P \rightarrow (Q \rightarrow R) \Leftrightarrow (P \vee Q) \wedge R$

(d) $P \rightarrow (Q \rightarrow R) \Leftrightarrow (P \wedge Q) \rightarrow R$

Q.22 Which of the following is correct implication ?

(a) $(P \rightarrow (Q \rightarrow R)) \Rightarrow (P \rightarrow Q) \rightarrow (P \rightarrow R)$

(b) $(P \uparrow (Q \uparrow R)) \uparrow (P \rightarrow Q) \uparrow (R)$

(c) $P \uparrow Q \rightarrow R \uparrow P \rightarrow R$

(d) $R \uparrow R \rightarrow P \rightleftarrows P \rightarrow Q \uparrow P$

Q.23 The Disjunctive normal form of $P \wedge (P \rightarrow Q)$ is

(a) $(P \vee \neg P) \wedge (P \wedge Q)$

(b) $(P \vee \neg P) \wedge (P \vee Q)$

(c) $P \wedge Q$

(d) $(P \wedge \neg P) \vee (P \wedge Q)$

Q.24 The principal disjunctive normal form of $\neg P \vee Q$ is

(a) $(\neg P \wedge Q) \vee (\neg P \wedge \neg Q) \vee (P \wedge Q)$

(b) $(\neg P \wedge \neg Q) \vee (\neg P \wedge \neg Q) \wedge (P \wedge Q)$

(c) $(\neg P \uparrow Q) \wedge (\neg P \wedge \neg Q)$

(d) None of these

Q.25 What is the value of $P \rightarrow (Q \rightarrow R)$?

(a) $(P \wedge Q) \wedge Q$

(b) $(P \wedge Q) \rightarrow R$

(c) $(P \vee Q) \rightarrow R$

(d) $(P \vee Q) \vee R$

Q.26 A statement that is true for all possible values of its propositional variables is called

(a) contradiction

(b) absurdity

(c) contingency

(d) tautology

Q.27 If P and Q are statements, the compound statement if P then Q denoted $P \rightarrow Q$, is called

(a) biconditional

(b) conditional

(c) conclusion

(d) dia

Q.28 Let $A = \{2, 3, 4, 5\}$, $p(x)$: x is even, $q(x)$: x is odd which of the following statements is true

(a) $(\forall x \in A) : (P(x) \wedge Q(x))$

(b) $(\exists x \in A) : (P(x) \wedge Q(x))$

(c) $(\forall x \in A) : (P(x) \Rightarrow Q(x))$

(d) $(\forall x \in A) : (P(x) \vee Q(x))$

Q.29 Which one of following four statements is a tautology?

(a) $(q \Rightarrow p) \wedge (\sim p)$

(b) $p \Rightarrow (\sim q) \vee r$

(c) $\sim p \Rightarrow \sim(p \wedge q)$

(d) $p \wedge q \wedge \sim(p \vee q)$

Q.30 Which one of following four statements is a tautology?

(a) $(p \Rightarrow q) \wedge (p \wedge \sim q)$

(b) $(\sim p \Rightarrow r) \wedge (p \Leftrightarrow q)$

(c) $p \Rightarrow (\sim q \vee r)$

(d) $\sim(p \wedge q) \vee (p \Leftrightarrow q)$

LEVEL–2

Common data for questions 31 to 33:

Let B = {{1}, {2}, {1, 2}, ϕ}

P = {1}, Q = {2}, R = {1, 2},

$\therefore$ B = {P, Q, R, ϕ}

The table for union U is as follow :

U	P	Q	R	ϕ
P	P	R	R	P
Q	R	Q	R	Q
R	R	R	R	R
ϕ	P	Q	R	ϕ

Q.31 Which of the following is true?

(a) Inverse of every element of B exist

(b) B is closed w.r.t. given operations

(c) Identity element of B does not exist w.r.t. given operation

(d) None of these

Q.32 The union U in the given set B is

(a) Closed

(b) Commutative

(c) Both (a) and (b)

(d) None of these

Q.33 Which of the following is not true?

(a) B is not commutative w.r.t. the given operation

(b) Associative property exist in B

(c) Closure property exist in B

(d) Complement law exist in B

Q.34 The truth table for exclusive disjunction will be

(i) A tautology

(ii) A contradiction

(iii) Logical Equivalent

(iv) p or q but not both

(a) (i)

(b) (ii)

(c) (iii)

(d) (iv)

Q.35 If P(n) is a statement such that truth of P(n) $\Rightarrow$ the truth of P(n+1) for $n \in N$, then P(n) is true

(a) for all n

(b) for all $n > 1$

(c) for all $n > m$, m is some fixed positive integer

(d) nothing can be said

Q.36 If P(x) : $2 + 4 + 6 + \ldots\ldots\ldots + 2n$, $n \in N$, then $P(m) = m(m + 1) + 2$

$\Rightarrow \quad P(m+1) = (m+1)(m+2)+2 \qquad \forall m \in N.$

So, we can conclude that $P(n) = n(n + 1) + 2$ for

(a) $n > 1$

(b) $n > 2$

(c) all $n \in N$

(d) nothing can be said

Q.37 which one of following four statements is not a tautology?

(a) $(q \Rightarrow q) \vee (\sim p \Leftrightarrow q)$

(b) $(p \Rightarrow q) \Leftrightarrow (q \vee \sim p)$

(c) $(\sim p \wedge q) \Leftrightarrow r \wedge p$

(d) $p \vee \sim(p \wedge q)$

Q.38 Which one of following statements is not a contradiction?

(a) $p \wedge \sim q \Leftrightarrow \sim p \vee q$

(b) $p \wedge (\sim p \vee q) \wedge (\sim q)$

(c) $(p \vee (\sim q)) \wedge ((\sim p) \vee q)$

(d) $\sim(p \Leftrightarrow q) \Leftrightarrow (p \Leftrightarrow \sim q)$

Q.39 Which of the following four statements is neither a tautology nor a contradiction?

(a) $p \wedge (\sim p \vee q) \wedge (\sim q)$

(b) $(q \vee p) \vee (\sim p \Leftrightarrow q)$

(c) $(\sim p \veebar q) \Leftrightarrow (p \veebar \sim q)$

(d) $p \Rightarrow (\sim q) \vee r$

Q.40 Let P(n) : $n^2 + n$ is an odd integer. It is seen truth of P(n) $\Rightarrow$ the truth of P(n + 1). Therefore, P(n) is true for all

(a) $n > 1$

(b) n

(c) $n > 2$

(d) none of these

Q.41 $(P \vee Q) \wedge (P \rightarrow R) \wedge (Q \rightarrow S)$ is equivalent to

(a) $S \wedge R$

(b) $S \vee R$

(b) $S \rightarrow R$

(d) none of these

Q.42 Consider two well-formed formulas in propositional logic

F1 : $P \rightarrow \neg P$ F2 : $(P \rightarrow \neg P) \vee (\neg P \rightarrow P)$

which of the following statements is correct ?

(a) F1 is satisfiable, F2 is valid

(b) F1 is unsatisfiable, F2 is satisfiable

(c) F1 is unsatisfiable, F2 is valid

(d) F1 and F2 are both satisfiable

Q.43 The conditional statement $P \rightarrow q$ and its contrapositive are

(a) Converse

(b) Inverse

(c) Logically equivalent

(d) None of these

Q.44 Consider the following truth table:

p	q	Y
T	T	F
T	F	F
F	T	F
F	F	T

Then output Y denotes

(i) Joint denial of p and q

(ii) Neither p nor q

(iii) Exclusive disjunction

(a) (i)

(b) both (i) and (ii)

(c) (iii)

(d) both (i) and (iii)

LEVEL–3

Q.45 $p \veebar q$ (read exclusive or q) is true when either p or q is true. But not both and is false other wise. Which of the following distributive laws connecting $\wedge$, $\vee$, $\veebar$ is INVALID:

(a) $p \wedge (q \vee r) \Leftrightarrow (p \wedge q) \vee (p \wedge r)$

(b) $p \wedge (q \veebar r) \Leftrightarrow (p \wedge q) \veebar (p \wedge r)$

(c) $p \veebar (q \wedge r) \Leftrightarrow (p \veebar q) \wedge (p \veebar r)$

(d) $p \vee (q \wedge r) \Leftrightarrow (p \vee q) \wedge (p \vee r)$

Q.46 If $x > -1$, then the statement

$P(n) : (1 + x)^n > 1 + nx$ is true for

(a) all $n \in N$

(b) all $n > 1$

(c) all $n > 1$ and $x \neq 0$

(d) none of these

GATE QUESTIONS

Q.47 Which of the following well–formed formulas are equivalent? **[GATE 1988]**

(I) $P \rightarrow Q$

(II) $\sim P \rightarrow Q$

(III) $\sim P \vee Q$

(IV) $\sim Q \rightarrow P$

(a) only (I) and (II)

(b) only (I) and (III)

(c) (I) & (III) and (II) & (IV)

(d) none of the above

Q.48 If F1, F2 and F3 are propositional formulae such that

$F1 \wedge F2 \rightarrow F3$ and $F1 \wedge F1 \rightarrow \sim F2$

are both tautologies, then which of the following is TRUE ? **[GATE 1991]**

(a) Both F1 and F2 are tautologies

(b) The conjunction $F1 \wedge F2$ is not satisfiable

(c) Neither is tautologous

(d) Neither is satisfiable

(e) None of the above

Q.49 Which of the following is/are tautology ? **[GATE 1992]**

(a) $a \vee b \rightarrow b \wedge c$

(b) $a \wedge b \rightarrow b \vee c$

(c) $a \vee b \rightarrow (b \rightarrow c)$

(d) $a \rightarrow b \rightarrow (b \rightarrow c)$

Q.50 Which of the following predicate calculus statements is/are valid ? **[GATE 1992]**

(a) $(\forall x)\ P(x) \vee (\forall x)\ Q(x) \rightarrow (\forall x)\ \{P(x) \vee Q(x)\}$

(b) $(\exists x)\ P(x) \wedge (\exists x)\ Q(x) \rightarrow (\exists x)\ \{P(x) \wedge Q(x)\}$

(c) $(\forall x)\ \{P(x) \vee Q(x)\} \rightarrow (\forall x)\ P(x) \vee (\forall x)\ Q(x)$

(d) $(\exists x)\ \{P(x) \vee Q(x)\} \rightarrow \sim(\forall x)\ P(x) \vee (\exists x)\ Q(x)$

Q.51 The proposition $p \wedge (\sim p \vee q)$ is **[GATE 1993]** **[2-Marks]**

(a) A tautology

(b) A contradiction

(c) Logical equivalence to $p \wedge q$

(d) Logical equivalence to $p \vee q$

Q.52 If the proposition $\sim p \Rightarrow q$ is true, then the truth value of the proposition $\sim p \vee (p \Rightarrow q)$, where $\sim$ is negation, '$\vee$' is inclusive or and $\Rightarrow$ is implication, is **[GATE 1995]** **[2-Marks]**

(a) true

(b) multiple-valued

(c) false

(d) cannot be determined

Q.53 Which of the following propositions is a tautology? **[GATE 1997]** **[1-Mark]**

(a) $(p \vee q) \rightarrow p$

(b) $p \vee (q \rightarrow p)$

(c) $p \vee (p \rightarrow q)$

(d) $p \rightarrow (p \rightarrow q)$

Q.54 Let a, b, c, d be propositions. Assume that the equivalence $a \leftrightarrow (b \vee \neg b)$ and $b \leftrightarrow c$ hold. Then the truth value of the formula $(a \wedge b) \rightarrow ((a \wedge c) \vee d)$ is always **[GATE 2000]** **[2-Marks]**

(a) True

(b) False

(c) Same as the truth value of b

(d) Same as the truth value of d

Q.55 "If X then Y unless Z" is represented by which of the following formulas in propositional logic? ("$\neg$" is negation, "$\wedge$" is conjunction, and "$\rightarrow$" is implication) **[GATE 2002]** **[1-Mark]**

(a) $(X \wedge \neg Z) \rightarrow Y$

(b) $(X \wedge Y) \rightarrow \neg Z$

(c) $X \rightarrow (Y \wedge \neg Z)$

(d) $(X \rightarrow Y) \wedge \neg Z$

Q.56 Which of the following is a valid first order formula? (Here α and β are first order formulae with x as their only free variable) **[GATE 2003]** **[2-Marks]**

(a) $((\forall x)\ [\alpha] \Rightarrow (\forall x)\ [\beta]) \Rightarrow (\forall x)\ [\alpha \Rightarrow \beta]$

(b) $(\forall x)\ [\alpha] \Rightarrow (\exists x)\ [\alpha \wedge \beta]$

(c) $(\forall x)\ [\alpha \vee \beta] \Rightarrow (\exists x)\ [\alpha] \Rightarrow (\forall x)\ [\alpha]$

(d) $(\forall x)\ [\alpha \Rightarrow \beta] \Rightarrow ((\forall x)\ [\alpha]) \Rightarrow (\forall x)\ [\beta])$

Q.57 Consider the following logic program P

$A(x) \leftarrow B(x, y), C(y)$

$\leftarrow B(x, x)$

Which of the following first order sentences is equivalent to P? **[GATE 2003]** **[2-Marks]**

(a) $(\forall x)\ [(\exists y)\ [B(x, y) \wedge C(y)] \Rightarrow A(x)] \wedge \neg(\exists x)\ [B(x,x)]$

(b) $(\forall x)\ [(\forall y)\ [B(x, y) \wedge C(y)] \Rightarrow A(x)] \wedge \neg(\exists x)\ [B(x,x)]$

(c) $(\forall x)\ [(\exists y)\ [B(x, y) \wedge C(y)] \Rightarrow A(x)] \vee \neg(\exists x)\ [B(x,x)]$

(d) $(\forall x)\ [(\forall y)\ [B(x, y) \wedge C(y)] \Rightarrow A(x)] \wedge (\exists x)\ [B(x,x)]$

Q.58 The following resolution rule is used in logic programming :

Derive clause $(P \vee Q)$ from clauses $(P \vee R)$, $(Q \vee \neg R)$

Which of the following statements related to this rule is FALSE? **[GATE 2003]**

[2-Marks]

(a) $((P \vee R) \wedge (Q \vee \neg R)) \Rightarrow (P \vee Q)$ is logically valid.

(b) $(P \vee Q) \Rightarrow ((P \vee R) \wedge (Q \vee \neg R))$ is logically valid.

(c) $(P \vee Q)$ is satisfiable if and only if $(P \vee R) \wedge (Q \vee \neg R)$ is satisfiable.

(d) $(P \vee R) \Rightarrow$ FALSE if and only if both P and Q are unsatisfiable.

Q.59 Identify the correct translation into logical notation of the following assertion :

Some boys in the class are taller than all the girls.

Note : taller (x, y) is true if x is taller than y.

[GATE 2004]

[1-Mark]

(a) $(\exists x)$ (boy(x) $\rightarrow$ $(\forall y)$ (girl(y) $\wedge$ taller(x,y)))

(b) $(\exists x)$ (boy(x) $\wedge$ $(\forall y)$ (girl(y) $\wedge$ taller(x,y)))

(c) $(\exists x)$ (boy(x) $\rightarrow$ $(\forall y)$ (girl(y) $\rightarrow$ taller(x,y)))

(d) $(\exists x)$ (boy(x) $\wedge$ $(\forall y)$ (girl(y) $\rightarrow$ taller(x,y)))

Q.60 The following prepositional statement is $(P \rightarrow (Q \vee R)) \rightarrow ((P \wedge Q) \rightarrow R)$ **[GATE 2004]**

[2-Marks]

(a) satisfiable but not valid

(b) valid

(c) a contradiction

(d) none of the above

Q.61 Let a(x, y); b(x, y) and c(x, y) be three statements with variables x and y chosen from some universe. Consider the following statement:

$(\exists x)$ $(\forall y)$ $[(a(x, y) \wedge (b(x, y)) \vee \neg c(x, y)]$

Which one of the following is its equivalent?

[IT-GATE 2004]

[1 Mark]

(a) $(\forall x)$ $(\exists y)$ $[(a(x, y) \vee b(x, y)) \rightarrow c(x, y)]$

(b) $(\exists x)$ $(\forall y)$ $[(a(x, y) \vee b(x, y)) \wedge \neg c(x, y)]$

(c) $\neg(\forall x)$ $(\exists y)$ $[(a(x, y) \wedge b(x, y)) \rightarrow c(x, y)]$

(d) $\neg(\forall x)$ $(\exists y)$ $[(a(x, y) \vee b(x, y)) \rightarrow c(x, y)]$

Q.62 Let X and Y be two exponentially distributed and independent random variables with mean α and β, respectively. If Z = min (X, Y), then the mean of Z is given by **[IT-GATE 2004]**

[2-Marks]

(a) $\dfrac{1}{\alpha+\beta}$

(b) $\min(\alpha, \beta)$

(c) $\dfrac{\alpha\beta}{\alpha+\beta}$

(d) $\alpha + \beta$

Q.63 Let $n = p^2q$, where p and q are distinct prime numbers. How many numbers m satisfy $1 \le m \le n$ and gcd(m,n) = 1? Note that gcd(m,n) is the greatest common divisor of m and n.

