K. J. Somaiya Institute of Engineering and Information Technology
Sion, Mumbai - 400022
NAAC Accredited Institute with 'A' Grade
NBA Accredited 3 Programs
(Computer Engineering, Electronics & Telecommunication Engineering and Electronics Engineering)
Permanently Affiliated to University of Mumbai

EXAMINATION TIME TABLE (JANUARY 2021)

PROGRAMME - T.E. (Computer) (REV. -2016) (Choice Based)

SEMESTER - V

Days and Dates	Time	Course Code	Paper
Thursday, January 7, 2021	3.30 p.m to 5.30 p.m	CSC501	Microprocessor
Saturday, January 9, 2021	3.30 p.m to 5.30 p.m	CSC502	Database Management System
Tuesday, January 12, 2021	3.30 p.m to 5.30 p.m	CSC503	Computer Network
Thursday, January 14, 2021	3.30 p.m to 5.30 p.m	CSC504	Theory of Computer Science
Saturday, January 16, 2021	3.30 p.m to 5.30 p.m	CSDLO5011	Elective I: Multimedia System
Saturday, January 16, 2021	3.30 p.m to 5.30 p.m	CSDLO5012	Elective I: Advance Operating System
Saturday, January 16, 2021	3.30 p.m to 5.30 p.m	CSDLO5013	Elective I: Advance Algorithm

Important Note: ● **Change if any, in the time table shall be communicated on the college web site.**

PRINCIPAL

Mumbai
20th December, 2020

University of Mumbai

Examination 2020 under cluster 4 (Lead College: PCE, New Panvel)

Examinations Commencing from 23rd December 2020 to 6th January 2021 and from 7th January 2021 to 20th January 2021

Program: **Computer Engineering**

Curriculum Scheme: **Rev2016**

Examination: **TE Semester V**

Course Code: **CSC501** and Course Name: **Microprocessor**

Time: 2 hour Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	For single step execution ….. flag is used.
Option A:	IF
Option B:	TF
Option C:	DF
Option D:	OF
2.	Size of every location in instruction queue of 8086 microprocessor is ……. bits
Option A:	8
Option B:	16
Option C:	20
Option D:	32
3.	ALE signal from microprocessor 8086 in minimum mode is connected to …..
Option A:	Address Latches
Option B:	Transceivers
Option C:	Clock generator
Option D:	Bus controller
4.	Duty cycle of the clock required for microprocessor 8086 is …
Option A:	20 percent
Option B:	33 percent
Option C:	50 percent
Option D:	66 percent
5.	In maximum mode of 8086 DT/ $\overline{R}$ signal is generated by ……
Option A:	Microprocessor
Option B:	Address latches
Option C:	Transceivers
Option D:	Bus controller
6.	In 8086 instruction DIV CL stores quotient at …..
Option A:	AL
Option B:	AH

Option C:	CL
Option D:	CH
7.	Addressing mode of SUB AL, BL is …..
Option A:	Register
Option B:	Immediate
Option C:	Direct
Option D:	Register Indirect
8.	Which of the following is assembler directive?
Option A:	ADD
Option B:	MUL
Option C:	DIV
Option D:	SEGMENT
9.	8086 Instruction CMP AL, BL uses …….. operation.
Option A:	Addition
Option B:	Subtraction
Option C:	Complement
Option D:	Division
10.	How many hardware interrupt inputs are available on 8086 microprocessor?
Option A:	1
Option B:	2
Option C:	8
Option D:	16
11.	Which of the following ICWs are compulsory in any situation while programming 8259?
Option A:	ICW1 and ICW2
Option B:	ICW1 and ICW3
Option C:	ICW2 and ICW3
Option D:	ICW2 and ICW4
12.	Address of last location of EPROM in 8086 based memory system is …….
Option A:	00000H
Option B:	FFFFFH
Option C:	0000H
Option D:	FFFFEH
13.	Size of counters in 8253/8254 is ….
Option A:	8 bits
Option B:	16 bits
Option C:	20 bits
Option D:	32 bits
14.	How many I/O modes can be programmed using 8255?
Option A:	1

Option B:	2
Option C:	3
Option D:	4
15.	IC 8257 is ……
Option A:	Programmable Peripheral Interface
Option B:	DMA Controller
Option C:	Bus Controller
Option D:	Clock generator
16.	BSR mode of 8255 is applicable to
Option A:	Port A
Option B:	Port B
Option C:	Port C
Option D:	Not applicable to ports
17.	PE bit in Control Register of 80836 DX is used to enable ……
Option A:	Paging
Option B:	Real address mode
Option C:	Protected address mode
Option D:	Not applicable to 80386 DX
18.	How many segment registers are present in 80386 DX
Option A:	4
Option B:	5
Option C:	6
Option D:	8
19.	Branch prediction is done in …. Stage of Integer pipeline of Pentium processor.
Option A:	PF
Option B:	D1
Option C:	D2
Option D:	EX
20.	In MESI protocol “M” stands for
Option A:	Main
Option B:	Modern
Option C:	Modified
Option D:	Master
Q2	**Solve any Four out of Six 5 marks each**
A	Explain the use of $\overline{BHE}$ and A0 in 8086 based system.
B	List and explain any 5 assembler directives.
C	Explain with diagram how hardware interrupt capabilities of 8086 system can be increased beyond 2 hardware interrupts.
D	Explain Mode 2 of 8255 with diagram.
E	Distinguish Real address mode and Protected address mode.
F	Discuss Floating pipeline stages used in Pentium processor.

Q3.	**Solve any Two Questions out of Three** **10 marks each**
A	Draw and explain timing diagram for write operation in minimum mode of 8086.
B	Write assembly language program for 8086 to check the given string of 10 characters represent Palindrome.
C	Design 8086 based system with following specifications a) 8086 working at 5 MHz in minimum mode. b) 64 KB SRAM using 16 KB chips c) 32 KB EPROM using 16 KB chips

University of Mumbai

Examination 2020 under cluster 4 (Lead College: PCE, New Panvel)

Examinations Commencing from 23rd December 2020 to 6th January 2021 and from 7th January 2021 to 20th January 2021

Program: **Computer Engineering**

Curriculum Scheme: **Rev2016**

Examination: **TE Semester V**

Course Code: **CSC501** and Course Name: **Microprocessor**

Time: 2 hour Max. Marks: 80

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Question Number	Correct Option (Enter either 'A' or 'B' or 'C' or 'D')
Q1.	B
Q2.	A
Q3.	A
Q4	B
Q5	D
Q6	A
Q7	A
Q8.	D
Q9.	B
Q10.	B
Q11.	A
Q12.	B
Q13.	B
Q14.	C
Q15.	B
Q16.	C
Q17.	C
Q18.	C
Q19.	B
Q20.	C

Q. No	Points	Marks
Q2. (A)	- Diagram - Explanation	2 3
Q2. (B)	- Explanation 1 mark for each	5
Q2. (C)	Diagram Explanation	3 2
Q2. (D)	- Diagram - Explanation	2 3
Q2. (E)	- any five points	5
Q2. (F)	- Diagram - Explanation	2 3

Q. No	Points	Marks
Q3. (A)	- AD, M/ $\overline{IO}$ and ALE pin correctly drawn - Other signal correctly drawn - Explanation	3 3 4
Q3. (B)	- Program with any correct logic	10
Q3. (C)	- External Frequency correctly shown - Calculation of no. of chips and addresses - Address Mapping - Complete Diagram	1 2 4 3

University of Mumbai

Examination 2020 under cluster 4 (Lead College: PCE,New Panvel)

Examinations Commencing from 23rd December 2020 to 6th January 2021 and from 7th January 2021 to 20th January 2021