[IT-GATE 2005]

[2-Marks]

(a) p(q – 1)

(b) pq

(c) $(p^2 - 1)$ (q – 1)

(d) p(p – 1) (q – 1)

Q.64 What is the first order predicate calculus statement equivalent to the following?

'Every teacher is liked by some student'.

[GATE 2005]

[2-Marks]

(a) $\forall(x)$ {teacher(x) $\rightarrow$ $\exists(y)$ [student(y) $\rightarrow$ likes(y,x)]]

(b) $\forall(x)$ {teacher(x) $\rightarrow$ $\exists(y)$ [student(y) $\wedge$ likes (y,x)]]

(c) $\exists(y)$ $\forall(x)$ [teacher(x) $\rightarrow$ [student(y) $\wedge$ likes(y,x)]]

(d) $\forall(x)$ [teacher(x) $\wedge$ $\exists(y)$ [student(y) $\rightarrow$ likes(y,x)]]

Q.65 Let P(x) and Q(x) be arbitrary predicates. Which of the following statements is always TRUE?

[IT-GATE 2005]

[2-Marks]

(a) $((\forall x\ P(x) \vee Q(x))) \Rightarrow ((\forall x\ P(x)) \vee (\forall x\ Q(x)))$

(b) $(\forall x\ (P(x) \Rightarrow Q(x))) \Rightarrow ((\forall x\ P(x)) \Rightarrow (\forall x\ Q(x)))$

(c) $((\forall x\ (P(x)) \Rightarrow (\forall x\ Q(x))) \Rightarrow (\forall x\ (P(x) \Rightarrow Q(x)))$

(d) $((\forall x\ (P(x)) \Leftrightarrow (\forall x\ Q(x)))) \Rightarrow (\forall x\ (P(x) \Leftrightarrow Q(x)))$

Q.66 Let P, Q and R be tree atomic prepositional assertions, Let X denote $(P \vee Q) \rightarrow R$ and Y denote $(P \rightarrow R) \vee (Q \rightarrow R)$. Which one of the following is a tautology?

[GATE 2005]

[2-Marks]

(a) $X \equiv Y$

(b) $X \rightarrow Y$

(c) $Y \rightarrow X$

(d) $\neg Y \rightarrow X$

Q.67 Which one of the first order predicate calculus statements given below correctly expresses the following English statement?

"Tigers and lions attack if they are hungry or threatened." **[GATE 2006]**

[2-Marks]

(a) $\forall x\ [(\text{tiger}(x) \wedge \text{lion}(x)) \rightarrow \{(\text{hungry}(x) \vee \text{threatened}(x)) \rightarrow \text{attacks}(x)\}]$

(b) $\forall x\ [(\text{tiger}(x) \vee \text{lion}(x)) \rightarrow \{(\text{hungry}(x) \vee \text{threatened}(x)) \wedge \text{attacks}(x)\}]$

(c) $\forall x\ [(\text{tiger}(x) \vee \text{lion}(x)) \rightarrow \{(\text{attacks}(x) \rightarrow (\text{hungry}(x) \rightarrow \text{threatened}(x)\}]$

(d) $\forall x\ [(\text{tiger}(x) \vee \text{lion}(x)) \rightarrow \{(\text{hungry}(x) \vee \text{threatened}(x)) \rightarrow \text{attacks}(x)\}]$

Q.68 Consider the following propositional statements:

P1 : $((A \wedge B) \rightarrow C)) \equiv ((A \rightarrow C) \wedge (B \rightarrow C))$

P2 : $((A \vee B) \rightarrow C)) \equiv ((A \rightarrow C) \vee (B \rightarrow C))$

Which of the following is true?

[GATE 2006]

[2-Marks]

(a) P1 is tautology, but not P2

(b) P2 is a tautology, but not P1

(c) P1 and P2 are both tautologies

(d) Both P1 and P2 are not tautologies

Q.69 A logical binary relation $\odot$, is defined as follows:

A	B	$A \odot B$
True	True	True
True	False	True
False	True	False
False	False	True

Let ~ be the unary negation (NOT) operator, with higher precedence than $\odot$. Which one of the following is equivalent to $A \wedge B$? **[GATE 2006]**

[2-Marks]

(a) $(\sim A \odot B)$

(b) $\sim(A \odot \sim B)$

(c) $\sim(\sim A \odot \sim B)$

(d) $\sim(\sim A \odot B)$

Q.70 Let Graph(x) be a predicate which denotes that x is a graph. Let connected(x) be a predicate which denotes that x is connected. Which of the following first order logic sentences DOES NOT represent the statement. "Not every graph is connected"? **[GATE 2007]**

[2-Marks]

(a) $\neg\forall x(\text{Graph}(x) \Rightarrow \text{Connected}(x))$

(b) $\exists x(\text{Graph}(x) \wedge \neg\text{Connected}(x))$

(c) $\neg\forall x(\neg\text{Graph}(x) \vee \text{Connected}(x))$

(d) $\forall x(\text{Graph}(x)) \Rightarrow \neg\text{Connected}(x))$

Q.71 Which of the following tuple relational calculus expression(s) is/are equivalent to $\forall t \in r(P(t))$

I. $\neg\exists t \in r(P(t))$

II. $\exists t \notin r(P(t))$

III. $\neg\exists t \in r(\neg P(t))$

IV. $\exists t \notin r(\neg P(t))$ **[GATE 2008]**

[1-Mark]

(a) I only

(b) II only

(c) III only

(d) III and IV only

Q.72 Let fsa and pda be two predicates such that fsa(x) means x is a finite state automation and pda(y) means, that y is a push down automation.

Let equivalent be another predicate such that equivalent (a,b) means a and b are equivalent. Which of the following first order logic statements represent the following:

Each finite state automation has an equivalent pushdown automation. **[GATE 2008]**

[2-Marks]

(a) $(\forall x\ fsa(x)) \Rightarrow (\exists y\ pda(y) \wedge equivalent(x,y))$

(b) $\sim\forall y(\exists x\ fsa(x) \Rightarrow (\exists y\ pda(y) \wedge equivalent(x,y))$

(c) $\forall x\ \exists y\ (fsa(x) \wedge pda(y) \wedge equivalent(x,y))$

(d) $\forall x\ \exists y\ (fsa(x) \wedge pda(x) \wedge equivalent(x,y))$

Q.73 P and Q are two propositions. Which of the following logical expressions are equivalent?

I. $P \vee \sim Q$

II. $\sim(\sim P \wedge Q)$

III. $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge \sim Q)$

IV. $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge Q)$

[GATE 2008]

(a) Only I and II

(b) Only I, II and III

(c) Only I, II and IV

(d) All of I, II, III and IV

Q.74 Which one of the following is the most appropriate logical formula to represent the statement ?

"Gold and silver ornaments are precious"

The following notations are used :

G(x) : x is a gold ornament.

S(x) : x is a silver ornament.

P(x) : x is precious **[GATE 2009]**

[2-Marks]

(a) $\forall x(P(x) \rightarrow (G(x) \wedge S(x)))$

(b) $\forall x((G(x) \wedge S(x)) \rightarrow P(x))$

(c) $\exists x((G(x) \wedge S(x)) \rightarrow P(x))$

(d) $\forall x((G(x) \vee S(x)) \rightarrow P(x))$

Q.75 The binary operation is defined as follows

P	Q	P□Q
T	T	T
T	F	T
F	T	F
F	F	T

which one of the following is equivalent to P∨Q?

[GATE 2009]

[2-Marks]

(a) $\neg Q \square \neg P$

(b) $P \square \neg Q$

(c) $\neg P \square Q$

(d) $\neg P \square \neg Q$

ANSWER KEY

1	a	2	d	3	c	4	c	5	d
6	a	7	b	8	b	9	a	10	c
11	a	12	b	13	c	14	a	15	c
16	d	17	d	18	c	19	c, d	20	b
21	d	22	a	23	d	24	a	25	b
26	d	27	b	28	d	29	c	30	d
31	b	32	c	33	a	34	d	35	d
36	d	37	c	38	d	39	d	40	d
41	b	42	c	43	c	44	b	45	c
46	c	47	c	48	b	49	b	50	a, d
51	c	52	b	53	c	54	a	55	d
56	d	57	c	58	b	59	d	60	a
61	c	62	c	63	d	64	b	65	a
66	b	67	d	68	d	69	d	70	d
71	c	72	a	73	b	74	d	75	b

SOLUTIONS

S.1 (a)

p	q	$p \vee q$
T	T	**T**
T	F	**T**
F	T	**T**
F	F	**F**

S.2 (d)

p	q	$\sim p$	$\sim q$	$\sim p \wedge \sim q$
T	T	F	F	**F**
T	F	F	T	**F**
F	T	T	F	**F**
F	F	T	T	**T**

S.3 (c)

p	q	$p \vee q$	$\sim (p \vee q)$
T	T	T	**F**
T	F	T	**F**
F	T	T	**F**
F	F	F	**T**

S.4 (c)

p	q	$p \Leftrightarrow q$
T	T	**T**
T	F	**F**
F	T	**F**
F	F	**T**

$p \Leftrightarrow q$ is true if both p and q have same truth value (T) otherwise false (F) truth value.

S.5 (d)

p	q	p ∧ q
T	T	T
T	F	F
F	T	F
F	F	F

p ∧ q have truth value T if p and q both have truth value (T) otherwise false (F).

S.6 (a)

Since p : "5 × 7 = 35" is true

and q : "Earth revolves around the sun" is true

∴ p and q both are true.

Hence, **p ∧ q has truth value 'true'.**

S.7 (b)

The truth value of the correct answer of Q.6 is 'T'.

∴ Its negation will be **'F'.**

S.8 (b)

p	q	~ p	~ q
T	T	F	F
T	F	F	T
F	T	T	F
F	F	T	T

S.9 (a)

Disjunction means the truth value 'T' if either 1st or 2nd is true or both are true and false 'F' if both are false.

∴ Disjunction of the right answer of Q.8 i.e., disjunction of {F, F, T, T} and {F, T, F, T} is **{F, T, T, T}.**

S.10 (c)

Negation of {F, T, T, T} is **{T, F, F, F}.**

S.11 (a)

The correct answer of Q.8 is {F, F, T, T} {F, T, F, T}

∴ Conjunction is **{F, F, F, T}.**

S.12 (b)

In the above statement inverse of I drink is I am not drinking and inverse of I do not eat is I eat.

S.13 (c)

p	q	~p	p→q
T	T	F	T
T	F	F	F
F	T	T	T
F	F	T	T

From the above table, it is clea hat p → q is equivalent to ~p ∨

S.14 (a)

Since A is a tautology so it is true for all possible inputs. So (A ∨ B) is true for all inputs regardless of Therefore A ∨ B is a tautology.

S.16 (d)

p ⇒ q

Inverse : ~p ⇒ ~q

Converse : q ⇒ p

Contrapositive : ~q ⇒ ~p

In the given question (a), (b) and (c) are correct statements.

S.17 (d)

Option (d) is false.

Taking x = 5 ∈ A the condition x + 3 < 8 ⇒ 5 + 3 = 8 is false.

S.19 (c, d)

p	q	r	~p	~q	~r	p∧q	p∧q⇒r	~p∨~q	~p∨~q⇒~r
T	T	T	F	F	F	T	T	F	T
T	T	F	F	F	T	T	F	F	T
T	F	T	F	T	F	F	T	T	F
T	F	F	F	T	T	F	T	T	T
F	T	T	T	F	F	F	T	T	F
F	T	F	T	F	T	F	T	T	T
F	F	T	T	T	F	F	T	T	F
F	F	F	T	T	T	F	T	T	T

S.21 (d)

P	Q	R	Q→R	P→(Q→R)	P∧Q	(P∧Q)→R
T	T	T	T	T	T	T
T	T	F	F	F	T	F
T	F	T	T	T	F	T
T	F	F	T	T	F	T
F	T	T	T	T	F	T
F	T	F	F	T	F	T
F	F	T	T	T	F	T
F	F	F	T	T	F	T

Therefore, $P \rightarrow (Q \rightarrow R) = (P \wedge Q) \rightarrow R$

S.29 (c)

p	q	~p	p∧r	~(p∧q)	~p ⇒ ~(p∧q)
T	T	F	T	F	T
T	F	F	F	T	T
F	T	T	F	T	T
F	F	T	F	T	T

S.30 (d)

p	q	p∧q	~(p∧q)	p ⇔ q	~(p ∧ q) ∨ (p ⇔ q)
T	T	T	F	T	T
T	F	F	T	F	T
F	T	F	T	F	T
F	F	F	T	T	T

S.31 (b)

Since all the entries of the given table is same as given in the set B.

∴ B is closed w.r.t. given operation.

S.32 (c)

Clearly from the table B is closed as well as commutative property exist.

S.33 (a)

Clearly 1st option is true, because B is commutative w.r.t. given operation.

S.34 (d)

The proportional connective $\veebar$ is called the exclusive disjunction, $p \veebar q$ is read "p or q but not both"

The truth table for $p \veebar q$ is true if p is true or if q is true but not if both are true; the truth table of $p \veebar q$ is shown below.

p	q	$p \veebar q$
T	T	F
T	F	T
F	T	T
F	F	F

S.35 (d)

Nothing can be said about the truth of P(n), for all $n \in N$ because true of P(1) is not given.

S.36 (d)

Since P(1) = 2, therefore P(n) = n (n + 1) + 2 is not true for n = 1.

∴ Principle of Induction is not applicable. So, **nothing can be said** about the truth of the statement P(n) = n (n + 1) + 2.

S.37 (c)

p	q	r	~p∧q	r∨p	~p∧q→r∧p
T	T	T	F	T	T
T	T	F	F	F	T
T	F	T	F	T	T
T	F	F	F	F	T
F	T	T	T	F	F
F	T	F	T	F	F
F	F	T	F	F	T
F	F	F	F	F	T

So, $\sim p \wedge q \rightarrow r \wedge p$ is not a tautology.

S.40 (d)

Since P(1): $1^2+1 = 2$ is not an odd integer, so P(1) is not true.

∴ Principle of Induction is not applicable. In fact, P(n) = n(n + 1) being the product of two consecutive integers is always even.

S.43 (c)

The given conditional statement $p \to q$ and its contrapositive $\sim q \to \sim p$ are logically equivalent.

				Conditional	Converse	Inverse	Contrapositive
p	q	~p	~q	p → q	q → p	~p → ~q	~q → ~p
T	T	T	T	T	T	T	T
T	F	F	T	F	T	T	F
F	T	T	F	T	F	F	T
F	F	T	T	T	T	T	T
				(I)			(II)

From (I) and (II) we can say that

$p \to q$ and $\sim q \to \sim p$ are logically equivalent.

Thus A conditional statement $p \to q$ and its contrapositive $\sim q \to \sim p$ are logically equivalent.

S.44 (b)

The proportional connective ! The given statement is true only when **$n > 1$ and $x \neq 0$ is called the joint denial**, $p \downarrow q$ as read **neither p nor q.** $p \downarrow q$ is true only in the case that p is not true and q is not true, the truth table of $p \downarrow q$ is as follows :-

p	q	$p \downarrow q$
T	T	F
T	F	F
F	T	F
F	F	T

S.46 (c)

P(1) is true,

For n = 2, $P(2) : (1+x)^2 > 1+2x$ is true if $x \neq 0$.

Let $P(k) : (1+x)^k > 1+kx$ be true

$\therefore$ $(1+x)^{k+1} = (1+x)(1+x)^k$

$> (1+x)(1+kx)$

$= 1+(k+1)x+kx^2$

$> 1+(k+1)x$

$[\because kx^2 > 0]$

S.47 (c)

Two statement patterns are said to be logically equivalent if they have the same truth values corresponding to the truth values of their components. Hence $P \to Q$ and $\sim P \vee Q$ are logically equivalent as can be seen from the following table:

P	Q	$P \to Q$	~P	$\sim P \vee Q$
T	T	T	F	T
T	F	F	F	F
F	T	T	T	T
F	F	T	T	T

Hence (I) and (III) are equivalent.

A conditional statement is logically equivalent to its contrapositive.

Hence $\sim P \to Q$ is equivalent to $\sim Q \to \sim(\sim P)$ i.e., $\sim Q \to P$.

Therefore, (II) and (IV) are equivalent.

S.48 (b)

$F_1 \wedge F_2 \to F_3$ is a valid argument since it is a tautology

$F_1 \wedge F_2 \to \sim F_3$ is also a valid argument since it is a tautology.

But this itself is a contradiction.

Hence it follows that the conjuction $F_1 \wedge F_2$ is not satisfiable.