Program: Computer Engineering

Curriculum Scheme: Rev2016

Examination: TE Semester V

Course Code: CSC502 and Course Name: Database Management System

Time: 2 hour Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	The physical storage structure or device could be changed without affecting the conceptual schema, this is known as _____
Option A:	Physical data Independence
Option B:	Logical data Independence
Option C:	External data independance
Option D:	View data independance
2.	A data dictionary is a repository that manages _____
Option A:	Memory
Option B:	Metadata
Option C:	Log
Option D:	Schema
3.	If you want to maintain and store information about your car inurance company, a car would be considered a(n) _____
Option A:	Relation
Option B:	Entity
Option C:	Instance
Option D:	Attribute
4.	The number of entities to which another entity can be associated via a relationship set is expressed as:
Option A:	Entity
Option B:	Attribute
Option C:	Schema
Option D:	Cardinality
5.	The attribute Retiremnet_date is calculated from DATE_OF_JOINING. The attribute Retirement_date is
Option A:	Single Valued
Option B:	Multivalued
Option C:	Derived
Option D:	Composite
6.	The _____ operation, allows us to find set of all common tuples that are belonging to both Relation R and Relation S.

Option A:	Union
Option B:	Set Intersection
Option C:	Set difference
Option D:	Join
7.	The type of operation which extends the Projection operation by allowing functions of attributes to be included in the projection list.
Option A:	Join
Option B:	Union
Option C:	Projection
Option D:	Generalized Projection
8.	The operation which produces a relation R(X) that includes all tuples t[x] in R1(Z) that appears in R1 in combination with every tuple from R2(Y.)
Option A:	Cartesian Product
Option B:	Set difference
Option C:	Set division
Option D:	Join
9.	The Join operation in which it keeps every tuple in first or left relation R if no matching tuple is found in S, then the attributes of S in join result filled with NULL values
Option A:	Outer Join
Option B:	Left Outer join
Option C:	Right Outer Join
Option D:	Full Join
10.	In SQL which command is used to add new column in existing table ?
Option A:	Create
Option B:	Insert
Option C:	Alter
Option D:	Record
11.	Consider the following relation Movies (theater,address,capacity) Which of the options will be needed at the end of the SQL query : SELECT P1.address FROM movies P1 such that it always finds the addresses of theaters with maximum capacity?
Option A:	WHERE P1.capacity > = All (select P2. capacity from Movies P2)
Option B:	WHERE P1.capacity > = Any (select P2. capacity from Movies P2)
Option C:	WHERE P1.capacity > All (select max (P2. capacity) from Movies P2)
Option D:	WHERE P1.capacity >Any (select max (P2. capacity) from Movies P2)
12.	The output of SQL statement SELECT SUBSTR('ABFJRTSKIL',6) FROM Schema;
Option A:	TSKIL
Option B:	RTSKIL
Option C:	SKIL
Option D:	KIL
13.	In SQL , the View command is declared as:

Option A:	define view V as <query expression>;
Option B:	Create V as <query expression>
Option C:	Create or replace view V as <query expression>;
Option D:	define view V like <query expression>;
14.	When a non key attribute depends on another non key attribute, it is called
Option A:	Functional Dependency
Option B:	Transitive dependency
Option C:	Partial dependency
Option D:	Automicity
15.	2NF is
Option A:	every non-key attribute is fully functionally dependent on the entire primary key
Option B:	1NF and every non-key attribute is fully functionally dependent on the entire primary key
Option C:	No transitive dependencies
Option D:	only atomic attributes and primary key is defined
16.	If a transaction has obtained a _____ lock, it can read but cannot write on the item
Option A:	Shared Mode
Option B:	Exclusive Mode
Option C:	Read only mode
Option D:	Write only mode
17.	Deadlocks are possible only when one of the transactions wants to obtain a(n) ____ lock on a data item
Option A:	Binary
Option B:	Exclusive
Option C:	Shared
Option D:	Complete
18.	Which of the following concurrency control protocols ensure both conflict serialzability and freedom from deadlock? I. 2-phase locking II. Time-stamp ordering
Option A:	I only
Option B:	II only
Option C:	Both I and II
Option D:	Neither I and II
19.	If a schedule S can be transformed into a schedule S' by a series of swaps of non-conflicting instructions, then S and S' are
Option A:	Strict
Option B:	Equivalent
Option C:	Conflict Equivalent
Option D:	Non-Conflict Equivalent

20.	If several concurrent transactions are executed over the same data set and the second transaction updates the database before the first transaction is finished, the ____ property is violated and the database is no longer consistent.
Option A:	Automicity
Option B:	Consistency
Option C:	Durability
Option D:	Isolation

Q2	**Solve any Four out of Six** **5 marks each**
A	Discuss the roles of DBA
B	Explain data independence and discuss types of data independence
C	Explain Specialization and Generalization in EER with example
D	Explain different integrity constraints
E	Discuss the need of Normalization in Database design.Explain 3NF.
F	Explain deadlock with wait-for graph

Q3.	**Solve any Two Questions out of Three** **10 marks each**
A	Draw an E-R diagram for University database consisting of entities Student,Faculty,Department,Class. A student has a Unique id,the student can enroll for multiple classes and has at most one major. Faculty must belong to department and faculty can take multiple classes Every student will get a grade for the class he/she was enrolled. Convert E-R diagram into relational schema
B	Consider the employee database *employee (employeename, street, city,date of join)* *works (employeename, company name, salary)* *company (company name, city)* *manages (employee name, manager name)* Write SQL queries for the following statements 1) Find all the employees who joined in the month of october 2) Modify the database so that 'Anjali' now lives in 'Mumbai' 3) List all the employees who live in the same cities as their managers. 4) Find all employees who earn more than the average salary of all the employees of their company 5) Give all the employees of ABC corporation a 15 percent raise.
C	Explain any two concurrency control protocol in database system

University of Mumbai

Examination 2020 under cluster 4 (Lead College: PCE,New Panvel)

Examinations Commencing from 23rd December 2020 to 6th January 2021 and from 7th January 2021 to 20th January 2021

Program: Computer Engineering

Curriculum Scheme: Rev2016

Examination: TE Semester V

Course Code: CSC502 and Course Name: Database Management System

Time: 2 hour Max. Marks: 80

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Question Number	Correct Option (Enter either 'A' or 'B' or 'C' or 'D')
Q1.	A
Q2.	B
Q3.	B
Q4	D
Q5	C
Q6	B
Q7	D
Q8.	C
Q9.	B
Q10.	C
Q11.	A
Q12.	A
Q13.	C
Q14.	B
Q15.	B
Q16.	A
Q17.	B
Q18.	B
Q19.	C
Q20.	D

Q2	**Solve any Four out of Six** **5 marks each**
A	Que: Discuss the roles of DBA Explanation of minimum 4 responsibilities of DBA 5 marks If only listed --3 marks
B	Que :Explain data independence and discuss types of data independence Definition of data independance 2-marks Explanation/definition of Logical and Physical data independence -3 marks
C	Que:Explain Specialization and Generalization in EER with example Definition of Generalization /Specialization 2 marks Designing approch difference and example 3 marks
D	Que :Explain different integrity constraints Listing 4 types integrity constraints 2 marks - concept of primary key and foreign key ,Unique key 2 marks -Concept of Check and Null constraint
E	Que:Discuss the need of Normalization in Database design.Explain 3NF. - Need of normalization-2 marks - 3 normal form – 1 mark - Example – 2marks
F	Que:Explain deadlock with wait-for graph Definition of Deadlock in DBMS 2-marks - Diagram- for WFG 2 marks - Mechanism with of Detection 1 marks