S.49 (b)

a	b	c	$a \vee b$	$a \wedge b$	$b \vee c$	$b \wedge c$	$b \to c$	$a \to b$
T	T	T	T	T	T	T	T	T
T	T	F	T	T	T	F	F	T
T	F	T	T	F	T	F	T	F
T	F	F	T	F	F	F	T	F
F	T	T	T	F	T	T	T	T
F	T	F	T	F	T	F	F	T
F	F	T	F	F	T	F	T	T
F	F	F	F	F	F	F	T	T

■

It follows that $a \vee b \rightarrow b \wedge c$ is not tautology, since $T \rightarrow F$ is F.

$a \wedge b \rightarrow b \vee c$ is a tautology since $F \rightarrow T$ is T and $F \rightarrow F$ is T.

$a \vee b \rightarrow (b \rightarrow c)$ is not a tautology since $T \rightarrow F$ is F.

$a \rightarrow b \rightarrow (b \rightarrow c)$ is not a tautology since $T \rightarrow F$ is F.

S.50 (a, d)

(a) and (d) are valid and (b) and (c) are invalid. If we want to prove $p \rightarrow q$, it is enough to prove if $p = T$ then $q = T$.

S.51 (c)

$p \wedge (\sim p \vee q)$

$\Leftrightarrow (p \wedge \sim p) \vee (p \wedge q)$

$\Leftrightarrow F \vee (p \wedge q)$

$\Leftrightarrow \mathbf{p \wedge q}$

S.52 (b)

First of all, note that $p \Rightarrow q$ and $\sim p \vee q$ are logically equivalent.

(This may be verified from the truth table)

Hence $\sim p \Rightarrow q \equiv \sim(\sim p) \vee q \equiv p \vee q$

$\sim p \vee (p \Rightarrow q) \equiv \sim p \vee (\sim p \vee \sim) \equiv \sim p \vee q$

It is given that $p \vee q$ is true.

$\Rightarrow$ $p \vee q$ takes on the values $T \vee T$, $T \vee F$, $F \vee T$

$\Rightarrow$ $\sim p \vee q$ takes on the values $F \vee T$, $F \vee F$, $T \vee T$. i.e. T, F, T.

$\Rightarrow$ the truth value of the proposition $\sim p \vee (p \Rightarrow q)$ is **multiple-valued.**

S.53 (c)

p	q	$p \rightarrow q$	$p \vee (p \rightarrow q)$
T	T	T	T
T	F	F	T
F	T	T	T
F	F	T	T

$\therefore$ **$p \vee (p \rightarrow q)$ is a tautology.** Others are not tautology.

S.54 (a)

$b \vee \sim b = T$ (Tautology)

$a \leftrightarrow (b \vee \sim b) \equiv a \leftrightarrow T$

$\Rightarrow$ a is a tautology.

$b \leftrightarrow c$

$\Rightarrow$ b and c have same truth values.

Let $b = T$

$\Rightarrow$ $c = T$

$(a \wedge b) \rightarrow ((a \wedge c) \vee d)$

$\equiv (T \wedge T) \rightarrow ((T \wedge T) \vee d)$

$\equiv T \rightarrow T \vee d$

$\Rightarrow$ Even if d is T or F, $T \rightarrow T \vee d \equiv T \rightarrow T \equiv T$.

Hence (d) is false.

Let $b = F$

$\Rightarrow$ $c = F$

$(a \wedge b) \rightarrow ((a \wedge c) \vee d)$

$\equiv (T \wedge F) \rightarrow ((T \wedge F) \vee d)$

$\equiv F \rightarrow (F \vee d)$

Let $d = F$

$\equiv F \rightarrow (F \vee F)$

$\equiv F \rightarrow F$

$\equiv T$

Let $d = T$

$\equiv F \rightarrow (F \vee T)$

$\equiv F \rightarrow T$

$\equiv T$

Hence (c) is false and (a) is true.

S.55 (d)

If x then y can be represented as $x \rightarrow y$ and if x then y unless z is represented as $(x \rightarrow y) \wedge \neg z$.

S.56 (d)

(b) and (c) are certainly false. (a) doesn't follow logically.

(d) is the only valid formula.

Because

$(\forall x)[\alpha \Rightarrow \beta] \Rightarrow ((\forall x)[\alpha] \Rightarrow \forall(x)[\beta])$ is a logical equivalence and therefore, a valid first order formula.

S.57 (c)

$p \Rightarrow q \equiv \sim p \vee q$

$B(x, x) \rightarrow [B(x, y), C(y) \rightarrow A(x)] \equiv \neg B(x, x) \vee [B(x, y) \wedge C(y) \rightarrow A(x)]$

Which is same as choice (c).

S.58 (b)

Derive clause $P \vee Q$ from clauses $P \vee R$, $Q \vee \neg R$ means that $(P \vee R) \wedge (Q \vee \neg R) \Rightarrow P \vee Q$

Since, $x \Rightarrow y$ does not imply that $y \Rightarrow x$

$\therefore$ $\mathbf{P \vee Q \rightarrow (P \vee R) \wedge (Q \vee \neg R)}$

$\therefore$ may or may not be true.

S.59 (d)

The statement is "some boys in the class are taller than all the girls". So the notation for the given statement is

$\mathbf{(\exists x)\ (boy(x) \wedge (\forall y)\ (girl(y) \rightarrow taller(x,y)))}$

where taller (x, y) represent x is taller than y. x represents boys and y represents girls.

S.60 (a)

$(P \rightarrow (Q \vee R) \rightarrow ((P \wedge Q) \rightarrow R)$

$\equiv (P \rightarrow Q + R) \rightarrow (PQ \rightarrow R)$

$\equiv [P' + Q + R] \rightarrow [(PQ)' + R]$

$\equiv [P' + Q + R] \rightarrow [P' + Q' + R]$

$\equiv (P' + Q + R)' + P' + Q' + R$

$\equiv PQ'R' + P' + Q' + R$

$\equiv Q' + Q'PR' + P' + R$

$\equiv Q' + P' + R$ (by absorption law)

Which is a contingency (i.e. satisfiable but not valid.)

S.61 (c)

$(\exists x)\ (\forall y)\ [(a(x, y) \wedge (b(x, y)) \vee \neg c(x, y)]$

is equivalent as

$\neg[(\forall x)\ (\exists y)\ [(a(x, y) \wedge (b(x, y)) \rightarrow c(x, y)]]$

S.62 (c)

Let x and y be two exponentially distributed and independent random variables with mean α and β and $z = \min(x, y)$.

Then relation between mean of these three is

$$\frac{1}{\text{mean of min }(x, y)} = \frac{1}{\text{mean of } x} + \frac{1}{\text{mean of } y}$$

$$\frac{1}{\text{mean of } z} = \frac{1}{\alpha} + \frac{1}{\beta}$$

$$\textbf{mean of } z = \frac{\alpha\beta}{\alpha + \beta}$$

S.63 (d)

$\because$ $n = p^2q$, $\gcd(m,n) = 1$, $1 \le m \le n$

let $n = 12$

$12 = 2^2.3 \Rightarrow p = 2$ and $q = 3$

If we put in option (d), we get

$$2(2 - 1)\ (3 - 1)$$
$$= 2.2 = 4$$

Number which are co-prime with 12 are

1, 5, 7, 11

gcd(12, 1)= 1

gcd(12, 5)= 1

gcd(12, 7)= 1

gcd(12, 11)= 1

S.64 (b)

"Every teacher is liked by some student", then logical expression is (b); where likes (y,x) means y likes x : such that y represent the student and x represent the teacher.

S.66 (b)

$X : (P \vee Q) \rightarrow R$

$Y : (P \rightarrow R) \vee (Q \rightarrow R)$

$X : P+Q \rightarrow R \equiv (P+Q)'+R \equiv P'Q'+R$

$Y : (P'+R)+(Q'+R) \equiv P'+Q'+R$

clearly $X \neq Y$

consider $X \rightarrow Y$

$\equiv (P'Q'+R) \rightarrow (P'+Q'+R)$

$\equiv (P'Q'+R)'+P'+Q'+R$

$\equiv (P'Q')'\cdot R'+P'+Q'+R$

$\equiv (P+Q)\cdot R'+P'+Q'+R$

$\equiv PR'+QR'+P'+Q'+R$

$\equiv (PR'+R)+(QR'+Q')+P'$

$\equiv (P+R)(R'+R)+(Q+Q')\times(R'+Q')+P'$

$\equiv (P+R)+(R'+Q')+P'$

$\equiv P+P'+R+R'+Q'$

$\equiv 1+1+Q'$

$\equiv 1$

$\therefore$ **$X \rightarrow Y$ is a tautology.**

S.67 (d)

The given statement should be read as "If an animal is a tiger or a lion, then (if the animal is hungry or threatened, then it will attack).

Therefore the correct translation is

$\forall x$ [(tiger(x) $\vee$ lion(x)) $\rightarrow$ {(hungry(x) $\vee$ threatened (x)) $\rightarrow$ attacks(x)}]

which is choice (d).

S.68 (d)

A	B	C	$A \vee B$	$A \wedge B$	$(A \vee B) \rightarrow C$ (3)	$(A \wedge B) \rightarrow C$ (1)
T	T	T	T	T	T	T
T	T	F	T	T	F	F
T	F	T	T	F	T	T
T	F	F	T	F	F	T
F	T	T	T	F	T	T
F	T	F	T	F	F	T
F	F	T	F	F	T	T
F	F	F	F	F	T	T

$A \rightarrow C$	$B \rightarrow C$	$(A \rightarrow C) \wedge (B \rightarrow C)$ (2)	$(A \rightarrow C) \vee (B \rightarrow C)$ (4)
T	T	T	T
F	F	F	F
T	T	T	T
F	T	F	T
T	T	T	T
T	F	F	T
T	T	T	T
T	T	T	T

Since column (1) and (2) are not identical so P_1 is not a tautology.

Similarly, column (3) and (4) are not identical so P_2 is not a tautology.

S.69 (d)

By using min terms we can define

$(A \odot B) = AB + AB' + A'B' = A + A'B'$

$= (A + A') \cdot (A + B') = A + B'$

(a) $\sim A \odot B = A' \odot B = A'+B'$

(b) $\sim (A \odot \sim B) = (A \odot B')' = (A + (B')')'$

$= (A + B)' = A'B'$

(c) $\sim(\sim A \odot \sim B) = (A' \odot B')' = (A'+ (B')')'$

$= (A'+ B)' = AB'$

(d) $\sim(\sim A \odot B) = (A' \odot B)' = (A' + B')'$

$\sim(\sim A \odot B) = (A' + B')' = A \cdot B = A \wedge B$

$\therefore$ only choice (d) $\equiv A \wedge B$.

S.70 (d)

Let us consider each statement separately:

(a) $\neg \forall x$ (Graph (x) $\Rightarrow$ Connected (x)) represents that not for all graphs connectivity is there implies some graphs may not be connected.

(b) $\exists x$ (Graph (x) $\wedge \neg$ Connected (x)) represents that there exists a graph that is not connected.

(c) $\neg \forall x$ ($\neg$ Graph (x) $\vee$ Connected (x)) is same as option (a) because $\neg P \vee Q$ is same as $P \Rightarrow Q$.

(d) $\forall x$ (Graph (x) $\Rightarrow \neg$ Connected (x)) represents that all graphs are not connected.

Option (d) does not represent the given statement.

S.71 (c)

Given statement $\forall t \in r(P(t))$ is equivalent to $\neg\exists t \in r(\neg P(t))$.

S.72 (a)

"For x which is an fsa, there exists a y which is a pda and which is equivalent to x."

$(\forall x\ fsa(x)) \Rightarrow (\exists y\ pda(y) \wedge equivalent(x,y))$ is the logical representation.

S.73 (b)

(i) $P \vee \sim Q \equiv p + q'$

(ii) $\sim(\sim P \wedge Q) \equiv (p'\ q)' \equiv p + q'$

(iii) $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge \sim Q)$

$\equiv pq + pq' + p'q'$

$\equiv p(q + q') + p'q'$

$\equiv p + p'q'$

$\equiv (p + p')(p + q')$

$\equiv p + q'$

(iv) $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge Q)$

$\equiv pq + pq' + p'q$

$\equiv p(q + q') + p'q$

$\equiv p + p'q$

$\equiv (p + p')(p + q)$

$\equiv p + q$

Clearly **(i), (ii) and (iii) are equivalent.**

S.74 (d)

The correct translation of "Gold and silver ornaments are precious" is choice (d)

$\forall x\ ((G(x) \vee S(x)) \rightarrow P(x))$

which is read as "If an ornament is gold or silver, then it is precious". Now since a given ornament cannot be both gold and silver at the same time.

choice (b) $\forall x\ ((G(x) \wedge S(x)) \rightarrow P(x))$ is incorrect.

S.75 (b)

The given table can be translated into boolean functions by adding minterms corresponding to true rows.

P	Q	P□Q
T	T	T
T	F	T
F	T	F
F	F	T

Translate $P \square Q = PQ + PQ' + P'Q'$

Using this we check which one is equivalent to P+Q

Choice (a) $\neg Q \square \neg P \equiv Q' \square P'$

$\equiv Q'P' + Q'(P')' + (Q')'\ (P')'$

$\equiv Q'P' + Q'P + QP$

$\equiv Q'P' + P(Q+Q')$

$\equiv Q'P' + P \equiv (Q'+P)\ (P'+P) \equiv Q' + P$

Choice (b) $P \square \neg Q \equiv P \square Q'$

$\equiv PQ' + P(Q')' + P'\ (Q')'$

$\equiv PQ' + PQ + P'Q$

$\equiv P(Q' + Q) + P'Q$

$\equiv P + P' Q$

$\equiv (P + P')\cdot(P + Q) = P+Q$

Choice (c) $\neg P \square Q \equiv P' \square Q$

$\equiv P'Q + P'Q' + (P')'Q'$

$\equiv P'Q + P'Q' + PQ'$

$\equiv P'(Q+Q') + PQ' \equiv P'+PQ'$

$\equiv (P'+P)\ (P'+Q') \equiv P'+Q'$

Choice (d) $\neg P \square \neg Q \equiv P' \square Q'$

$\equiv P'Q' + P'\ (Q')' + (P')'\ (Q')'$

$\equiv P'Q' + P'Q + PQ$

$\equiv P'(Q'+Q) + PQ \equiv P' + PQ$

$\equiv (P' +P)\ (P'+Q)$

$\equiv (P'+P)\ (P'+Q)$

$\equiv P' + Q$

As we can clearly see only $P \square \neg Q$ is equivalent to $P + Q$.

Note: This problem can also be solved by constructing the truth tables for each choice and checking which one matches the truth table of $P + Q$.

12.2 PROBABILITY

LEVEL–1

Q.1 A bag contains 6 white balls, 9 black balls. The probability of drawing of black ball is

(a) 2/5

(b) 3/5

(c) 1/2

(d) 1

Q.2 Probability of getting a total of more than 10 in a single throw with 2 dice

(a) 1/7

(b) 1/9

(c) 1/12

(d) 2/5

Q.3 A card is drawn from a pack of 52 cards and then a second is drawn. Probability that both the cards drawn are queen is

(a) 1/219

(b) 1/13

(c) 1/79

(d) 1/221

Q.4 In a throw of 3 dice the probability that at least one die shows up 1 is

(a) 5/8

(b) 1/8

(c) 91/216

(d) 90/216

Q.5 The probability of getting a multiple of 2 in the throw of a die is

(a) 1/3

(b) 1/4

(c) 1/5

(d) 1/2

Q.6 Two cards are drawn at random from a pack of 52 cards. The probability that one may be a jack and other an Ace is

(a) 1/16

(b) 7/663

(c) 8/663

(d) 2/16

Q.7 In a shooting competition, the probability of hitting the target by A is 2/5, by B is 2/3 and by C is 3/5. If all of them fire independently at the same target, calculate the probability that only one of them will hit the target.