Q3.	**Solve any Two Questions out of Three** **10 marks each**
A	Draw an E-R diagram for University database consisting of entities Student,Faculty,Department,Class. A student has a Unique id,the student can enroll for multiple classes and has at most one major. Faculty must belong to department and faculty can take multiple classes Every student will get a grade for the class he/she was enrolled. Convert E-R diagram into relational schema Solution : Correctly identification of entity and relationship -2 marks ER diagram with all components – 5 marks Relational model (tables)- 3 marks
B	Consider the employee database *employee (employeename, street, city,date of join)* *works (employeename, company name, salary)* *company (company name, city)* *manages (employee name, manager name)*

	Write SQL queries for the following statements 1) Find all the employees who joined in the month of october 2) Modify the database so that 'Anjali' now lives in 'Mumbai' 3) List all the employees who live in the same cities as their managers. 4) Find all employees who earn more than the average salary of all the employees of their company 5) Give all the employees of ABC corporation a 15 percent raise. 2 marks for each correctly written query 1) Select * from employee where tochar(dateofjoin,'mon')='October' 2) Update employee set city ='Mumbai' where employeename='Anjali' 3) select p.employee-name from employee p, employee r, manages m where p.employee-name = m.employee-name and m.manager-name = r.employee-name and p.city = r.city 4) select employee-name from works t where salary >(select avg(salary) from works s where t.company-name = s.company-name) 5) Update works set salary=salary+salary*.15 where company-name='ABC corporation'
C	Explain any two concurrency control protocol in database system Time stamp ordering- 1 mark Example- 2 marks Explanation- 3 mark Two phase locking protocol- 1 mark Example- 2 marks Explanation- 3 mark

University of Mumbai

Examination 2020 under cluster 4 (Lead College: Pillai,New Panvel)

Examinations Commencing from 23rd December 2020 to 6th January 2021 and from 7th January 2021 to 20th January 2021

Program: **Computer Engineering**

Curriculum Scheme: Rev2016 Examination: TE Semester V

Course Code: CSC503 and Course Name: Computer Network (CN)

Time: 2 hour Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	Physical or logical arrangement of network is called as
Option A:	Networking
Option B:	Topology
Option C:	Routing
Option D:	Remote services
2.	When data is transfer from Source to Destination, it creates communication path, which also called as
Option A:	Medium
Option B:	Node
Option C:	Link
Option D:	Topology
3.	When Single link is use to connect multiple devices, is also called as,
Option A:	Time Shared
Option B:	Spatially Shared
Option C:	Point to Point
Option D:	Multipoint
4.	Which Layers are implemented in End System?
Option A:	Presentation layer, Session layer and Transport layer
Option B:	Application Layer, Presentation Layer and Network Layer
Option C:	Presentation Layer, Session Layer and DataLink Layer
Option D:	Presentation Layer, Transport Layer and DataLink Layer
5.	The primary objective of Physical layer is for _____
Option A:	Process to Process delivery
Option B:	Bit by Bit delivery
Option C:	Application to Application delivery
Option D:	End to End
6.	_____ Cable consists of an inner copper core and a second conducting outer sheath.
Option A:	Shielded twisted-pair
Option B:	Twisted-pair
Option C:	Fiber-optic

Option D:	Coaxial
7.	_____ are used for cellular phone, satellite, and wireless LAN communications.
Option A:	Radio waves
Option B:	Infrared waves
Option C:	Microwaves
Option D:	Ultraviolet Waves
8.	The data link layer takes packet from network layer and encapsulates into_____.
Option A:	Packet
Option B:	Trailer
Option C:	Segment
Option D:	Frame
9.	Automatic repeat request error management mechanism is provided by
Option A:	Media access control sublayer
Option B:	Logical link control sublayer
Option C:	Network interface control sublayer
Option D:	Application access control sublayer
10.	Suppose Two or more bits in a data unit has been changed during the transmission, the error is called as
Option A:	Burst error
Option B:	Random error
Option C:	Inverted error
Option D:	Double error
11.	CSMA is based on which types of medium?
Option A:	Listen before sending
Option B:	Sense before transmit
Option C:	Sense before collision
Option D:	Listen before talk
12.	The purpose of Hamming code is ?
Option A:	Flow control
Option B:	Error correction
Option C:	Error detection
Option D:	Error correction and Detection
13.	The ability of a single network to span multiple physical networks is known as
Option A:	Fragmenting
Option B:	Masking
Option C:	Subnetting
Option D:	Hopping
14.	Which Routing uses the Dijkstra algorithm to build routing table?
Option A:	Link state routing
Option B:	Distance Vector routing
Option C:	Hierarchical routing
Option D:	Vector routing

15.	Transport layer aggregates data from different applications into a single stream before passing it to_____
Option A:	Network layer
Option B:	Data Link layer
Option C:	Application layer
Option D:	Physical layer
16.	Transport layer protocols deals with_____
Option A:	Application to Application communication
Option B:	Process to Process communication
Option C:	Node to Node communication
Option D:	Process to Node Communication
17.	Which among the following is uncontrolled and un-registered form of ephemeral ports in accordance to IANA?
Option A:	Static Port
Option B:	Registered Port
Option C:	Well Known Port
Option D:	Dynamic Port
18.	A user at one site to establish a connection to another site and then pass keystrokes from local host to remote host. Which service will use?
Option A:	Telnet
Option B:	FTP
Option C:	GFTP
Option D:	HTTP
19.	Which one of the following protocol delivers/stores mail to receiver server?
Option A:	Internet Mail Access Protocol
Option B:	Post office protocol
Option C:	Hypertext Transfer protocol
Option D:	Simple mail transfer protocol
20.	Which service is offer by the Application layer ?
Option A:	Node to Node
Option B:	Process to Process
Option C:	End to End
Option D:	Process to Node

Q2	**Solve any Four out of Six** **5 marks each**
A	*Explain with examples the classification of IPV4 address*
B	*Explain the advantages of Fiber Optics as a communication medium*
C	*Explain Design Issues of Data Link Layer*
D	Describe UDP header format with suitable diagram
E	*Explain Open Loop Congestion Control*
F	Explain Channel Allocation Problem

Q3.	**Solve any Two Questions out of Three** **10 marks each**
A	*What is Traffic Shaping? How Leaky Bucket Algorithms is use for Traffic Shaping?*
B	*Explain CSMA Protocols. How Collision are handled in CSMA/CD*
C	*Explain Framing Methods. What are the advantage of variable length frame over fixed layer frame*

University of Mumbai

Examination 2020 under cluster 4 (Lead College: PCE,New Panvel)

Examinations Commencing from 23rd December 2020 to 6th January 2021 and from 7th January 2021 to 20th January 2021

Program: **Computer Engineering**

Curriculum Scheme: Rev2019/2016/2012 (Keep the required)

Examination: FE/SE/TE/BE Semester I/II/III/IV/V/VI/VII/VIII (Keep the Required)

Course Code: CSC503 and Course Name: Computer Network

Time: 2 hour Max. Marks: 80

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Question Number	Correct Option (Enter either 'A' or 'B' or 'C' or 'D')
Q1.	B
Q2.	C
Q3.	D
Q4	A
Q5	B
Q6	D
Q7	C
Q8.	D
Q9.	B
Q10.	A
Q11.	B
Q12.	D
Q13.	C
Q14.	A
Q15.	A
Q16.	B
Q17.	D
Q18.	A
Q19.	D
Q20.	C

University of Mumbai

Examination 2020 under cluster 4(Lead College: PCE)

Examinations Commencing from 7th January 2021 to 20th January 2021

Program : **Computer Engineering**

Curriculum Scheme: Rev2016

Examination : TE Semester : V

Course Code : CSC504 and Course Name: Theory of Computer Science

Time: 2 hour Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	How many final states will be there while designing FSM to accept strings starts with "111" or "011" over ∑ = {0, 1}?
Option A:	2
Option B:	1
Option C:	3
Option D:	1 or 2
2.	Which of the following statements are true in case of NFA? **Statement 1:** Missing Transitions **Statement 2:** Multiple transitions **Statement 3:** Transitions without reading input **Statement 4:** Deterministic transitions
Option A:	1 and 4
Option B:	1, 2 and 4
Option C:	2 and 3
Option D:	1, 2 and 3
3.	Which of the following statements are true? **Statement 1:** Mealy and Moore machine are equivalent in terms of capacity **Statement 2:** While converting from Mealy to Moore machine, If initial state is splitted then one of the splitted states will become new initial state. **Statement 3:** For Mealy machine, the output depends on the current input. **Statement 4:** There exists more number of states in Moore machine as compared to Mealy machine.
Option A:	1 and 2
Option B:	1, 2 and 3
Option C:	1 only
Option D:	1, 2 and 4
4.	The alphabet of ternary number includes symbols?
Option A:	0, 1
Option B:	0, 1, 2
Option C:	0, 1, 2, 3
Option D:	1, 2, 3

5.	If regular expression (101)* is converted to ε-NFA then how many states will be there in converted ε-NFA?
Option A:	5
Option B:	7
Option C:	8
Option D:	6
6.	Let P, Q and R be the regular expression over given input symbol set and P is not ε(epsilon), then R = Q + RP has a unique solution:
Option A:	Q*P
Option B:	QP*
Option C:	Q*P*
Option D:	(P*Q*) *
7.	Arden's theorem is applicable to finite automata if it contains _____.
Option A:	More than one initial states
Option B:	Null transitions
Option C:	Non-null transitions
Option D:	More than one final states
8.	The regular expression that represents zero or more instances of an x or y is _____.
Option A:	(x+y)
Option B:	(x+y)*
Option C:	(x*+y)
Option D:	(xy)*
9.	While converting CFG into GNF it must be in _____.
Option A:	Simplified
Option B:	CFG
Option C:	Regular Grammar
Option D:	Any form
10.	Given grammar G: 1) S □ AS 2) S □ aBC | b 3) A □ SAA 4) A □ aa Which of the following productions denies the format of Greibach Normal Form?
Option A:	1 and 2
Option B:	2 and 3
Option C:	1, 2, 3 and 4
Option D:	1, 3 and 4
11.	The productions of the form non-terminal → one non-terminal, is called _____.
Option A:	Null production

Option B:	Unit production
Option C:	Nullable production
Option D:	Useless production
12.	_____ is Type 2 grammar according to Chomsky Hierarchy.
Option A:	Regular Grammar
Option B:	Context Sensitive Grammar
Option C:	Context Free Grammar
Option D:	Unrestricted Grammar
13.	What do you mean by the transition (q_1, ε, z_0) = { (q_2, z_0) }?
Option A:	Stack is empty and input is over
Option B:	Stack is full
Option C:	Pop operation is performed
Option D:	No operation
14.	The PDA is more powerful than Finite Automata because of _____.
Option A:	Implementation of Regular Languages
Option B:	Stack of infinite size
Option C:	Operation performed in PDA
Option D:	Implementation of Context Free Grammar
15.	The information stored on the tapes in Universal Turing Machine includes .
Option A:	Description of any other TM
Option B:	Description of any other TM, Input String, States
Option C:	Description of any other TM, Input String
Option D:	Description of any other TM, States
16.	How many components are present in the formal definition of Turing Machine and which are they?
Option A:	5, { Q, Σ, d, q_0, F }
Option B:	6 , { Q, Σ, Γ, d, q_0, F }
Option C:	4 , { Q, Σ, d, q_0 }
Option D:	7 , { Q, Σ, Γ, d, q_0, B, F }
17.	In which direction the head of Turing Machine can move?
Option A:	Right
Option B:	Left
Option C:	Cannot move
Option D:	Left and Right both
18.	What do the symbols {Γ, B} indicate in formal definition of Turing Machine?
Option A:	{ input alphabet, Blank symbol }
Option B:	{ tape alphabet, Blank symbol }
Option C:	{ input alphabet, Stack symbol }
Option D:	{ Stack alphabet, Blank symbol }
19.	Which of the following statement is True in case of Multi-tape Turing Machine?

Option A:	Multiple tapes have multiple heads
Option B:	Only one head used for multiple tapes
Option C:	Each tape have two or more heads
Option D:	Multiple tapes each having an independent head
20.	Which of the following are undecidable problem?
Option A:	Decide Language is regular or not
Option B:	Check Ambiguity
Option C:	Derive Parse Tree
Option D:	Halting Problem

Q2. **(20 Marks)**	**Solve any Two Questions out of Three 10 marks each.**
A	Let G be the grammar S → aB | bA A → a | aS | bAA B → b | bS | aBB Find leftmost derivation, rightmost derivation and parse tree for the string "**bbaaabbaba**" .
B	Design Turing Machine to recognize language, L= { $a^n b^{n+1}$ | n≥ 1 }.
C	Design Finite State Machine to check whether any ternary number is divisible by 3 or not.

Q3. **(20 Marks)**	
A	**Solve any Two 5 marks each.**
i.	Explain Post Correspondence Problem in detail.
ii.	Prove that L = { W c W^R | W Є (a + b)* } is not regular.
iii.	Explain Universal Turing Machine in detail.
B	**Solve any One 10 marks each**
i.	Convert given Regular Expression, RE= a(a + b)*b to Minimized DFA.
ii.	Design PDA for L= {$a^{2n} b^n$, n ≥ 1}.

University of Mumbai

Examination 2020 under cluster __ (Lead College: _____)

Examinations Commencing from 23rd December 2020 to 6th January 2021 and from 7th January 2021 to 20th January 2021

Program : **Computer Engineering**

Curriculum Scheme: Rev2016

Examination : TE Semester : V

Course Code : CSC504 and Course Name: Theory of Computer Science

Time: 2 hour Max. Marks: 80

==========

Question Number	Correct Option (Enter either 'A' or 'B' or 'C' or 'D')
Q1.	A
Q2.	D
Q3.	D
Q4	B
Q5	D
Q6	B
Q7	C
Q8.	B
Q9.	A
Q10.	D
Q11.	B
Q12.	C
Q13.	A
Q14.	B
Q15.	B
Q16.	D
Q17.	D
Q18.	B
Q19.	D
Q20.	D

Q 2. A)

- **Step 1 :** Number all the productions.
- **Step 2 :** Generate Leftmost Derivation for String ‘bbaaabbaba’
- **Step 3 :** Generate Rightmost Derivation for String ‘bbaaabbaba’
- **Step 4 :** Draw Parse Tree
- **Step 5 :** Check for ambiguity

Q 2. B)

- **Define Language, L =** { abb, aabbb, aaabbbb, ...}

- **Logic :**
  Replace input 'a', by ‘X‘ and move right till we get symbol ‘b’.
  Replace input ‘b', by ‘Y‘ and move left till we get ‘X’.
  Repeat till all a’s are over
  When a’s are over search for last ‘b’