(a) 2/5

(b) 2/3

(c) 4/5

(d) 1/3

Q.8 If A and B are two event such that P (A∪B)= 5/6. P(A∩B)=1/3 $P(\overline{B})$ = 1/2 then the events A and B are

(a) dependent

(b) independent

(c) mutually exclusive

(d) none of above

Q.9 Two sisters A and B appeared for an Audition. The probability of selection of A is 1/5 and that of B is 2/7. The probability that both of them are selected is

(a) 2/35

(b) 1/5

(c) 2/7

(d) 1/7

Q.10 From a bag containing 4 white and 5 black balls a man draws 3 balls at random. Then the probability that all 3 are black is

(a) 5/42

(b) 1/42

(c) 1/25

(d) 1/5

Q.11 A problem in mathematics is given to three students Dayanand, Ramesh and Naresh whose chances of solving it are $\frac{1}{2},\frac{1}{3},\frac{1}{4}$ respectively. The probability that the problem is solved is

(a) 1/4

(b) 1/2

(c) 3/4

(d) 1/3

Q.12 Two dice are thrown the probability of getting odd number on the one and a multiple of 3 on the other is

(a) 11/36

(b) 13/36

(c) 10/36

(d) 12/36

Q.13 A pack of cards contains 4 aces, 4 queens and 4 jacks. Two cards are drawn at random. The probability that at least one of them is an ace is

(a) $\frac{19}{33}$

(b) $\frac{3}{16}$

(c) $\frac{1}{6}$

(d) $\frac{1}{8}$

Q.14 Four persons are chosen at random from a group containing 3 men, 2 women and 4 children. The chance that exactly 2 of them will be children is

(a) 10/21

(b) 5/8

(c) 13/32

(d) 23/32

Q.15 There are three events A, B, C, one of which must, and only one can happen, the odds are 8 to 3 against A, 5 to 2 against B. The odds against C are

(a) 43 to 34

(b) 32 to 23

(c) 34 to 13

(d) 30 to 15

Q.16 An urn contains 5 red and 10 black balls. Eight of them are placed in another urn. The chance that the latter then contains 2 red and 6 black balls is

(a) $\frac{140}{429}$

(b) $\frac{129}{440}$

(c) $\frac{139}{420}$

(d) $\frac{125}{435}$

Q.17 A bag contains 8 white and 6 red balls. The probability of drawing two balls of the same colour is

(a) $\frac{43}{88}$

(b) $\frac{43}{91}$

(c) $\frac{43}{93}$

(d) $\frac{43}{95}$

Q.18 A restaurant serves two special dishes A and B to its customers consisting of 60% men and 40% women. 80% of men order dish A and the rest B and 70% women order dish A and the rest B. In what ratio of A to B should the restaurant prepare the dishes?

(a) 19 : 6

(b) 1 : 9

(c) 16 : 7

(d) 3 : 16

Common Data For Questions 19 & 20:

Given : $P(A_1 \cup A_2) = \frac{5}{6}$, $P(A_1 \cap A_2) = \frac{1}{3}$

and $P(\bar{A}_1) = \frac{1}{2}$.

Q.19 $P(A_1)$ and $P(A_2)$ respectively are

(a) $\frac{2}{3}, \frac{1}{2}$

(b) $\frac{1}{2}, \frac{2}{3}$

(c) $\frac{1}{2}, \frac{1}{2}$

(d) $\frac{2}{3}, \frac{2}{3}$

Q.20 A_1 and A_2 are independent

(a) True

(b) False

(c) Uncertain

(d) Can not be said

Q.21 The number of adults living in homes on a randomly selected city block is described by the following probability distribution.

Number of adults, x	1	2	3	4 or more
Probability, P(x)	0.25	0.50	0.15	???

What is the probability that 4 or more adults reside at a randomly selected home?

(a) 0.10

(b) 0.15

(c) 0.25

(d) 0.50

Q.22 If during a war, one out of 9 ships could not arrive safely, find the probability that exactly 3 out of a convoy of 6, would arrive safely.

(a) 0.002

(b) 0.005

(c) 0.05

(d) 0.5

Q.23 In a Poisson distribution if $3P(X=3)=4P(X=4)$. Find $P(X=7)$

(a) 0.987

(b) 0.0216

(c) 0.0349

(d) 0.0254

Q.24 Between 2 and 4 pm the average number of phone calls per minute coming into the switch board of a company is 2.5. Find the probability that during one particular minute there will be no phone call at all (given $e^{-2} = 0.13435$ and $e^{-0.5} = 0.60650$).

(a) 0.0821

(b) 0.0987

(c) 0.03

(d) 0.57

Q.25 Consider the table given below

Marks	Number of students
0-10	12
11-20	18
21-30	27
31-40	20
41-50	17
51-60	6

The arithmetic means of the marks given above, is

(a) 18

(b) 28

(c) 27

(d) 6

Q.26 The mode of the given distribution is

Weight (in Kg.)	40	43	46	49	52	55
Number of children	5	8	16	9	7	3

(a) 55

(b) 46

(c) 40

(d) None

Q.27 A can solve 90% of the problems given in a book and B can solve 70%. What is the probability that at least one of them will solve a problem, selected at random from the book?

(a) 0.16

(b) 0.63

(c) 0.97

(d) 0.20

Q.28 A dice is thrown 100 times. Getting an even number is considered as success. The variance of the number of successes is

(a) 50

(b) 25

(c) 10

(d) None

Q.29 An urn contains 5 red and 10 black balls. Eight of them are placed in another urn. The chance that the latter then contains 2 red and 6 black balls is

(a) $\frac{140}{429}$

(b) $\frac{129}{440}$

(c) $\frac{139}{420}$

(d) none of these

Q.30 $P(A \cap \bar{B}/C) + P(A \cap B/C) = P\left(\frac{A}{C}\right)$

(a) True

(b) False

(c) Can't say

(d) none of these

Q.31 A bag contains 8 white and 6 red balls. The probability of drawing two balls of the same colour.

(a) $\frac{43}{88}$

(b) $\frac{43}{91}$

(c) $\frac{43}{93}$

(d) none of these

LEVEL–2

Q.32 A card is drawn from an ordinary pack of playing cards and a person bets that it is a spade or an ace. Then the odds against his winning this bet is

(a) 9 to 4

(b) 8 to 7

(c) 5 to 4

(d) None of above

Q.33 In a garden 40% of the flowers are roses and the rest are carnations. If 25% of the roses and 10% of the carnations are red, the probability that a red flower selected at random is a rose is

(a) 5/6

(b) 1/4

(c) 3/5

(d) 5/8

Q.34 There are two bags, one of which contains 5 red and 7 white balls and the other 3 red and 12 white balls. A ball is to be drawn from one or other of the two bags, find the chance of drawing a red ball.

(a) 37/120

(b) 1/12

(c) 1/15

(d) 1/87

Q.35 A speaks truth in 75% and B in 80% of the cases. In what percentage of cases are they likely to contradict each other narrating the same incident.

(a) 75%

(b) 60%

(c) 35%

(d) 95%

Q.36 Three machines A, B and C produce respectively 60%, 30% and 10% of the total number of items of a factory. The percentages of defective output of these machines are respectively 2%, 3% and 4%. An item is selected at random and found defective. Find the probability that the item was produced by machine C.

(a) 2/25

(b) 1/47

(c) 4/25

(d) 3/46

Q.37 The chances of a person being alive who is new 35 years old, till he is 75 are 8 : 6 and of another person being alive now 40 years old till he is 80 are 4:5. The probability that at least one of these persons would die before completing 40 years hence is

(a) 8/14

(b) 16/63

(c) 4/9

(d) 47/63

Q.38 In a Binomial distribution, the mean and standard deviation are 12 and 2 respectively. The value of n and p is respectively.

(a) 12,2

(b) $9,\frac{1}{3}$

(c) $18,\frac{2}{3}$

(d) $\frac{2}{3},18$

Q.39 One of the two mutually exclusive events must occur if the chance of one is 2/3 of the other, then odds in favor of the other are

(a) 1:3

(b) 1:2

(c) 2:3

(d) 3:2

Q.40 A bag has 13 red, 14 green and 15 black balls. The probability of getting exactly 2 blacks on pulling out 4 balls is P_1. Now the number of each colour ball is doubled and 8 balls are pulled out. The probability of getting exactly 4 blacks is P_2. Then

(a) $P_1 = P_2$

(b) $P_1 > P_2$

(c) $P_1 < P_2$

(d) none of these

Linked Questions 41 & 42:

Q.41 A man has 9 friends (4 and 5 women). In how many ways can he invite them, if there have to be exactly 3 woman in the invites.

(a) 300

(b) 160

(c) 80

(d) 200

Q.42 In above question 41, what is the probability that the invitees have two man?

(a) $\frac{13}{16}$

(b) $\frac{12}{16}$

(c) $\frac{11}{16}$

(d) $\frac{10}{16}$

Q.43 There are two bags one of which contains 3 black and 4 white balls while other contains 4 black and 4 while balls. A dice is cast, if face 1 or 3 turns up, a ball is taken from first bag and if any other face turns up, a ball is chosen from second bag. The probability of choosing of black ball is

(a) $\frac{10}{21}$

(b) $\frac{21}{11}$

(c) $\frac{12}{21}$

(d) $\frac{21}{12}$

Q.44 A box A contains 2 white and 4 black balls. Another box B contains 5 white and 7 black balls. A ball is transferred from the box A to the box B. Then a ball is drawn from the box B. The probability that it is white is

(a) $\frac{16}{39}$

(b) $\frac{14}{39}$

(c) $\frac{12}{39}$

(d) $\frac{9}{39}$

Q.45 The odds that a book will be reviewed favourably by the independent critics are 5 to 2,4 to 3 and 3 to 4. The probability that of the three reviews, a majority will be favourable is

(a) $\frac{208}{343}$

(b) $\frac{209}{343}$

(c) $\frac{210}{343}$

(d) none of these

Q.46 A bag contains 10 blue marbles, 20 green marbles and 30 red marbles. A marble is drawn from the bag, its colour recorded and it is put back in the bag. This process is repeated 3 times. The probablility that no two of the marbles drawn have the same colour is

(a) 1/36

(b) 1/6

(c) 1/4

(d) 1/3

Q.47 S.D of n observation a_1, a_2, a_3,.....a_n is σ, then S.D of the observations $\lambda a_1, \lambda a_2, \lambda a_3, \ldots\ldots \lambda a_n$ is

(a) $\lambda\sigma$

(b) $-\lambda\sigma$

(c) $|\lambda|\sigma$

(d) σ

Common Data For Questions 48 to 50:

A committee consists of 9 students, two of which are from 1st year, three from 2nd year and four from 3rd year. Three students are to be removed at random.

Q.48 The chance that three students belong to different classes, is

(a) $\frac{3}{7}$

(b) $\frac{2}{7}$

(c) $\frac{4}{7}$

(d) $\frac{5}{7}$

Q.49 The chance that two belong to the same class and third to the different class, is

(a) $\frac{55}{84}$

(b) $\frac{54}{85}$

(c) $\frac{56}{87}$

(d) $\frac{57}{81}$

Q.50 The chance that three belong to the same class is

(a) $\frac{5}{84}$

(b) $\frac{5}{86}$

(c) $\frac{5}{88}$

(d) none of these

Q.51 The average number of homes sold by the Acme realty company is 2 homes per day. What is the probability that exactly 3 homes will be sold tomorrow?

(a) 0.180

(b) 0.108

(c) 0.810

(d) 0.801

Q.52 Ten coins are thrown simultaneously. Find the probability of getting at least seven heads.

(a) 0.172

(b) 0.174

(c) 0.173

(d) 0.177

Common Data For Questions 53 to 55:

If 10% of the pens manufactured by the company are defective, find the probability that a box of 12 pens contain.

Q.53 Exactly two defective pens

(a) 0.2301

(b) 0.341

(c) 0.2825

(d) none of these

Q.54 Atleast two defective pens

(a) 0.341

(b) 0.315

(c) 0.2825

(d) none of these

Q.55 No defective pen.

(a) 0.2824

(b) 0.2825

(c) 0.2852

(d) 0.2952

Q.56 Assuming that 20% of the population of a city are literate, so that the chance of an individual being literate is 1/5 and assuming that 100 investigators each take 10 individuals to see whether they are literate, how many investigators would you expect to report that 3 or less were literate ?

(a) 98

(b) 68

(c) 78

(d) 88

Q.57 Find the probability that at the most 5 defective fuses will be found in a box of 200 fused of experience shows that 2% of such fuses are defective.

(a) 0.9857

(b) 0.8751

(c) 0.7851

(d) 0.5781

Common Data For Questions 58 & 59:

Suppose 300 misprints are distributed randomly throughout a book of 500 pages. Find the probability that a given page contains

Q.58 exactly 2 misprints

(a) 0.9882

(b) 0.9782

(c) 0.1216

(d) 0.1548

Q.59 2 or more misprints

(a) 0.9882

(b) 0.9782

(c) 0.1216

(d) 0.1548

Q.60 Find the probability of 5 or more telephone calls arriving in a 9 minute period in a college switch board, if the telephone calls that are received at the rate of 2 every 3 minute follow a Poisson distribution.

(a) 0.719

(b) 0.819

(c) 0.7149

(d) 0.8419

Q.61 A program consists of two modules executed sequentially. Let $f_1(t)$, $f_2(f)$ respectively denote the probability density functions of time taken to execute the two modules. The probability density function of the overall time taken to execute the program is given by

(a) $f_1(t)+f_2(t)$

(b) $\int_0^t f_1(X)f_2(X)dx$

(c) $\int_0^t f_1(x)f_2(t-x)dx$

(d) max $\{f_1(t), f_2(t)\}$

Q.62 The odds against a husband who is 45 years old living till he is 70 are 7:5 and the odds against his wife who is 36, living till she is 61 are 5:3. The probability that at least one of them will be alive 25 years hence, is

(a) $\frac{61}{96}$

(b) $\frac{5}{36}$

(c) $\frac{13}{64}$

(d) None

Q.63 The sum and product of the mean and variance of a binomial distribution are 24 and 18 respectively. Then, the distribution is

(a) $\left(\frac{1}{7}+\frac{1}{8}\right)^{12}$

(b) $\left(\frac{1}{4}+\frac{3}{4}\right)^{16}$

(c) $\left(\frac{1}{6}+\frac{5}{6}\right)^{24}$

(d) $\left(\frac{1}{2}+\frac{1}{2}\right)^{32}$

Q.64 If $\Sigma x_i = 24$, $\Sigma y_i = 44$, $\Sigma x_i y_i = 306$, $\Sigma x_i^2 = 164$, $\Sigma y_i^2 = 574$, and $n = 4$, then the regression coefficient b_{yx} is equal to

(a) 2.1

(b) 1.6

(c) 1.225

(d) 1.75

Q.65 The probability of drawing an ace or a spade or both from a deck of cards is

(a) $\frac{3}{13}$

(b) $\frac{4}{13}$

(c) $\frac{4}{17}$

(d) $\frac{5}{13}$

Q.66 A man alternately tosses a coin and throws a dice, beginning with the coin. Then the probability that he will get a head before he gets a 5 or 6 on dice is

(a) $\frac{1}{4}$

(b) $\frac{3}{4}$

(c) $\frac{4}{5}$

(d) $\frac{4}{7}$

LEVEL–3

Q.67 There are two bags. One bag contains 4 white and 2 black balls. Second bag contains 5 white and 4 black balls. Two balls are transferred from first bag to second bag. Then one ball is taken from the second bag. The probability that it is white is

(a) 42/165

(b) 95/165

(c) 51/175

(d) 57/165

Q.68 Two persons each make a single throw with a dice. The probability they get equal value is P_1. Four persons each make a single throw and probability of three being equal is P_2. Then

(a) $P_1 = P_2$

(b) $P_1 < P_2$

(c) $P_1 > P_2$

(d) none of these

Linked Questions 69 & 70:

Q.69 Ten points are marked on a straight line and 11 points are marked on another straight line. How many triangles can be constructed with vertices from among the above points?

(a) 550

(b) 1045

(c) 495

(d) none of these

Q.70 If in above question 68, we choose any three points, what is the probability that it forms a triangle?

(a) $\frac{11}{14}$

(b) $\frac{{}^{21}C_3}{\left({}^{10}C_3 + {}^{11}C_3\right)}$

(c) $\frac{6}{7}$

(d) $\frac{{}^{10}C_3 + {}^{11}C_3}{1045}$

Q.71 Three machines M_1, M_2 and M_3 produce identical items. Of their respective output 5%, 4% and 3% of items are faulty. On a certain day, M_1 has produced 25% of the total output, M_2 has produced 30% and M_3 the remaining. An item selected at random is found to be faulty. What are the chances that it was produced by the machine with the highest output?

(a) 0.155

(b) 0.255

(c) 0.355

(d) 0.455

Q.72 From a box containing 4 white and 6 black balls, 3 balls are transferred to another empty box. From new box a ball is drawn and it is black. What is the probability that out of 3 balls transferred 2 are white and one black?

(a) $\frac{1}{4}$

(b) $\frac{1}{5}$

(c) $\frac{1}{6}$

(d) $\frac{1}{7}$

Q.73 If standard deviation of a variable x is σ, then standard deviation of the variable $\frac{ax+b}{c}$ (a, b, c are constants) is

(a) $\left(\frac{a}{c}\right)\sigma$

(b) $\left|\frac{a}{c}\right|\sigma$

(c) $\left(\frac{a^2}{c^2}\right)\sigma$

(d) none of these

Q.74 m identical balls are to be placed in a distinct bags. You are given that $m \geq kn$, where kn is a natural number ≤ 1. In how many ways can the balls be placed in the bags if each must contain at least k balls?