- **Define Input Alphabet, ∑ =** { *a, b* }

- **Define Input Tape Symbols, Γ** = { *a,* b, X, Y, B }

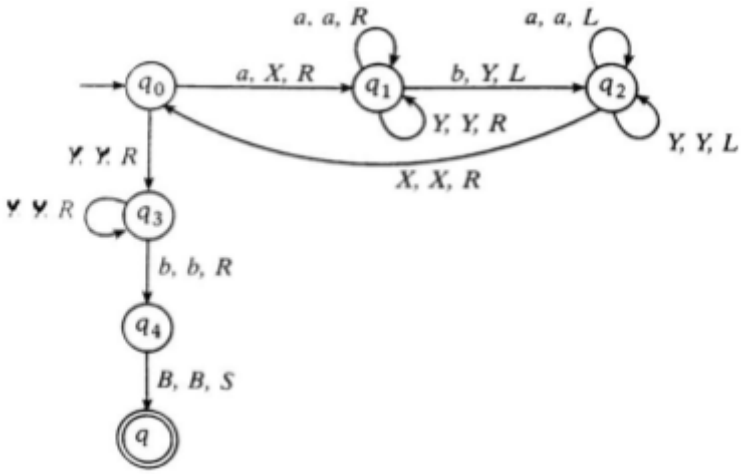
- **States :**

q0 : Read ‘a’ make it ‘X’ move right
q1 : Read ‘b’ make it ‘Y’ move left
q2 : Search ‘X’ keep it as ‘X’ move right
q3 : Search for last ‘b’
q4 : Extra ‘b’
qf : Final state

- **Transition Table :**

Q \ Γ	**a**	**b**	**X**	**Y**	**B**
q0	(q1, X, R)			(q3, Y, R)	
q1	(q1, a, R)	(q2, Y, L)		(q1, Y, R)	
q2	(q2, a, L)		(q0, X, R)	(q2, Y, L)	
q3		(q4, b, R)		(q3, Y, R)	
q4					(qf, B, S)
qf*	Final State				

Transition Diagram :



Q 2. C)

- **Define input alphabet,** $\sum$ = { 0, 1, 2 }
- **Define Language, L**= {0000,0010, 0020, 0100.....}
- **Possible States, Q** ={ remainder 0, remainder 1, remainder 2}

  q_s → Initial State

  q_0 → remainder 0

  q_1 → remainder 1

  q_2 → remainder 2

  Q = {q_s, q_0, q_1 ,q_2 }

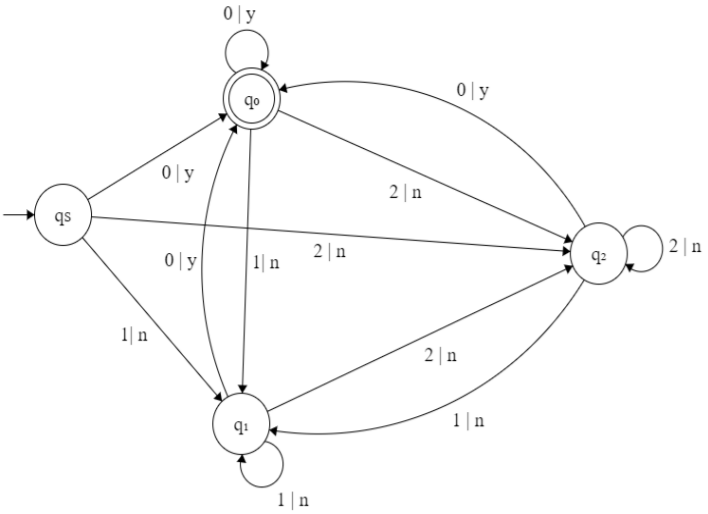
- **State Transition Function :**

States	Inputs		
	0	1	2
→q_s	q_0	q_1	q_2
q_0*	q_0	q_1	q_2
q_1	q_0	q_1	q_2
q_2	q_0	q_1	q_2

- **Machine Function :**

States	Inputs		
	0	1	2
→q_s	y	n	n
q_0*	y	n	n
q_1	y	n	n
q_2	y	n	n

- **Transition Diagram :**



Q3. A (i)

- The post correspondence problem is to determine if there exists a sequence of one or more integers such that

  $a_i\ a_j\ a_k\ \ldots\ldots a_m = b_i\ b_j\ b_k\ldots..\ .b_m$
- Where each of these integers i, j, k ….m is greater than or equal to '1' and less than or equal to n ('n' is the length of A and B).
- The sequence (i, j, k,….m) is called as solution to the post correspondence problem.
- The PCP is unsolvable since there is no algorithm which can determine such sequence for the given lists.
- **Example :** Does the PCP with two lists?

  A = {a, abaaa, ab}

  B = {aaa, ab, b} have a solution?
- **Solution:**
- We have to find such sequence using which if we list out the elements of A and B then it will generate same strings.
- Consider the sequence (2, 1, 1, 3)
- A2 A1 A1 A3 = abaaaaaab
- B2 B1 B1 B3 = abaaaaaab
- Thus, A2 A1 A1 A3 = B2 B1 B1 B3
- Thus the PCP has the solution. The solution is sequence (2, 1, 1, 3).

Q3. A (ii)

Step 1 : Assume L is regular.

Step 2 : Find special property of language L.

$W \in (a + b)^*$

Select any string, Let $W = a^n b^n$ and $W^R = b^n a^n$

When we calculate length, we will get total length of string as 4n + 1.

Special Property : The length all strings is odd.

Step 3 : Let l is constant of pumping lemma.

Step 4 : By pumping lemma z = uvw

$|z| = |u\ v\ w| = 4l + 1$

Step 5 : According to pumping lemma uv^iw belongs to L.

Step 6 : Put i=2 in $uv^i\ w$, we get uv^2w

- we have $l \leq v \leq l$
- Add 4l+1 on both sides of equation
- $l+4l+l \leq |uv^2w| \leq l+4l+l$
- $2+4l \leq |uv^2w| \leq 5l+l$
- $1+4l < |uv^2w| < 5l+2$

Step 7 : Put l = 1 in above equation

$5 < |uv^2w| < 7$

i.e. Length = 6 and it is not odd.

Put l = 2

$9 < |uv^2w| < 12$

i.e. Length = 10 or 11 and it is not odd always.

The string uv^2w does not hold the property of Language L.

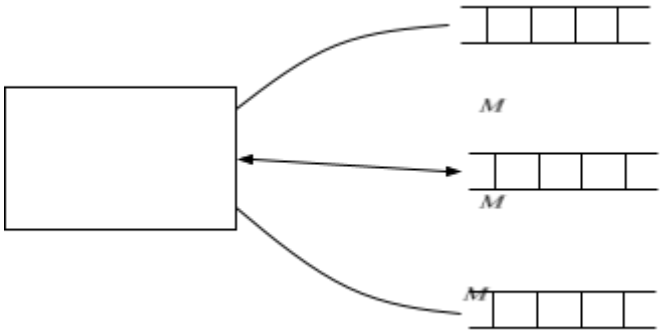
Thus, it is contradiction with our assumption. Hence L is not regular.

Q3. A (iii)

- A limitation of standard Turing Machines is that they are "hardwired" they execute only one program
  - Real Computers are re-programmable
- Solution: Universal Turing Machine
- We can construct a single Turing machine which can solve all sorts of problems.
- This type of Turing machine is called as Universal Turing Machine (UTM). Thus, Universal Turing Machine is a Turing Machine which simulates any other Turing Machine for a given input.
- The input of this Universal Turing Machine consists of:

  Description of transitions of other Turing machine M

  Input string of other Turing machine M
- Universal Turing Machine consists of three different tapes to store all its input.



Q3. B (i)

Step 1 : Draw NFA with Є-moves for the RE a(a + b)*b

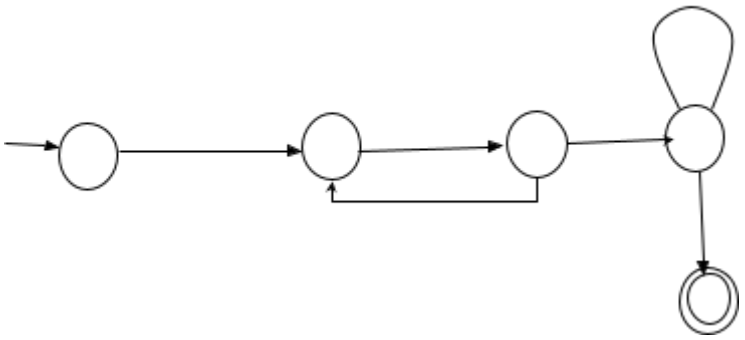
Step 2 : Design Transition Table to convert to DFA.

Step 3 : Convert to Minimized the DFA (if applicable).

Q3. B (ii)

- **Define Language, L =** { aab, aaaabb, aaaaaabbb,……}
- **Logic :**
  Push ‘a' into stack for alternate input ‘a’.
  For each input 'b', pop one ‘a' from stack
  If input is over and stack is empty then accept
- **Define Input Alphabet, ∑ = {** *a, b* }
- **Define Stack Symbols, Γ =** { a, z_0 }
- **States :**
  q_s : initial state
  q_0: read ‘a’ (push ‘a’)
  q_1: read ‘a’ (read ‘a’ , no operation)
  q_2:read ‘b’ (pop)
  q_3: input is over and stack is empty (accept)
- **Transition Rules :**
  - $(qs, a, z_0)=\{(q0,az_0)\}$
  - $(q0, a, a)=\{(q1,a)\}$
  - $(q1, a, a)=\{(q0,aa)\}$
  - $(q1, b, a)=\{(q2,\varepsilon)\}$
  - $(q2, b, a)=\{(q2,\varepsilon)\}$
  - $(q2, \varepsilon, z_0)=\{(q3,z_0)\}$

- **Transition Diagram**



University of Mumbai

Examination 2020 under cluster 4 (Lead College: PCE)

Examinations Commencing from 7th January 2021 to 20th January 2021

Program: **Computer Engineering**

Curriculum Scheme: Rev2016

Examination: TE Semester :V

Course Code: CSDLO5011 and Course Name: Multimedia Systems

Time: 2 hour Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	CCITT Group 3 compression utilizes Huffman coding to generate a set of code and set of codes for given bit stream.
Option A:	makeup code, terminating code
Option B:	Vertical Code, Pass Code
Option C:	Pas code, Terminating code
Option D:	Vertical Code, Terminating code
2.	While enlarging the image,_____image will blur while _____image will not blur.
Option A:	vector,bitmap
Option B:	bitmap,gif
Option C:	bitmap,vector
Option D:	bitmap, jpeg
3.	What is the extension at the image file used by digital cameras and supports upto 24-bit colors?
Option A:	.bmp
Option B:	.jpeg
Option C:	.gif
Option D:	.tif
4.	If I want to use Google meet as a tool for my online class. Which of the following will be best supported Multimedia System Architecture for the same?
Option A:	Workstation Architecture
Option B:	IMA Architecture
Option C:	Network Architecture
Option D:	Internet Architecture
5.	_____ correlation between adjacent frames in a sequence of images in video applications.
Option A:	Spatial redundancy
Option B:	Spectral redundancy
Option C:	Temporal redundancy
Option D:	Coding redundancy

6.	_____ in JPEG aims at reducing the total number of bits in the compressed image.
Option A:	Zig-zag ordering
Option B:	run-length encoding
Option C:	Quantization
Option D:	Entropy coding
7.	WAVE sound file format bit stream encoding is the _____
Option A:	PCM
Option B:	DM
Option C:	PWM
Option D:	DPCM
8.	Component video is an analog format that carries _____ only
Option A:	Audio data
Option B:	visual data
Option C:	Text Data
Option D:	Image Data
9.	The higher the bit rate, the less compression, which results in overall _____ of audio file.
Option A:	less quality
Option B:	zero quality
Option C:	Poor quality
Option D:	higher quality
10.	_____ a digital compression of video data that compresses the size of the video file by compressing the image data of each frame
Option A:	Temporal compression
Option B:	Spatial compression
Option C:	redundant compression
Option D:	visual compression
11.	In video compression, _____saves even more space by using differences between the current frame and both the preceding and following frames to specify its content.
Option A:	B - frames
Option B:	Multi-frame
Option C:	I - frame
Option D:	P - frames
12.	In H.261, each CIF frame is composed of Groups of Blocks (GOBs)
Option A:	8
Option B:	10
Option C:	12
Option D:	16
13.	Multicast packets are encapsulated inside regular IP packets for "tunneling", so that they can be sent to the destination through the islands. Is the a feature of _____packets.

Option A:	RTP
Option B:	RTCP
Option C:	IGMP
Option D:	MBONE
14.	_____ is a measure of smoothness of the audio/video playback, related to the variance of frame/packet delays.
Option A:	Packet loss
Option B:	Latency
Option C:	Jitter
Option D:	Data rate
15.	In IP-Multicast, message is sent to
Option A:	only receiver
Option B:	only one node
Option C:	all nodes in the domain
Option D:	a set of specified nodes
16.	_____ monitors QoS in providing feedback to the server (sender) on quality of data transmission and conveys information about the participants of a multiparty conference.
Option A:	RTCP
Option B:	RTP
Option C:	IGMP
Option D:	RTSP
17.	Digital signatures offer a way of verifying both the authenticity and _____ of a message.
Option A:	integrity
Option B:	Confidentiality
Option C:	Copyrights
Option D:	Privacy and Anonymity
18.	Which of the following is not type of Steganography?
Option A:	Image
Option B:	Audio
Option C:	Video
Option D:	Text
19.	if I want to edit my childhood photograph, first I have to convert it into the digital format. What would be the best suitable device for the same?
Option A:	Camera
Option B:	scanner
Option C:	printer
Option D:	Electric pen
20.	What will be more suitable from below to describe a digital signature?
Option A:	Signature which is used to authenticate the person on digital documents
Option B:	Signature image which is used in online platform to fill the form whenever its needed.

Option C:	Signature which provides the authentication of the user through self produced methods
Option D:	Signature which provides the authentication of the user through security mechanisms

Q2	**Solve any Four out of Six** **5 marks each**
A	Describe different mediums in multimedia.
B	Compare CCITT group 3 one D and CCITT group 3 two D.
C	What are the different types of redundancies in image?
D	Compare WAV and MPEG Audio.
E	Explain different types of video signals.
F	What are design issues face to design the authoring system.

<table>
<tr><td>Q3</td><td>Solve any Two Questions out of Three 10 marks each</td></tr>
<tr><td>A</td><td>A networking company uses a compression technique to encode the message before transmitting over the network. Suppose the message contains the following characters with their frequency:
a:7 b:16 c:19 d:45 e:13 f:6 Note that each character in input message takes 1 byte. If the compression technique used is Huffman Coding, how many bits will be saved in the message?</td></tr>
<tr><td>B</td><td>
<table>
<tr><td>Symbol</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr>
<tr><td>Frequency</td><td>12</td><td>8</td><td>7</td><td>6</td><td>5</td></tr>
</table>
Explain the step by step Shannon-Fano compression algorithm and Solve by the Shannon-Fano frequency code for following frequencies of symbols.
</td></tr>
<tr><td>C</td><td>Write a short note on Steganographic methods.</td></tr>
</table>

University of Mumbai

Examination 2020 under cluster 4 (Lead College: PCE)

Examinations Commencing from 7th January 2021 to 20th January 2021

Program: **Computer Engineering**

Curriculum Scheme: Rev2016

Examination: TE Semester :V

Course Code: CSDLO5011 and Course Name: Multimedia Systems

Time: 2 hour Max. Marks: 80

==========

Question Number	Correct Option (Enter either 'A' or 'B' or 'C' or 'D')
Q1.	A
Q2.	C
Q3.	B
Q4	A
Q5	C
Q6	C
Q7	A
Q8.	B
Q9.	D
Q10.	B
Q11.	A
Q12.	C
Q13.	D
Q14.	C
Q15.	D
Q16.	A
Q17.	A
Q18.	D
Q19.	B
Q20.	D

A. Describe different mediums in multimedia.

Ans-

classify media according to perception, representation, presentation, storage, transmission and information exchange

B. Compare CCITT group 3 two D and CCITT group 4 two D

Ans Each difference carries one mark.