(a) $\binom{m-k}{n-1}$

(b) $\binom{m-kn+n-1}{n-1}$

(c) $\binom{m-1}{n-k}$

(d) $\binom{m-kn+n+k-2}{n-k}$

Q.75 A has one share in a lottery in which there is 1 prize and 2 blanks. B has three shares in a lottery in which there are 3 prizes and 6 blanks; compare the probability of A's success to that of B's success is

(a) 7:16

(b) 16:7

(c) 6:14

(d) 14:6

Q.76 The events $E_1, E_2, \ldots\ldots, E_n$ are mutually exclusive.

Let $E = \bigcup_{i=1}^{n} E_I$

If $P(A/E_i) = P(B/E_i)$, $i = 1,2,\ldots\ldots m$ n, then $P(A/E) = P(B/E)$

(a) True

(b) False

(c) Can't say

(d) None of these

GATE QUESTIONS

Q.77 Let A and B be any two arbitrary events, then which one of the following is true? **[GATE 1994]**

(a) $P(A \cap B) = P(A)\,P(B)$

(b) $P(A \cup B) = P(A) + P(B)$

(c) $P(A/B) = P(A \cap B)\,P(B)$

(d) $P(A \cup B) \leq P(A) + P(B)$

Q.78 The probability that a number selected at random between 100 and 999 (both inclusive) will not contain the digit 7 is **[GATE 1995]** **[1-Mark]**

(a) 16/25

(b) $(9/10)^3$

(c) 27/75

(d) 18/25

Q.79 A bag contains 10 white balls and 15 black balls. Two balls are drawn in succession. The probability that one of them is black and the other is white is **[GATE 1995]**

[2-Marks]

(a) 2/3

(b) 4/5

(c) 1/2

(d) 1/3

Q.80 Two dice are thrown simultaneously. The probability that at least one of them will have 6 facing up in **[GATE 1996]**

(a) $\frac{1}{36}$

(b) $\frac{1}{3}$

(c) $\frac{25}{36}$

(d) $\frac{11}{36}$

Q.81 The probability that top and bottom cards of a randomly shuffled deck are both aces is **[GATE 1996]**

(a) $\frac{4}{52}\times\frac{4}{52}$

(b) $\frac{4}{52}\times\frac{3}{52}$

(c) $\frac{4}{52}\times\frac{3}{51}$

(d) $\frac{4}{52}\times\frac{4}{51}$

Q.82 The probability that it will rain today is 0.5. The probability that it will rain tomorrow is 0.6. The probability that it will rain either today or tomorrow is 0.7. What is the probability that it will rain today and tomorrow? **[GATE 1997]**

[1-Mark]

(a) 0.3

(b) 0.25

(c) 0.35

(d) 0.4

Q.83 A die is rolled three times. The probability that exactly one odd number turns up among the three outcomes is **[GATE 1998]**

[2-Marks]

(a) $\frac{1}{6}$

(b) $\frac{3}{8}$

(c) $\frac{1}{8}$

(d) $\frac{1}{2}$

Q.84 Suppose that the expectation of a random variable X is 5. Which of the following statements is true ? **[GATE 1999]**

(a) There is a sample point at which X has the value 5.

(b) There is a sample point at which X has value greater than 5

(c) There is a sample point at which X has a value greater than or equal to 5.

(d) None of the above

Q.85 Consider two events E_1 and E_2 such that probability of E_1, $P[E_1] = 1/2$, probability of E_2, $P[E_2] = 1/3$ and probability of E_1 and E_2, $P[E_1 \text{ and } E_2] = 1/5$. Which of the following statements is/are true? **[GATE 1999]**

[2-Marks]

(a) $P[E_1 \text{ or } E_2]$ is 2/3

(b) Events E_1 and E_2 are independent

(c) Events E_1 and E_2 are not independent

(d) $P\left[\frac{E_1}{E_2}\right]=\frac{4}{5}$

Q.86 E_1 and E_2 are events in a probability space satisfying the following constraints :

$Pr(E_1) = Pr(E_2)$

$Pr(E_1 \cup E_2) = 1$

E_1 and E_2 are independent

The value of $Pr(E_1)$, the probability of the event E_1 is **[GATE 2000]**

[2-Marks]

(a) 0

(b) 1/4

(c) 1/2

(d) 1

Q.87 Seven (distinct) car accidents occurred in a week. What is the probability that they all occurred on the same day? **[GATE 2001]**

[2-Marks]

(a) $1/7^7$

(b) $1/7^6$

(c) $1/2^7$

(d) $7/2^7$

Q.88 Four fair coins are tossed simultaneously. The probability that at least one head and one tail turn up is **[GATE 2002]**

[2-Marks]

(a) 1/16

(b) 1/8

(c) 7/8

(d) 15/16

Q.89 Let P (E) denote the probability of the event E. Given P(A) = 1, P(B) = 1/2, the values of P (A/B) and P(B/A) respectively are

[GATE 2003]

[1-Mark]

(a) 1/4,1/2

(b) 1/2,1/4

(c) 1/2,1

(d) 1,1/2

Q.90 If a fair coin is tossed four times. What is the probability that two heads and two tails will result? **[GATE 2004]**

[1-Mark]

(a) 3/8

(b) 1/2

(c) 5/8

(d) 3/4

Q.91 An examination paper has 150 multiple choice questions of one mark each, with each question having four choices. Each incorrect answer fetches –0.25 mark. Suppose 1000 students choose all their answers randomly with uniform probability. The sum total of the expected marks obtained by all these student is

[GATE 2004]

[2-Marks]

(a) 0

(b) 2550

(c) 7225

(d) 9375

Q.92 A point is randomly selected with uniform probability in the X-Y plane within the rectangle with corners at (0,0), (1,0), (1,2) and (0,2). If p is the length of the position vector of the point, the expected value of p^2 is **[GATE 2004]**

[2-Marks]

(a) 2/3

(b) 1/3

(c) 4/3

(d) 5/3

Q.93 In a population of N families, 50% of the families have three children, 30% of the families have two children and the remaining families have one child, what is the probability that a randomly picked child belongs to a family with two children? **[IT-GATE 2004]**

[1 Mark]

(a) $\frac{3}{23}$

(b) $\frac{6}{23}$

(c) $\frac{3}{10}$

(d) $\frac{3}{5}$

Q.94 In a class of 200 students, 125 students have taken Programming Language course, 85 students have taken Data Structures course, 65 students have taken Computer Organization course; 50 students have taken both Programming Language and Data Structures, 35 students have taken both Data Structures and Computer Organization; 30 students have taken both Data Structures and Computer Organizational, 15 students have taken all three course.

How many students have not taken any of the three courses? **[IT-GATE 2004]**

[1 Mark]

(a) 15

(b) 20

(c) 25

(d) 35

Q.95 In how many ways can we distribute 5 distinct balls, $B_1, B_2, ..., B_5$ in 5 distinct cells, $C_1, C_2, ..., C_5$ such that Ball B_i is not in cell C_i, $\forall i = 1, 2, ..., 5$ and each cell contains exactly one ball?

[IT-GATE 2004]

[2-Marks]

(a) 44

(b) 96

(c) 120

(d) 3125

Q.96 A bag contains 10 blue marbles, 20 green marbles and 30 red marbles. A marble is drawn from the bag, its colour recorded and it is put back in the bag. This process is repeated 3 times. The probability that no two of the marbles drawn have the same colour is

[IT-GATE 2005]

[1 Mark]

(a) $\frac{1}{36}$

(b) $\frac{1}{6}$

(c) $\frac{1}{4}$

(d) $\frac{1}{3}$

Q.97 An unbiased coin is tossed repeatedly until the outcome of two successive tosses is the same. Assuming that the trials are independent, the expected number of tosses is **[IT-GATE 2005]**

[2-Marks]

(a) 3

(b) 4

(c) 5

(d) 6

Q.98 In a communication network, a packet of length L bits takes link L1 with a probability of p_1 or link L2 with a probability of p_2. Link L1 and L2 have bit error probability of b_1 and b_2 respectively. The probability that the packet will be received without error via either L1 or L2 is:

[IT-GATE 2005]

[2-Marks]

(a) $(1 - b_1)^L p_1 + (1 - b_2)^L p_2$

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

(c) $(1 - b_1)^L (1 - b_2)^L p_1p_2$

(d) $1-\left(b_1^L p_1 + b_2^L p_2\right)$

Q.99 A fair dice is rolled twice. The probability that an odd number will follow an even number of is

[EC-GATE 2005]

[1-Mark]

(a) $\frac{1}{2}$

(b) $\frac{1}{6}$

(c) $\frac{1}{3}$

(d) $\frac{1}{4}$

Q.100 Let f(x) be the continuous probability density function of random variable X. The probability that $a<X\leq b$, is **[GATE 2005]**

(a) f(b–a)

(b) f(b)–f(a)

(c) $\int_a^b f(x)dx$

(d) $\int_a^b xf(x)dx$

Q.101 For each element in a set of size 2n, an unbiased coin is tossed. The 2n coin tossed are independent. An element is chosen if the corresponding coin toss were head. The probability that exactly n elements are chosen is

[GATE 2006]

[2-Marks]

(a) $\frac{^{2n}C_n}{4^n}$

(b) $\frac{^{2n}C_n}{2^n}$

(c) $\frac{1}{^{2n}C_n}$

(d) $\frac{1}{2}$

Q.102 Three companies X,Y and Z supply computers to a university. The percentage of computers supplied by them and the probability of those being defective are tabulated below

Company	% of computers supplied	Probability of being defective
X	60%	0.01
Y	30%	0.02
Z	10%	0.03

Given that a computer is defective, the probability that it was supplied by Y is

[GATE 2006]

(a) 0.1

(b) 0.2

(c) 0.3

(d) 0.4

Q.103 An examination consists of two papers, paper 1 and paper 2. The probability of failing in paper 1 is 0.3 and that in paper 2 is 0.2. Given that a student has failed in paper 2. The probability of failing in paper 1 is 0.6. The probability of a student failing in both the papers is

[EC-GATE 2007]

[2-MarkS]

(a) 0.5

(b) 0.18

(c) 0.12

(d) 0.06

Q.104 Suppose we uniformly and randomly select a permutation from the 20! permutations of 1,2,3.....,20. What is the probability that 2 appears at an earlier position than any other even number in the selected permutation?

[GATE 2007]

[2-Marks]

(a) $\frac{1}{2}$

(b) $\frac{1}{10}$

(c) $\frac{9!}{20!}$

(d) None of these

Q.105 Which of the following function would have only odd powers of x in its Taylor series expansion about the point x = 0 ? **[EC-GATE 2008]**

[1-Mark]

(a) $\sin(x^3)$

(b) $\sin(x^2)$

(c) $\cos(x^3)$

(d) $\cos(x^2)$

Q.106 Aishwarya studies either computer science or mathematics everyday. If she studies computer science on a day, then the probability that she studies mathematics the next day is 0.6. If she studies mathematics on a day, then the probability that she studies computer science the next day is 0.4. Given that Aishwarya studies computer science on Monday, what is the probability that she studies computer science on Wednesday? **[GATE 2008]**

[2-Marks]

(a) 0.24

(b) 0.36

(c) 0.40

(d) 0.6

Q.107 Let X be a random variable following normal distribution with means +1 and variance 4. Let Y be another normal variable with mean−1 and variance unknown,. If $P(X \le -1) = P(Y \ge 2)$ the standard deviation of Y is **[GATE 2008]**

[2-Marks]

(a) 3

(b) 2

(c) $\sqrt{2}$

(d) 1

Q.108 A fair coin is tossed 10 items. What is the probability that ONLY the first two tosses will yield heads. **[EC-GATE 2009]**

[1-Mark]

(a) $\left(\frac{1}{2}\right)^2$

(b) ${}^{10}C_2\left(\frac{1}{2}\right)^2$

(c) $\left(\frac{1}{2}\right)^{10}$

(d) ${}^{10}C_2\left(\frac{1}{2}\right)^{10}$

Q.109 An unbalanced dice (with 6 faces numbered from 1 to 6) is thrown. The probability that the face value is odd is 90% of the probability that the face value is even. The probability of getting any even numbered face is the same.

If the probability that the face is even given that it is greater than 3 is 0.75, which one of the following options is closest to the probability that the face value exceeds 3? **[GATE 2009]**

[2-Marks]

(a) 0.453

(b) 0.468

(c) 0.485

(d) 0.492

ANSWER KEY

1	b	2	c	3	d	4	c	5	d
6	c	7	d	8	b	9	a	10	a
11	c	12	a	13	a	14	a	15	a
16	a	17	b	18	a	19	b	20	a
21	a	22	b	23	b	24	a	25	b
26	b	27	c	28	b	29	a	30	a
31	b	32	a	33	d	34	a	35	c
36	c	37	d	38	c	39	d	40	b
41	b	42	c	43	a	44	a	45	b
46	b	47	c	48	b	49	a	50	a
51	a	52	a	53	a	54	a	55	a
56	d	57	c	58	a	59	c	60	c
61	c	62	a	63	d	64	a	65	b
66	b	67	b	68	c	69	b	70	a
71	c	72	c	73	b	74	b	75	a
76	a	77	d	78	d	79	c	80	d
81	c	82	d	83	b	84	a	85	c
86	c	87	b	88	c	89	d	90	a
91	d	92	d	93	b	94	c	95	b
96	b	97	a	98	a	99	d	100	c
101	a	102	d	103	c	104	d	105	a
106	c	107	a	108	c	109	b		

SOLUTIONS

S.1 (b)

Total number of equally likely and exhaustive cases $= n=6+9 = 15$

Number of favourable cased $= {}^9C_1 = 9$

[$\therefore$ number of black balls =9]

Probability of drawing a black ball $= \frac{9}{15} = \frac{3}{5}$

S.2 (c)

Sample space $= 6^2 = 36$

Favourable cases are (5,6), (6,5), (6,6)

Probability $= \frac{3}{36} = \frac{1}{12}$

S.3 (d)

First draw: Probability of getting a queen

$= \frac{4}{52} = \frac{1}{13}$

Second draw : After drawing the first queen we are left with 51 cards with 3 queens

$\therefore$ Probability of getting a queen in second draw

$= \frac{3}{51} = \frac{1}{17}$

$\therefore$ Probability of both the cards are queen

$= \frac{1}{13} \times \frac{1}{17} = \frac{1}{221}$

S.4 (c)

P = probability of getting 1 in a throw of a dice = 1/6

$\therefore q = 1-p = 1-\frac{1}{6} = \frac{5}{6}$

Probability of getting at least one dice = $1-q^3$

$= 1-\left(\frac{5}{6}\right)^3 = \frac{91}{216}$

S.5 (d)

S = {1,2,3,4,5,6}, n(S) = 6

Let A be the event that the dice shows a multiple of 2

$\therefore$ A = {2,4,6}

$\therefore$ n(A) = 3

$P(A) = \frac{n(A)}{n(S)} = \frac{3}{6} = \frac{1}{2}$

S.6 (c)

Two cards can be selected in $^{52}C_2$ ways

$\therefore n(S) = {}^{52}C_2 = 26 \times 51$

Let A be the event that 2 cards selected is jack and an Ace.

Jack can be selected in $^4C_1$ ways and the Ace can also be selected in $^4C_1$ ways.

$\therefore n(A) = {}^4C_1 \times {}^4C_1 = 16$

$\therefore P(A) = \frac{n(A)}{n(S)} = \frac{16}{26\times 51} = \frac{8}{663}$

S.7 (d)

$P(A) = \frac{2}{5}$ $P(A') = \frac{3}{5}$

$P(B) = \frac{2}{3}$ $P(B') = \frac{1}{3}$

$P(C) = \frac{3}{5}$ $P(C') = \frac{2}{5}$

Probability that only one of them hits the target = probability that A hits the target but not B and C + probability that B hits the target but not A and C + probability that C hits the target but not A and B

$= P(A\cap B'\cap C') + P(A'\cap B\cap C') + P(A'\cap B'\cap C)$

$= \frac{2}{5}\times\frac{1}{3}\times\frac{2}{5} + \frac{2}{3}\times\frac{3}{5}\times\frac{2}{5} + \frac{3}{5}\times\frac{3}{5}\times\frac{1}{3}$

$= \frac{4}{75} + \frac{12}{75} + \frac{9}{75} = \frac{25}{75} = \frac{1}{3}$

S.8 (b)

$P(B) = 1 - P(\bar{B}) = 1-\frac{1}{2} = \frac{1}{2}$

and $P(A\cup B) = P(A) + P(B) - P(A\cap B)$

or $\frac{5}{6} = P(A) + \frac{1}{2} - \frac{1}{3}$ or $P(A) = \frac{2}{3}$

$\therefore P(A)\,P(B) = \frac{2}{3}\times\frac{1}{2} = \frac{1}{3} = P(A\cap B)$

S.9 (a)

Let A be the event that A is selected and B be the event that B is selected

$\therefore$ P (A) =1/5 and P(B) = 2/7

Let C be the event that both are selected

$\therefore$ C be the event that both are selected.

$\therefore C = A\cap B$

$\therefore P(C) = P(A\cap B)$

$\therefore P(C) = P(A).P(B)$ as A and B independent events.