C. What are the different types of redundancies in image?

Ans -

(i)Redundancy can be broadly classified into Statistical redundancy and Psycho visual redundancy.
(ii) Statistical redundancy can be classified into inter-pixel redundancy and coding redundancy.
(iii) Inter-pixel can be further classified into spatial redundancy and temporal redundancy.
(iv) Spatial redundancy or correlation between neighboring pixel values.
(v) Spectral redundancy or correlation between different color planes or spectral bands.
(vi) Temporal redundancy or correlation between adjacent frames in a sequence of images in video applications.
(vii) Image compression research aims at reducing the number of bits needed to represent an image by removing the spatial and spectral redundancies as much as possible.
(viii) In digital image compression, three basic data redundancies can be identified and exploited: Coding redundancy, Inter-pixel redundancy and Psychovisual redundancy.

D. Compare WAV and MPEG Audio.

Ans-

Basis for comparison	WAV	MP3
Expands to	Waveform Audio File Format	MPEG layer 3
Basic	Implement minimal changes in the original file.	Removes the redundant portions of information from the file.
Compression level	Low	High
Size	Larger	Smaller
Quality	Good	Moderate
Developed by	Microsoft and IBM	MPEG

E. Explain different types of video signals.

Ans -

There are three types of video signals as follows:

- Composite Video
- Component Video

- S-Video

F. What are design issues face to design the authoring system.

Design issues of Authoring Systems:

• Display resolution

• File format and compression issues: Authoring systems should be capable of handling different file formats.

• The first – and hardest – part is to choose the technology for your presentation. The choice comes down to two main contenders,

Adobe Flash

• Flash allows you to create presentations where you can build in powerful animation. It also has very good video compression technology.

• Perhaps the best part of Flash is that it also allows you to put presentations directly onto your web site.

• The biggest problem though is that Flash is a difficult system to get to use.

Microsoft PowerPoint.

• The easiest way to create a multimedia presentation is in Microsoft PowerPoint. You can add in video, a soundtrack and also a reasonable degree of animation.

• By far the biggest advantage of making multimedia presentations in PowerPoint is that it is easy for anyone to be able to edit the presentation.

• Types of Authoring Systems

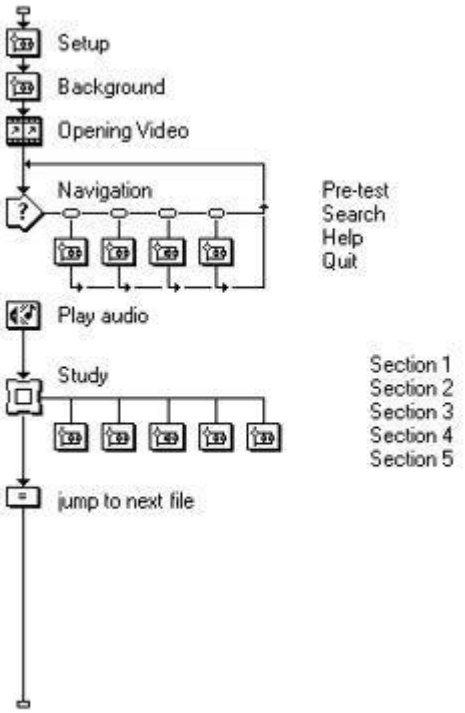
Icon based authoring system

• Each part is represented an icon (symbolic picture)

• Each icon does a specific task, e.g. plays a sound

• Icons are then linked together to form complete applications

• Can easily visualize the structure and navigation of the final application



Dedicated authoring system

• Dedicated authoring systems are designed for a single user consisting of single track for playback.

• In the case of dedicated authoring system, users need not to be experts in multimedia or a professional artist.

• Dedicated authoring systems are extremely simple since they provide drag and drop concept.

• Authoring is done on objects captured by video camera, image scanner or objects stored in multimedia library.

• It does not provide effective presentation due to single stream.

• Examples of Dedicated authoring systems are Paint, MS PowerPoint etc.

Telephone Authoring Systems

• There is an application where the phone is linking into multimedia electronic mail application.

• Telephone can be used as a reading device by providing full text-to-speech synthesis capability.

• The phone can be used for voice command input for setting up and managing voice mail messages.

• Digitized voice clips are captured via the phone and embedded in electronic mail messages.

• As the capability to recognize continuous speech is deployed, phones can be used to create electronic mail.

Programmable authoring system

• Structured authoring tools were not able to allow the authors to express automatic function for handling certain routine tasks.

• But, programmable authoring system has improved in providing powerful functions based on image processing and analysis and embedding program interpreters to use image processing functions. E.g. Visual Basic, Net beans, Visual Studio

Timeline Based Authoring

• It has an ability to develop an application like movie.

• It can create complex animations and transitions.

• All the tracks can be played simultaneously carrying different data.

• Best to use when you have a message with a beginning and an end.

• Played back at a speed that you can set.

• Other elements (such as audio events) are triggered at a given time or location in the sequence of events.