$= \frac{1}{5}\times\frac{2}{7} = \frac{2}{35}$

S.10 (a)

Three balls can be selected from 9 in $^9C_3$ ways

3 black balls can be selected from 5 in $^5C_3$ ways

$\therefore$ Required probability = $\frac{{}^5C_3}{{}^9C_3} = \frac{10}{84} = \frac{5}{42}$

S.11 (c)

The probability of Dayanand, Ramesh and Naresh solving the problem are

$\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ respectively

$\therefore$ The probabilities of Dayanand , Ramesh,

Naresh not solving the problem are

$1-\frac{1}{2}=\frac{1}{2}; 1-\frac{1}{3}=\frac{2}{3}; 1-\frac{1}{4}=\frac{3}{4}$ respectively.

∴ The probability that the problem is not solved by any one of them is

$$\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}=\frac{1}{4}$$

∴ The probability that the problem will be solved by at least one of them

$$= 1-\frac{1}{4} = \frac{3}{4}$$

S.12 (a)

n(S) = 36

The outcomes which have odd number and multiple of 3 are

(1,3) (1,6) (3,1) (3,3) (3,5) (3,6) (5,3) (5,6) (6,1) (6,3) (6,5)

favourable cases = 11

$$\text{Probability} = \frac{11}{36}$$

S.13 (a)

Total number of cards = 12

Probability of at least one ace

= 1– probability of no ace

$$= 1-\frac{{}^{8}C_2}{{}^{12}C_2}=1-\frac{14}{33} = \frac{19}{33}$$

S.14 (a)

The total number of ways in which four person can be selected out of 9 persons is ${}^{9}C_4$. For favourable cases, we want that 2 out of the four selected should be children. Two children can be selected out of 4 in ${}^{4}C_2$ ways. The other two are to be selected out of 5 persons (3 men and 2 women). Two persons can be selected out of 5 in ${}^{5}C_2$ ways.

∴ The number of favourable cased ${}^{4}C_2\times{}^{5}C_2$

$$\therefore \text{ Required probability} = \frac{{}^{4}C_2\times{}^{5}C_2}{{}^{9}C_4} = \frac{10}{21}$$

S.15 (a)

Since odds are 8 to 3 against A

$$\therefore \quad P(A) = \frac{3}{11};\ P(B) = \frac{2}{7}$$

and $P(A) + P(B) + P(C) = 1$

$$P(C) = \frac{1}{1}-\frac{3}{11}-\frac{2}{7}=\frac{34}{77}$$

⇒ Hence odds against C are **43 to 34.**

S.16 (a)

Number of ways in which 8 balls can be drawn out of 15 is ${}^{15}C_8$.

Number of ways of drawing 2 red balls is ${}^{5}C_2$ and corresponding to each of these ${}^{5}C_2$ ways of drawing a red ball, there are ${}^{10}C_6$ ways of drawing 6 black balls.

∴ Total number of ways in which 2 red and 6 black balls can be drawn = ${}^{5}C_2\times{}^{10}C_6$.

Hence required probability

$$= \frac{{}^{5}C_2\times{}^{10}C_6}{{}^{15}C_8} = \frac{140}{429}$$

S.17 (b)

Two balls out 14 can be drawn in ${}^{14}C_2$ ways which is the total number of outcomes.

Two white balls out of 8 can be drawn in ${}^{8}C_2$ ways.

∴ Probability of drawing 2 white balls =

$$\frac{{}^{8}C_2}{{}^{14}C_2}=\frac{28}{91}$$

Similarly 2 red balls out of 6 can be drawn in ${}^{6}C_2$ ways.

∴ Probability of drawing 2 red balls

$$= \frac{{}^{6}C_2}{{}^{14}C_2}=\frac{15}{91}$$

∴ Probability of drawing 2 balls of the same colour (either both white or both red)

$$= \frac{28}{91}+\frac{15}{91} = \frac{43}{91}$$

S.18 (a)

Ratio of A and B $= 60\times80+40\times70:60\times20+40\times30$

$= 76 : 24$

$= \mathbf{19 : 6}$

S.19 (b)

$$P(\bar{A}_1) = \frac{1}{2} \Rightarrow P(A_1) = \frac{1}{2}$$

$$P(A_1 \cup A_2) = P(A_1) + P(A_2) - P(A_1 \cap A_2)$$

$$\frac{5}{6} = \frac{1}{2} + P(A_2) - \frac{1}{3}$$

$$\therefore P(A_2) = \frac{2}{3}$$

S.20 (a)

$$P(A_1 \cap A_2) = \frac{1}{3} \text{ and } P(A_1) \times P(A_2) = \frac{1}{3}$$

$$\therefore \mathbf{P(A_1 \cap A_2) = P(A_1) \times P(A_2)}$$

S.21 (a)

The sum of all the probabilities is equal to 1. Therefore, the probability that four or more adults reside in a home is equal to 1-(0.25 + 0.50+0.15) or **0.10**.

S.22 (b)

Here X = number of ships that arrive safely,

n = 6 and p= P (ships arrive safely) = 1/9, r = 3,

$$q = 1-P = 1-\frac{1}{9} = \frac{8}{9}.$$

As $P(X=r) = {}^nC_r p^r q^{n-r}$, $r = 0,1,2,\ldots,6$

Hence $P(X=3) = {}^6C_3\, p^3 q^3$

$$= \frac{\lfloor 6}{\lfloor 3 \lfloor 3}\left(\frac{1}{9}\right)^3\left(\frac{8}{9}\right)^3 = \frac{2754}{531441} = \mathbf{0.005}$$

S.23 (b)

$3P(X=3) = 4P(X=4)$

$$\Rightarrow 3e^{-m}\frac{m^3}{\lfloor 3} = 4e^{-m}\frac{m^4}{\lfloor 4} \Rightarrow m = 3$$

$$\therefore P(X=7) = e^{-3}\frac{3^7}{\lfloor 7} = \frac{0.0498 \times 2187}{5040} = \mathbf{0.0216}$$

S.24 (a)

Here X~ P (2.5)

Required probability

$= P(X=0) = e^{-2.5} = e^{-2} \times e^{-0.5} = \mathbf{0.0821}.$

S.25 (b)

Class	Mid value x	Frequency f	Deviation d = x – A	f × d
0 – 10	5	12	–20	–240
10 – 20	15	18	–10	–180
20 – 30	25 = A	27	0	0
30 – 40	35	20	10	200
40 – 50	45	17	20	320
50 – 60	55	6	30	180
		$\Sigma f = 100$		$\Sigma(f \times d) = 280$

$$A.M = A + \frac{\Sigma(fd)}{\Sigma f} = \left(25 + \frac{280}{100}\right) = \mathbf{28}$$

S.26 (b)

Clearly, 46 occurs most often. So, mode = **46**

S.27 (c)

Let E = the event that A solves the problem. and

F = the event that B solve the problem.

Clearly E and F are independent events.

$$P(E) = \frac{90}{100} = 0.9, \quad P(F) = \frac{70}{100} = 0.7,$$

$P(E \cap F) = P(E)\ P(F) = 0.9 \times 0.7 = 0.63$

Required probability = $P(E \cup F)$

$= P(E) + P(F) - P(E \cap F) = (0.9 + 0.7 - 0.63)$

$= \mathbf{0.97}$

S.28 (b)

$$\text{Here } p = \frac{3}{6} = \frac{1}{2}, q = \left(1-\frac{1}{2}\right) = \frac{1}{2} \text{ and } n = 100$$

$$\text{Thus variance} = npq = \left(100 \times \frac{1}{2} \times \frac{1}{2}\right) = \mathbf{25}.$$

S.29 (a)

Number of ways in which 8 balls can be drawn out of 15 is $^{15}C_8$.

Number of ways of drawing 2 red balls is $^5C_2$ and corresponding to each of these $^5C_2$ ways of drawing a red ball, there are $^{10}C_6$ ways of drawings 6 black balls.

$\therefore$ Total number of ways in which 2 red and 6 black balls can be drawn = $^5C_2 \times {}^{10}C_6$.

Hence required probability $= \dfrac{^5C_2 \times {}^{10}C_6}{^{15}C_8} = \dfrac{140}{429}$

S.30 (a)

$$\text{LHS} = \frac{P(A \cap \bar{B} \cap C)}{P(C)} + \frac{(P(A \cap B \cap C))}{P(C)}$$

$$= \frac{P(A \cap \bar{B} \cap C) + P(A \cap B \cap C)}{P(C)}$$

$$= \frac{P\left[(A \cap \bar{B} \cap C) \cap P(A \cap B \cap C)\right]}{P(C)}$$

$$= \frac{P(A \cap C)}{P(C)} = P\left(\frac{A}{C}\right)$$

S.31 (b)

Two balls out 14 can be drawn in $^{14}C_2$ ways which is the total number of outcomes.

Two white balls out of 8 can be drawn in $^8C_2$ ways.

$\therefore$ Probability of drawing 2 red balls $= \dfrac{^8C_2}{^{14}C_2} = \dfrac{28}{91}$

Similarly 2 red balls out of 6 can be drawn in $^6C_2$ ways

$\therefore$ Probability of drawing 2 red balls $= \dfrac{^6C_2}{^{14}C_2} = \dfrac{15}{91}$

$\therefore$ Probability of drawing 2 balls of the same colour (either both white or both red)

$$= \frac{28}{91} + \frac{15}{91} = \frac{43}{91}$$

S.32 (a)

In a pack of 52 cards, 1 card can be drawn in 52 ways.

Since there are 13 spades and 3 aces (one ace is present in spade)

$\therefore$ Number of favourable case = 13 + 3 =16

Sample space = 52

Probability of getting a spade or an ace

$$= \frac{16}{52} = \frac{4}{13} = \frac{4}{9+4}$$

Odds against winning the bet are **9 to 4**.

S.33 (d)

Suppose there are 100 flowers

Number of roses = 40;

Number of carnations =60

25% of 40 = 10 roses are red and

10% of 60 = 6 carnations are red.

Let A be the event that the flower is red and B the event that the flower is a rose.

$\therefore$ A $\cap$ B is the event that the flower is a red rose.

$n(A) = 16 \quad \therefore P(A) = \dfrac{16}{100}$

$n(A \cap B) = 10 \quad \therefore P(A \cap B) = \dfrac{10}{100}$

P(B/A) = probability that a selected flower is a rose red is colour

$$P(B/A) = \frac{P(A \cap B)}{P(A)} = \frac{10/100}{16/100} = \frac{5}{8}$$

Alternate:

Let there are 100 flower.

$\therefore$ 40 are Rose.

Out of 40, 10 are Red.

60 are Carnations.

Out of 60, 6 are Red.

$\therefore$ Total Red flowers = 16

Total Red Roses = 10

$\therefore$ Required Probability $= \dfrac{^{10}C_1}{^{16}C_1} = \dfrac{5}{8}$

S.34 (a)

The chance of choosing the first beg is 1/2 and if the first bag be choosen the chance of drawing a red ball from it is 5/12 hence the chance of drawing red ball from the first bag is

$$\frac{1}{2}\times\frac{5}{12}=\frac{5}{24}$$

Similarly the chance of drawing a red ball from the second bag is $\frac{1}{2}\times\frac{3}{15}=\frac{1}{10}$. Hence, as these events are mutually exclusive, the chance required is $\frac{5}{24}+\frac{1}{10}=\frac{37}{120}$

S.35 (c)

Let P (A), P(B) be the probability of A and B speaking the truths, then

$$P(A)=\frac{75}{100}=\frac{3}{4,} \qquad P(B)=\frac{80}{100}=\frac{4}{5}$$

$$P(\bar{A})=\text{P (A tells a lie)}=1-P(A)=1-\frac{3}{4}=\frac{1}{4}$$

$$P(\bar{B})=\text{P (B tells a lie)}=1-P(B)=1-\frac{4}{5}=\frac{1}{5}$$

Now P (A and B will contradict) = P (A) P $(\bar{B})$ + P (B) P $(\bar{A})$

$$=\frac{3}{4}\times\frac{1}{5}+\frac{4}{5}\times\frac{1}{4}=\frac{7}{20}=35\%$$

S.36 (c)

Let X = defective items. We seek P (C/X) the probability that an item it produced by machine C, given that the item is defective

By Baye's theorem,

$$P(C/X)=\frac{P(C)P(X/C)}{P(A)P(X/A)+P(B)P(X/B)+P(C)P(X/C)}$$

$$=\frac{(0.10)(0.04)}{(0.60)(0.02)+(0.30)(0.03)+(0.10)(0.04)}$$

$$=\frac{4}{25}$$

S.37 (d)

Probability that the first person lives till he is 75 years $=\frac{8}{14}$

Probability that the second person lives till he is 80 years $=\frac{4}{9}$

Probability of the compound event that both the persons live 40 years

hence $=\frac{8}{14}\times\frac{4}{9}=\frac{32}{126}=\frac{16}{63}$

Probability that at least one of them would die without living 40 years hence $=1-\frac{16}{63}=\frac{47}{63}$

S.38 (c)

$np = 12$ $\sqrt{npq}=2$

$\therefore$ npq =4

$$\frac{npq}{np}=\frac{4}{12}=\frac{1}{3} \qquad \therefore q=\frac{1}{3}$$

$$\therefore p=1-q=1-\frac{1}{3}=\frac{2}{3}$$

Also np = 12

$$\therefore n\times\frac{2}{3}=12 \qquad \therefore n=18 \text{ and } p=\frac{2}{3}$$

S.39 (d)

Probability of first event $=\frac{2}{3}P$

Mutually exclusive events

$$P+\left(\frac{2}{3}\right)P=1 \qquad \text{Or } P=\frac{3}{5}=3:5$$

Hence odds in favor of the other are 3:5–3 i.e., **3 : 2**

S.40 (b)

$$P_1=\frac{{}^{15}C_2\times{}^{27}C_2}{{}^{42}C_4}$$

$$=\frac{15\times14\times27\times26\times1\times2\times3\times4}{1\times2\times1\times2\times42\times41\times40+39}=\frac{27}{82}$$

$$P_2 = \frac{^{30}C_4 \times ^{54}C_4}{^{84}C_8}$$

$$= \frac{30.29.28.27.54.53.52.51.8!}{4!4!84.83.82.81.80.79.78.77} = \frac{17.29.45.53}{11.79.82.83}$$

$$\frac{P_1}{P_2} = \frac{27}{82} \times \frac{11.79.82.83}{17.29.45.53} = \frac{33.79.83}{29.53.85}$$

$$= \frac{216381}{130645} > 1$$

Hence $P_1 > P_2$.

S.41 (b)

Out of the 5 women, 3 women can be invited in $^5C_3$ ways. Nothing is mentioned about the number of men that he has to invite. He can invite one, two, three, four or even number of men. Out of 4 men, he can invite them in the said manner in $(2)^4$ ways. Thus, the total number of ways is $^5C_3 \times (2^4) = 10 \times 16 = \mathbf{160}$

S.42 (c)

At least two men can be invited in the following number of ways. Zero number of man+1 man + 2 men $= 1 + {}^4C_1 + {}^4C_2$

$= 1 + 4 + 6 = 11$

$\therefore$ Total no. of ways in which at most which 2 men are invited $= {}^5C_3 \times 11 = \frac{5 \times 4 \times 3}{3 \times 2} \times 11 = 110$

From part (i), total no. of ways $= 160$

hence required probability $= \frac{110}{160} = \mathbf{\frac{11}{16}}$

S.43 (a)

Let E_1 be the event that a ball is drawn from first bag, E_2 the event that a ball is drawn from second bag and E the event a black ball is chosen, therefore

$$P(E) = P(E_1)P\left(\frac{E}{E_1}\right) + P(E_2)P\left(\frac{E}{E_2}\right)$$

$$= \frac{2}{6}\frac{3}{7} + \frac{4}{6}\frac{4}{8} = \frac{1}{3}\frac{3}{7} + \frac{2}{3}\frac{4}{8} = \mathbf{\frac{10}{21}}$$

S.44 (a)

Probability of drawing a white ball from box B will depend on whether transferred ball is black or white.

If a black ball is transferred from A to B, then its probability is $\frac{4}{6}$. There are now 5 white and 8 black balls in box B.

The probability of drawing white ball form box B $= \frac{5}{13}$.

$\therefore$ Probability of drawing a white ball form urn B , if transferred ball is black

$$= \frac{4}{6} \times \frac{5}{13} = \frac{10}{39}$$

Similarly, probability of drawing a white ball from urnB, if transferred ball is white

$$\frac{2}{6} \times \frac{6}{13} = \frac{2}{13}$$

$\therefore$ Required probability $= \frac{10}{39} + \frac{2}{13} = \mathbf{\frac{16}{39}}$

S.45 (b)

The probability that book shall be reviewed favourably by first crite is 5/7, by second 4/7 and by third 3/7.

A majority of the three review will be favourable when two or three are favourable

$\therefore$ Probability that the first two are favourable and the third unfavourable

$$= \frac{5}{7} \times \frac{4}{7} \times \left(1 - \frac{3}{7}\right) = \frac{80}{343}$$

Probability that the first and third are favourable and second unfavourable

$$= \frac{5}{7} \times \frac{3}{7} \times \left(1 - \frac{4}{7}\right) = \frac{45}{343}$$

Probability that the second and third are favourable and the first unfavourable

$$= \frac{4}{7} \times \frac{3}{7} \times \left(1 - \frac{5}{7}\right) = \frac{24}{343}$$

Hence, probability that all the three are favourable

$$= \frac{5}{7}\times\frac{4}{7}\times\frac{3}{7} = \frac{60}{343}$$

Since they are mutually exclusive events, the required probability

$$= \frac{80}{343}+\frac{45}{343}+\frac{24}{343}+\frac{60}{343} = \frac{209}{343}$$

S.46 (b)

As per the question, the draws could be in the following 6 orders.

Blue	Green	Red
Blue	Red	Green
Red	Blue	Green
Red	Green	Blue
Green	Blue	Red
Green	Red	Blue

Each of the above have a probability of occurance of

$$\frac{10}{60}\times\frac{20}{60}\times\frac{30}{60} = \frac{1}{36} \text{ ways}$$

$$\therefore \text{ Total probability} = \frac{1}{36}\times 6 = \frac{1}{6} \text{ ways}$$

S.47 (c)

Standard Deviation of new data

$$= \sqrt{\frac{\Sigma(\lambda\alpha_1)^2}{n} - \left(\frac{\Sigma\lambda\alpha_1}{n}\right)^2}$$

$$= \sqrt{\lambda^2}\sqrt{\frac{\Sigma\alpha_1^2}{n} - \left(\frac{\Sigma\alpha_1}{n}\right)^2} = |\lambda|\sigma$$

S.48 (b)

Total number of ways of choosing 3 students out $9 = {}^9C_3$ i.e. 84.

A student can be removed 1st year student in 2 ways, from 2nd year in 3 ways and from 3rd year in 4 ways so that total number of ways of removing three students, one from each group is $2\times3\times4$.

$$\therefore \text{ Required chance } = \frac{2\times3\times4}{{}^9C_3} = \frac{24}{84} = \frac{2}{7}$$

S.49 (a)

Number of ways of removing two from 1st year students and one from other $= {}^2C_2\times{}^7C_1$.

Number of ways of removing two from 2nd year students and one from other $= {}^3C_2\times{}^6C_1$.

Number of ways of removing 2 from 3rd year student and one from other $= {}^4C_2\times{}^5C_1$.

∴ Total number of ways in which two student of the same class and third from the others may be removed

$$= {}^2C_2\times{}^7C_1+{}^3C_2\times{}^6C_1+{}^4C_2\times{}^5C_1$$

$$= 7 + 18 + 30 = 55$$

$$\therefore \text{ Required chance } = \frac{55}{84}$$

S.50 (a)

Three students can be removed from 2nd year group in ${}^3C_2$, i.e. 1 way and from 3rd year group in ${}^4C_3$ i.e. 4 ways.

∴ Total number of ways in which three students belog to the same class = 1 + 4 = 5

$$\therefore \text{ Required chance } = \frac{5}{84}$$

S.51 (a)

This is a Poisson experiment in which we know the following:

- $\mu = 2$; since 2 homes are sold per day, or average.
- $x = 3$ since we want to find the likelihood that 3 homes will be sold tomorrow.
- $e = 2.71828$; since e is a constant equal to approximately 2.71828.

We plug these values into the Poisson formula as follows.

$P(x;\mu) = (e^{-\mu})\mu^x/x!$

$P(3;2) = (2.71828^{-2})(2^3)/3!$

$P(3;2) = (0.13534)\ (8)/6$

$P(3;2) = 0.180$

Thus, the probability of selling 3 homes tomorrow is **0.180**.

S.52 (a)

Let X = number of heads obtained.

Here n = 10, p = P (getting head) = 1/2,

q = 1 – p = 1/2

Also $P(X = r) = {}^{n}C_r p^r q^{n-r}$, r = 0,1,2,.....,10

∴ P (atleast seven heads) = P (X ≥ 7)

= P(7) + P(8) + P(9) + P(10)

$$= {}^{10}C_7\left(\frac{1}{2}\right)^{10} + {}^{10}C_8\left(\frac{1}{2}\right)^{10} + {}^{10}C_9\left(\frac{1}{2}\right)^{10} + {}^{10}C_{10}\left(\frac{1}{2}\right)^{10}$$

$$= \left(\frac{1}{2}\right)^{10}[120+45+10+1] = \frac{176}{1024} = \mathbf{0.172}$$

S.53 (a)

Let X denote the number of defective pens

Here n = 12, $p = \frac{10}{100} = 0.1$ and q = 1 – p = 0.9

and $P(X = r) = {}^{n}C_r\, p^r\, q^{n-r}$.

Required probability= P(X = 2)

$$= {}^{12}C_2(0.1)^2(0.9)^{10}$$

$$= \mathbf{0.2301}$$

S.54 (a)

P (X≥2) = 1– [P(0) + P(1)]

$$= 1-\left[{}^{12}C_0(0.1)^0(0.9)^{12} + {}^{12}C_1(0.1)^1(0.9)^{11}\right]$$

= 1 – [0.2824 + 0.3766]

= 1 – 0.659

= **0.341**

S.55 (a)

$P(X = 0) = {}^{12}C_0(0.1)^0(0.9)^{12} = \mathbf{0.2824}$

S.56 (d)

Here X ~ B (10,0.2) where n = 10, $P = \frac{20}{100} = 0.2$

Probability that 3 or less people are literate = P(X≤3) = P(0) + P(1) + P(2) + P(3)

$$= {}^{10}C_0\,(0.2)^0\,(0.8)^{10} + {}^{10}C_1(0.2)^1(0.8)^9 + {}^{10}C_2(0.2)^2(0.8)^8 + {}^{10}C_3\,(0.2)^3(0.8)^7$$

= 0.8791

Hence number of investigators which report that 3 or less people are literate

= 10 ×0.8791 = 87.91 = **88**

S.57 (c)

Here the number of independent trials is 200 which is very large, hence X should be considered as a Poisson variate denoting the number of defective fuses.

Here $n = 200,\ p = \frac{2}{100} = 0.02 \Rightarrow m = np = 4$

Also here $(X = r) = e^{-m}\frac{m^r}{\lfloor r}$ $\qquad r = 0,1,....$

Hence required probability is:-

P(X ≤ 5) = P(0) + P(1) + P(2) + P(3) + P(4) + P(5)

$$= e^{-m}\left[1+m+\frac{m^2}{\lfloor 2}+\frac{m^3}{\lfloor 3}+\frac{m^4}{\lfloor 4}+\frac{m^5}{\lfloor 5}\right]$$

$$= e^{-4}\left[1+4+\frac{4^2}{\lfloor 2}+\frac{4^3}{\lfloor 3}+\frac{4^4}{\lfloor 4}+\frac{4^5}{\lfloor 5}\right]$$

= 0.01832 × 42.8667

= **0.7851.**

S.58 (a)

Means number of misprint per page

$$= \frac{300}{500} = 0.6$$

Let X ~ P(0.6)

(i) P(X=2)

$$= e^{-0.6}\frac{(0.6)^2}{\lfloor 2} = 0.549 \times \frac{0.36}{2} = \mathbf{0.9882}$$

S.59 (c)

P (X ≥ 2) = 1 – P(X < 2) = 1 – [P(0) + P(1)]

$$= 1-\left[e^{-0.6} + e^{-0.6}(0.6)\right]$$

$$= 1 - e^{-0.6}(1.6) = 1 - 0.8784$$

$$= \mathbf{0.1216}$$

S.60 (c)

Let X_1, X_2, X_3, denote the number of telephone calls received in three consecutive 3 min period. As each of X_1, X_2, X_3 follows a poisson distribution with parameter m= 2, hence by reproductive property of Poisson distribution with parameter m = 2, hence by reproductive property of poison distribution $X = X_1+X_2+X_3$ follows a poisson distribution with parameter = 2+2+2 =6.

Hence required probability

$$= P(X \geq 5) = 1 - P(X \leq 4) = 1 - \sum_{r=0}^{4} e^{-6}\frac{6^r}{\lfloor r}$$

$$= 1-(0.0025 + 0.0149 + 0.0892 + 0.1339)$$

$$= \mathbf{1-0.2851 = 0.7149.}$$

S.61 (c)

Let the time taken for first and second modules be represented by x and y and total time = t.

$\therefore$ t = x+y is a random variable.

Now the joint density function

$$g(t) = \int_0^t f(x,y)dx$$

$$= \int_0^t f(x,t-x)dx$$

$$= \int_0^t f_1(x)f_2(t-x)dx$$

S.62 (a)

Let E = event that the husband will be alive 25 years hence and F= event that the wife will be alive 25

years hence.

Then, $P(E) = \frac{5}{12}$ and $P(F) = \frac{3}{8}$

Thus

$$P(\bar{E}) = \left(1-\frac{5}{12}\right) = \frac{7}{12} \text{ and } P(\bar{F}) = \left(1-\frac{3}{8}\right) = \frac{5}{8}$$

Clearly E and F are independent events.

So, $\bar{E}$ and $\bar{F}$ are independent events.

P(at least one of them will be alive 25 years hence)

= 1–P(none will be alive 24 years hence)

$$= 1-P(\bar{E}\cap\bar{F}) = 1-P(\bar{E})P(\bar{F})$$

$$= \left(1-\frac{7}{12}\times\frac{5}{8}\right) = \frac{61}{96}$$

S.63 (d)

$m + \sigma^2 = 24$ and $m\sigma^2 = 128$

On solving we get: m = 16 or 8.

$m = 16 \Rightarrow \sigma^2 = 8$ or $m = 8 \Rightarrow \sigma^2 = 56$.

Case I. np = 16 and npq = 8

$$\Rightarrow p = \frac{1}{2} \text{ and } q = \frac{1}{2} \text{ and } n = 32.$$

Case II. np =8 and npq = 56

Invalid case.

The distribution is $(q + p)^n = \left(\frac{1}{2}+\frac{1}{2}\right)^{32}$

S.64 (a)

$$b_{yx} = \frac{\Sigma x_i y_i - \frac{(\Sigma x_i)(\Sigma y_i)}{n}}{\left[\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}\right]}$$

$$= \frac{\left(306-\frac{24\times44}{4}\right)}{\left(164-\frac{(24)^2}{4}\right)} = \frac{(306-264)}{(164-144)} = \frac{42}{20} = \mathbf{2.1}$$

S.65 (b)

Probability of drawing an ace from a pack of 52 cards = 4/52.

Similarly the probability of drawing a card of spades = 13/52.

and the probability of drawing an ace of spades = 1/52

Since the two events (i.e. a card being an ace and a card being of spades) are not mutually exclusive,

$\therefore$ Probability of drawing an ace or a spade

$P(A + B) = P(A) + P(B) - P(A \cap B)$

$$= \frac{4}{52}+\frac{13}{52}-\frac{1}{52} = \mathbf{\frac{4}{13}}$$

S.66 (b)

Let A be the event of getting 5 or 6

$\therefore$ P(A) = $\frac{1}{3}$ and B be the event of getting 1,2,3,4; P (B) = $\frac{2}{3}$

In order to get a 'Head' before "5 or 6" the following, events have to occur,

H, TBH, TBTBH, TBTBTBH

$$\therefore P = \frac{1}{2}+\frac{1}{2}\times\frac{2}{3}\times\frac{1}{2}+\left(\frac{1}{3}\right)^2\frac{1}{2}+\left(\frac{1}{3}\right)^3\cdot\frac{1}{2}$$

$$= \frac{\frac{1}{2}}{1-\frac{1}{3}} = \frac{3}{4}$$

S.67 (b)

There are 3 mutually exclusive and exhaustive way in which 2 balls are transferred from first bag to second bag.

First Way:

Two white balls are transferred from first bag to second bag so that probability for that is $\frac{^4C_2}{^6C_2}$.

In the second bag we have 7 white and 4 black balls and the probability of getting s white ball is

$= \frac{7}{11}$

$\therefore$ Required probability

$$= \frac{^4C_2}{^6C_2}\times\frac{7}{11} = \frac{6}{15}\times\frac{7}{11} = \frac{42}{165}$$

Second way:

Two black balls have been transferred from first bag to the second bag so that probability for that is $\frac{^2C_2}{^6C_2} = \frac{1}{15}$

In the second bag we have five white and 6 black balls and probability of getting a white ball is $\frac{5}{11}$

$\therefore$ Required probability = $\frac{1}{15}\times\frac{5}{11} = \frac{5}{165}$

Third way:

One black and one white ball have been transferred from first bag to the second so that than probability for this is

$$\frac{^4C_1\times{}^2C_1}{^6C_2} = \frac{8}{15}$$

In the second bag we have 6 white and 5 black balls and the probability of drawing a white ball is 6/11.

$\therefore$ Required probability = $\frac{8}{15}\times\frac{6}{11} = \frac{48}{165}$

Since these three cases are mutually exclusive,

$\therefore$ the required probability of drawing a white ball

$$= \frac{42}{165}+\frac{5}{165}+\frac{48}{165} = \frac{95}{165}$$

S.68 (c)

$$P_1 = \frac{6}{36} = \frac{1}{6}$$

[$\therefore$ out of total of 36 ways both the persons can throw equal values in 6 ways]

To find p_2 the total number of ways $n = 6^4$ and the favourable number of ways $M = 15\times8 = 120$. Since any two number out of 6 can be selected in $^6C_2$ i.e., 15 ways and corresponding to each of these ways, there are 8 ways e.g. corresponding to the numbers 1 and 2 the eight ways are (1, 1, 1, 2) (1, 1, 2, 1) (1, 2, 1, 1) (2, 1, 1, 1) (2, 2, 2, 1) (2, 2, 1, 2) (2, 1, 2, 2) (1, 2, 2, 2)

Hence P = $\frac{120}{6^4} = \frac{5}{54}$

Since $\frac{1}{6} > \frac{5}{54}$, we have $P_1 > P_2$.

S.69 (b)

Two points are always collinear so we can say a triangle consists of two collinear points and one point which is not collinear to both of them simultaneously.

So here, we have no. of triangles.

= No. of triangles having 2 points on line 1 and one point one line 2

+ No. of triangles having 2 points on line 2 and one point on line 1

$= {}^{10}C_2 \times 11 + {}^{11}C_2 \times 10 = 45 \times 11 + 55 \times 10$

$= \mathbf{1045}$.

S.70 (a)

Total number of point $= 10 + 11 = 21$

$\therefore$ No. of 3 points group $= {}^{21}C_3$

$$= \frac{21\times 20\times 19}{3\times 2\times 1} = 7\times 10\times 19$$

No. of triangle (from part (i)) = 1045

$$\therefore \text{Required probability} = \frac{1045}{7\times 10\times 19} = \frac{209}{14\times 19}$$

$$= \frac{11\times 19}{14\times 19} = \frac{11}{14}$$

S.71 (c)

Let event of drawing a faulty item from any of the machines be A, and event that an item drawn at random was produced by M_i be B_i.

To P $(B_i|A)$ proceed as follows:

	M_1	M_2	M_3	Remarks
$P(B_i)$	0.25	0.30	0.45	$\therefore$ sum = 1
$P(A/B_i)$	0.05	0.04	0.03	
$P(B_i)P(A/B_i)$	0.0125	0.012	0.0135	sum = 0.38
$P(B/A)$	$\frac{0.0125}{0.038}$	$\frac{0.0125}{0.038}$	$\frac{0.0135}{0.038}$	By Baye's theorem

Highest output being from M_3, required probability $= \frac{0.0135}{0.038} = \mathbf{0.355}$

S.72 (c)

Let A,B,C,D be the event when 0(W) and 3(B);1(W) and 2 (B),2(W) and 1(B); 3(W) and 0(B) are transferred to the second box.

Let E be the event of drawing a black ball from the second box.

$$P(A) = \frac{{}^6C_3}{{}^{10}C_3} = \frac{1}{6}, P(B) = \frac{{}^4C_1 \times {}^6C_2}{{}^{10}C_3} = \frac{1}{2},$$

$$P(C) = \frac{3}{10}, P(D) = \frac{{}^4C_3}{{}^{10}C_3} = \frac{1}{30}$$

$P(A) + P(B) + P(C) + P(D)$

$$= \frac{1}{6} + \frac{1}{2} + \frac{3}{10} + \frac{1}{30} = 1$$

$\therefore$ Events, A, B, C, D are mutual exclusive and also exhaustive.

$$P\left(\frac{E}{A}\right) = \frac{3}{3} = 1; P\left(\frac{E}{B}\right) = \frac{2}{3}; P\left(\frac{E}{C}\right) = \frac{1}{3}; P\left(\frac{E}{D}\right) = 0$$

$$\text{Required Probability} = P\left(\frac{C}{E}\right)$$

$$= \frac{P\left(\frac{E}{C}\right)\times P(C)}{P\left(\frac{E}{A}\right)P(A)+P\left(\frac{E}{B}\right)P(B)+P\left(\frac{E}{C}\right)P(C)+P\left(\frac{E}{D}\right)P(D)}$$

$$= \frac{\frac{1}{3}\times\frac{3}{10}}{1\times\frac{1}{6}+\frac{2}{3}\times\frac{1}{2}+\frac{1}{3}\times\frac{3}{10}+0\times\frac{1}{30}}$$

$$= \frac{\frac{1}{10}}{\frac{1}{6}+\frac{1}{3}+\frac{1}{10}} = \frac{1}{6}$$

S.73 (b)

$$y = \frac{ax+b}{c}$$

$$\Rightarrow y = \frac{a}{c}x + \frac{b}{c}$$

$\Rightarrow y = Ax + B$

where, $A = \frac{a}{c}$ and $B = \frac{b}{c}$

So, $\bar{y} = A\,\bar{x} + B$

$\therefore\ y-\bar{y}=Ax+B-(A\bar{x}+B)=A(x-\bar{x})$

$\Rightarrow (y-\bar{y})^2=A^2(x-\bar{x})^2$

$\Rightarrow \Sigma(y-\bar{y})^2=A^2\Sigma(x-\bar{x})^2$

$\Rightarrow n\sigma_y^2 = A^2(n\sigma_x^2)$

$\Rightarrow \sigma_y = |A|\sigma_x$

S.74 (b)

Total number of bags = n

Total number of balls = m

$$m \leq kn$$

$$m - kn \geq 0$$

So the total number of ways such that each bag contains at least k balls in the solution to $x_1+x_2+x_3.....+x_n = m-kn$, which is

$$\binom{n-1+m-kn}{m-kn}=\binom{n-1+m-kn}{n-1}=\binom{m-kn+n-1}{n-1}$$

S.75 (a)

A can draw a ticket in ${}^3C_2 = 3$ ways.

Number of cases in which A can get a prize is clearly 1.

$\therefore$ Probability of A's success $= \frac{1}{3}$

Again B can draw a ticket in ${}^9C_3 = \frac{9.8.7}{3.2.1}=84$ ways..

Number of ways in which B gets all blanks = ${}^6C_3 = \frac{6.5.4}{3.2.1}=20.$

$\therefore$ Number of ways of getting a prize = 84 –20 = 64.

Thus, probability of B's success $= \frac{64}{84}=\frac{16}{21}$

hence A's probability of success: B's probability of success $= \frac{1}{3}:\frac{16}{21} = 7:16$

S.76 (a)

P(A/E) = P(B/E)

$$\frac{P(A\cap E)}{P(E)}=\frac{P(B\cap E)}{P(E)}$$

if P(A∩E) = P (B∩E)

$$\text{if } P\left(A\cap\bigcup_{i=1}^{n}E_i\right)=P\left(B\cap\bigcup_{i=1}^{n}E_i\right)$$

$$P\bigcup_{i=1}^{n}(A\cap E_i)=P\left(\bigcup_{i=1}^{n}(B\cap E_i)\right)\sum_{i=1}^{n}P(A\cap E_i)$$

$$=\sum_{i=1}^{n}P(B\cap E_i)$$

S.77 (d)

(a) holds for independent events.

(b) holds for exclusive events.

(c) is not correct. The correct result is p(A/B) $= \frac{P(A\cap B)}{P(B)}$ for conditional events.

For general events A and B,

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\Rightarrow P(A) + P(B) = P(A \cup B) + P(A \cap B)$

$\Rightarrow P(A \cup B) \leq P(A) + P(B)$

S.78 (d)

n(s) = 900 (100 to 999 both inclusive)

Let A = event that number selected at random with not contain the digit 7.

It is clear that all numbers are three digit numbers.

The first place can be filled in 8 ways (0, 7 excluded)

The second place can be filled in 9 ways (7 excluded)

The third place can be filled in 9 ways (7 excluded)

$\Rightarrow$ All three places can be filled in $8 \times 9 \times 9 = 648$ ways

$\Rightarrow n(A) = 648$

$$\Rightarrow p(A) = \frac{n(A)}{n(s)}=\frac{648}{900} = \frac{18}{25}$$

S.79 (c)

Since both are drawn without replacement, the events are conditional. The required events are $B \wedge W$ or $W \wedge B$.

$$P(B \wedge W) = P(B)\cdot P(W/B) = \frac{15}{25}\cdot\frac{10}{24} = \frac{1}{4}$$

$$P(W \wedge B) = P(W)\cdot P(B/W) = \frac{10}{25}\cdot\frac{15}{24} = \frac{1}{4}$$

$$\Rightarrow \text{required problem} = \frac{1}{4}+\frac{1}{4} = \frac{1}{2}$$

S.80 (d)

$n(s) = 6 \times 6 = 36$

Let A = event that at least one of them will have 6 facing up.

$\Rightarrow \bar{A}$ = event that none of them shows 6.

$$\Rightarrow n(\bar{A}) = 5 \times 5 = 25$$

$$\Rightarrow P(\bar{A}) = \frac{n(\bar{A})}{n(s)} = \frac{25}{36}$$

$$\Rightarrow P(A) = 1 - P(\bar{A}) = 1-\frac{25}{36} = \frac{11}{36}$$

Alternative method (Direct):

The number of ways in which only the first shows 6 is $1 \times 5 = 5$. Similarly, the number of ways in which only the second shows 6 is $1 \times 5 = 5$. Finally, the number of ways in which both dice shows is 1.

$$\Rightarrow n(A) = 5 + 5 + 1 = 11$$

$$\Rightarrow P(A) = \frac{n(A)}{n(s)} = \frac{11}{36}$$

S.81 (c)

The problem is equivalent to one of finding probability that when two cards are drawn at random from a pack, both should be aces.

$$\Rightarrow \text{Required probability} = \frac{{}^4C_2}{{}^5C_2} = \frac{6}{\left(\frac{52\times51}{2}\right)}$$

$$= \frac{12}{52\times51} = \frac{4}{52}\times\frac{3}{51}$$

Alternatively drawing two cards at a time in equivalent to drawing two cards one by one withou replacement. Hence event are conditional. The required event is $A \wedge A$.

$$P(A \wedge A) = P(A)\cdot P(A/A) = \frac{4}{52}\cdot\frac{3}{51} = \frac{4}{52}\times\frac{3}{51}$$

S.82 (d)

Let A = event that it will rain today

B = event that it will rain tomorrow

$\Rightarrow P(A) = 0.5,\ P(B) = 0.6,\ P(A \vee B) = 0.7$

$P(A \vee B) = P(A) + P(B) - P(A \wedge B)$

$\Rightarrow \quad 0.7 = 0.5 + 0.6 - P(A \wedge B)$

$\Rightarrow P(A \wedge B) = 1.1 - 0.7 = \mathbf{0.4}$

S.83 (b)

We use binomial distribution

$n = 3$

p = probability that an odd number turns up = ½

$q = 1 - p = ½$

r = number of successes and success means an odd number turns up.

$p(r) = {}^nC_r\, p^r q^{n-r}$

$$\Rightarrow p(r = 1) = {}^3C_1\left(\frac{1}{2}\right)^1\left(\frac{1}{2}\right)^{3-1} = \frac{3}{8}$$

Alternatively, probability that exactly one odd number turns up

$= p(O \wedge E \wedge E) + p(E \wedge O \wedge E) + p(E \wedge E \wedge O)$

$= p(O)\cdot p(E)\cdot p(E) + p(E)\cdot p(O)\cdot p(E) + p(E)\cdot p(E)\cdot p(O)$

$$= \frac{1}{2}\cdot\frac{1}{2}\cdot\frac{1}{2}+\frac{1}{2}\cdot\frac{1}{2}\cdot\frac{1}{2}+\frac{1}{2}\cdot\frac{1}{2}\cdot\frac{1}{2} = \frac{3}{8}$$

S.85 (c)

$$P(E_1 \vee E_2) = P(E_1) + P(E_2) - P(E_1 \wedge E_2) = \frac{1}{2}+\frac{1}{3}-\frac{1}{5} = \frac{5}{6}-\frac{1}{5} = \frac{19}{30}$$

$\therefore$ A is false.

$$P(E_1)\cdot P(E_2)=\frac{1}{2}\cdot\frac{1}{3}=\frac{1}{6}\neq P(E_1\wedge E_2)$$

$\therefore$ B is false

$\Rightarrow$ E_1 and E_2 are not independent.

$\Rightarrow$ **(c) is true.**

$$P\left(\frac{E_1}{E_2}\right)=\frac{P(E_1\wedge E_2)}{P(E_2)}=\frac{1/5}{1/3}=\frac{3}{5}$$

$\therefore$ (d) is false.

Hence only (c) is true.

S.86 (c)

Explanation:

Given $P(E_1) = P(E_2)$

$P(E_1 \cup E_2) = 1$

$\therefore$ E_1 & E_2 are independent.

$\therefore$ $P(E_1 \cap E_2) = P(E_1) + P(E_2) = 1$

$\therefore$ $P(E_1 \cap E_2) = 0$

$\therefore$ $2P(E_1) = 1$

$\therefore$ $P(E_1) = \frac{1}{2}$

S.87 (b)

First accident can happen on any of the 7 days.

$\therefore$ There are 7 ways in which it can occur.

After first accident, second can also happen in any of the 7 days.

$\therefore$ There are $7 \times 7 = 7^2$ ways in which first and second accident can happen.

Similarly, for 7 accidents, number of ways it can happen = 7^7.

Now, all the 7 accidents can happen on any of the 7 days.

$\therefore$ There are 7 ways in which all the accidents can happen on a single day.

$\therefore$ Required Probability = $\frac{7}{7^7} = \frac{1}{7^6}$

S.88 (c)

Given four coins tossed simultaneously.

Probability of getting a head (H) $=\frac{1}{2}$

Probability of getting a tail (T) $= 1-\frac{1}{2}=\frac{1}{2}$

$\therefore$ By Binomial Theorem

$$= {}^4C_1\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)^3+{}^4C_2\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^2$$

$$+{}^4C_3\left(\frac{1}{3}\right)^3\left(\frac{1}{2}\right)^1$$

$$= 4\times\frac{1}{16}+\frac{4\times3}{2}\times\frac{1}{16}+4\times\frac{1}{16}$$

$$= \frac{4+6+4}{16}=\frac{14}{16}=\frac{7}{8}$$

Alternate:

If 4 coins are tossed.

The possible outcomes can be

1 ways | H | H | H | H |

2 ways | T | T | T | T |

14 ways → | H or T | H or T | H or T | H or T |

$\therefore$ Total no. of outcomes = 16

Out of 16 except 1st and 2nd case

There can be 14 outcomes in which there is one head and one tails.

$\therefore$ Required probability = $\frac{14}{16}=\frac{7}{8}$

S.89 (d)

Given $P(A) = 1$

$P(B) = 1/2$

Both events are independent

So, $P(A\cap B) = P(A)\,P(B)$

$= 1\,1/2$

$= 1/2$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$= \frac{1/2}{1/2} = 1$$

$$P(B/A) = \frac{P(A \cap B)}{P(A)}$$

$$= \frac{1/2}{1} = 1/2$$

S.90 (a)

Given $P(H) = 1/2$

$P(T) = 1/2$

Apply Bernoulli's formula for binomial distribution,

$$P(X=2) = {}^4C_2 (1/2)\left(1-\frac{1}{2}\right)^{4-2}$$

$$= {}^4C_2 \left(\frac{1}{2}\right)^2 (1/2)^2$$

$$= \frac{{}^4C_2}{2^4}$$

$$= \frac{6}{16} = \frac{3}{8}$$

S.91 (d)

Let the marks obtained per question be a random variable X.

Its probability distribution table is given below:

X	1	–0.25
p(X)	1/4	3/4

Expected marks per question

$= E(x) = \Sigma X p(X)$

$= 1 \times 1/4 + (-0.25) \times 3/4$

$= 1/4 - 3/16$

$= 1/16$ marks

Total marks expected for 150 questions

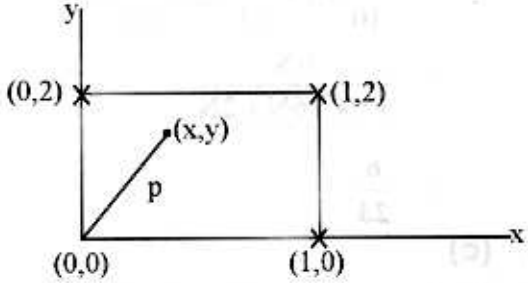
$$= 1/16 \times 150 = \frac{75}{8} \text{ marks per student}$$

Total expected marks of 1000 students

$$= \frac{75}{8} \times 1000$$

$= 9375$ **marks**

S.92 (d)



Length of position vector of point $= p = \sqrt{x^2 + y^2}$

$$p^2 = x^2 + y^2$$

$$E(p^2) = E(x^2 + y^2)$$

$$= E(x^2) + E(y^2)$$

Now x and y are uniformly distributed $0 \le x \le 1$ and $0 \le y \le 2$.

Probability density function of $x = \frac{1}{1-0} = 1$

Probability density function of $y = \frac{1}{2-0} = 1/2$

$$E(x^2) = \int_0^1 x^2 p(x)dx$$

$$= \int_0^1 x^2 . 1 . dx$$

$$= \left[\frac{x^3}{3}\right]_0^1 = \frac{1}{3}$$

$$E(y^2) = \int_0^2 y^2 p(y)dy$$

$$= \int_0^2 y^2 . 1/2 . dy$$

$$= \left[\frac{y^3}{6}\right]_0^2 = \frac{8}{6} = \frac{4}{3}$$

$\therefore$ $E(p^2) = E(x^2) + E(y^2)$

$$= \frac{1}{3} + \frac{4}{3} = \frac{5}{3}$$

S.93 (b)

Required probability is given by

$$= \frac{\frac{3N}{10}\times 2}{\frac{5N}{10}\times 3+\frac{3N}{10}\times 2+\frac{2N}{10}\times 1}$$

$$= \frac{6N}{15N+6N+2N}$$

$$= \frac{6}{23}$$

S.94 (c)

Total number of student who have taken one or more courses

$= (125 + 85 + 65) - (50 + 35 + 30) + 15$

$= 275 - 115 + 15 = 175$

Number of student have not taken any courses

$= 200 - 175 = \mathbf{25}$

S.95 (b)

Number of distribution is given by

$= 120 - (4 \times 3 \times 2 \times 1)$

$= 120 - 24 = \mathbf{96}$

S.96 (b)

Marbles - B → Blue
G → Green
R → Red

process repeated 3-times, so possible sequences of marble selection if no two marbles drawn have the same colour is $\lfloor 3$.

BGR, BRG, GBR, GRB, RGB, RBG

So required probability $= \left(\frac{10}{60}\times\frac{20}{60}\times\frac{30}{60}\right)\lfloor 3$

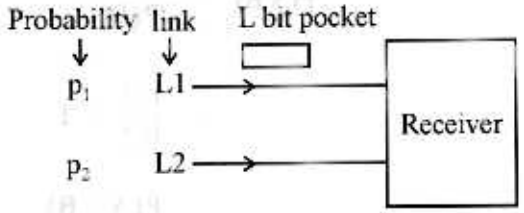
$$= \frac{1}{6}$$

S.97 (a)

Possibilities of two successive tosses will be as TTH, HTT, THTT, HTHH, THTHTT, HTHTHH,.....

So, **expected number of tosses is 3**

S.98 (a)



bit error probability in link L1 = b_1

bit error probability in link L2 = b_2

So error free transmission probability through link L1 is = $p_1(1 - b_1)^L$

and error free transmission probability through link L2 is = $p_2(1 - b_2)^L$

So without error via either L1 or L2 is

$$= \mathbf{p_1(1 - b_1)^L + p_2(1 - b_2)^L}$$

S.99 (d)

$$P_o = \frac{3}{6} = \frac{1}{2}$$

$$P_e = \frac{3}{6} = \frac{1}{2}$$

Since both events are independent of each other

$$P_{(odd/even)} = \frac{1}{2}\times\frac{1}{2} = \frac{1}{4}$$

S.100 (c)

If (x) is the continuous probability density function of a random variable X then,

$$P(a< x\le b) = P(a \le x \le b)$$

$$= \int_a^b f(x)dx$$

S.101 (a)

The probability that exactly n element are chosen

= The probability of getting n heads out of 2n tosses

$= {}^{2n}C_n\ (1/2)^n(1/2)^{2n-n}$ (Binomial form)

$= {}^{2n}C_n\ (1/2)^n\ (1/2)^n$

$$= \frac{{}^{2n}C_n}{2^{2n}} = \frac{{}^{2n}C_n}{(2^2)^n} = \frac{{}^{2n}C_n}{4^n}$$