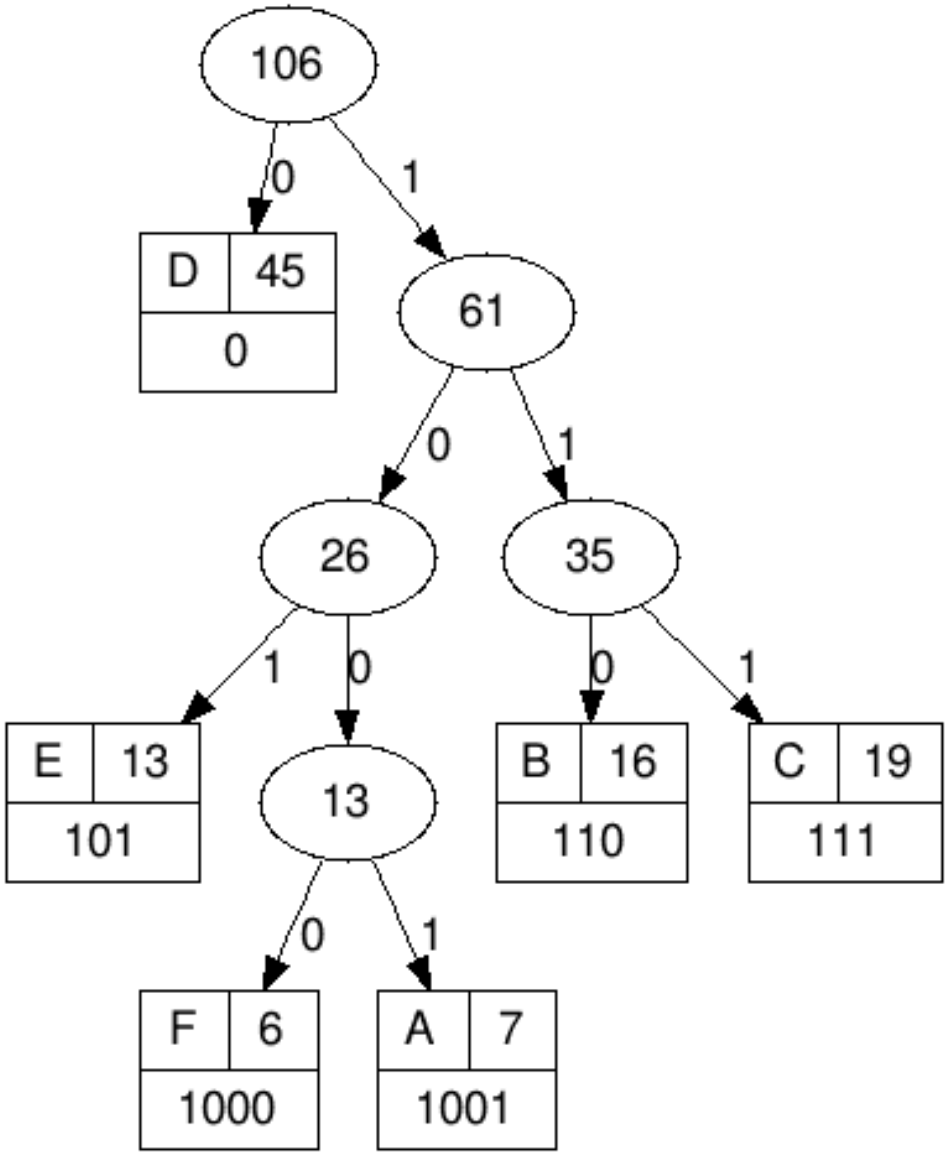
• Jumps to any location in a sequence

Example of Timeline Based Authoring system is Flash software.

Q3.

A. A networking company uses a compression technique to encode the message before transmitting over the network. Suppose the message contains the following characters with their frequency:
a:7 b:16 c:19 d:45 e:13 f:6 Note that each character in input message takes 1 byte. If the compression technique used is Huffman Coding, how many bits will be saved in the message?

Huffman coding



1 byte = 8 bits

Symbol	Freq. of Symbols	Length of Symbols (no. of bits)	Encoding	Length of Symbols (no. of bits) after encoding
D	45	45*8=360	0	45*1=45
C	19	19*8=152	111	19*3=57
B	16	16*8=128	110	16*3=48

E	13	13*8=104	101	13*3=39
A	7	7*8=56	1001	7*4=28
F	6	6*8=48	1000	6*4=24
Total	106	848	18	241

Saved bits are : 848-241=607

B. Explain the step by step Shannon-Fano compression algorithm and Solve by the Shannon-Fano frequency code for following frequencies of symbols.

Ans-

The steps of the algorithm are as follows:

1. Create a list of probabilities or frequency counts for the given set of symbols so that the relative frequency of occurrence of each symbol is known.
2. Sort the list of symbols in decreasing order of probability, the most probable ones to the left and least probable to the right.
3. Split the list into two parts, with the total probability of both the parts being as close to each other as possible.
4. Assign the value 0 to the left part and 1 to the right part.
5. Repeat the steps 3 and 4 for each part, until all the symbols are split into individual subgroups.

The Shannon codes are considered accurate if the code of each symbol is unique.

First division

Symbol	A	B	C	D	E
Frequency	12	8	7	6	5
Sum	(20)		(18)		
Assign bit	0		1		

Second division

Symbol	A	B	C	D	E
Frequency	12	8	7	6	5

Sum	12	8	7	11
Code	00	01	10	11

Third division

Symbol	A	B	C	D	E
Frequency				6	5
Sum				6	5
Code				110	111

Final Codes

Symbol	A	B	C	D	E
Code	00	01	10	110	111

C.

TYPES OF STEGANOGRAPHY

There are different ways to hide the message in another, well known are Least Significant bytes and Injection.

When a file or an image is created there are few bytes in the file or image which are not necessary or least important. These type of bytes can be replaced with a message without damaging or replacing the original message, by which the secrete message is hidden in the file or image.

Another way is a message can be directly injected into a file or image. But in this way the size of the file would be increasing accordingly depending on the secrete message

STEGANOGRAPHY IN IMAGE

Digital images are the most widely used cover objects for steganography. Due to the availability of various file formats for various applications the algorithm used for these formats differs accordingly.

An image is collection of bytes (know as pixels for images) containing different light intensities in different areas of the image. When dealing with digital images for use with Steganography, 8-bit and 24-bit per pixel image files are typical. Both have advantages and disadvantages 8-bit images are a great format to use because of their relatively small size. The drawback is that only 256 possible colors can be used which can be a potential problem during encoding. Usually a gray scale color palette is used when dealing with 8-bit images such as (.GIF) because its gradual change in color would be harder to detect after the image has been encoded with the secret message. 24-bit images offer much more flexibility when used for Steganography. The large

numbers of colors (over 16 million) that can be used go well beyond the human visual system (HVS), which makes it very hard to detect once a secret message, has been encoded.

Large amount of data can be encoded in to 24-bit images as it is compared to 8-bit images. The drawback of 24-bit digital images is their size which is very high and this makes them suspicious our internet due to their heavy size when compared to 8-bit images. Depending on the type of message and type of the image different algorithms are used.

Few types in Steganography in Images:

Least significant bit insertion

Masking and filtering

Redundant Pattern Encoding

Encrypt and Scatter

Algorithms and transformations

Least significant bit insertion

Least Significant Bit (LSB) insertion is most widely known algorithm for image steganography ,it involves the modification of LSB layer of image. In this technique,the message is stored in the LSB of the pixels which could be considered as random noise.Thus, altering them does not have any obvious effect to the image.

Masking and filtering

Masking and filtering techniques work better with 24 bit and grey scale images. They hide info in a way similar to watermarks on actual paper and are sometimes used as digital watermarks. Masking the images changes the images. To ensure that changes cannot be detected make the changes in multiple small proportions. Compared to LSB masking is more robust and masked images passes cropping, compression and some image processing. Masking techniques embed information in significant areas so that the hidden message is more integral to the cover image than just hiding it in the “noise” level. This makes it more suitable than LSB with, for instance, lossy JPEG images.

Redundant Pattern Encoding

Redundant pattern encoding is to some extent similar to spread spectrum technique. In this technique, the message is scattered through out the image based on algorithm. This technique makes the image ineffective for cropping and rotation. Multiple smaller images with redundancy increase the chance of recovering even when the stegano-image is manipulated.

Encrypt and Scatter

Encrypt and Scatter techniques hides the message as white noise and White Noise Storm is an example which uses employs spread spectrum and frequency hopping. Previous window size and data channel are used to generate a random number.And with in this random number ,on all the eight channels message is scattered through out the message.Each channel rotates,swaps and interlaces with every other channel. Single channel represents one bit and as a result there are many unaffected bits in each channel. In this technique it is very complex to draw out the actual message from stegano-image. This technique is more secure compared to LSB as it needs both algorithm and key to decode the bit message from stegano-image. Some users prefer this methos

for its security as it needs both algorithm and key despite the stegano image. This method like LSB lets image degradation in terms of image processing, and compression.

Algorithms and transformations

LSB modification technique for images does hold good if any kind of compression is done on the resultant stego-image e.g. JPEG, GIF. JPEG images use the discrete cosine transform to achieve compression. DCT is a lossy compression transform because the cosine values cannot be calculated exactly, and repeated calculations using limited precision numbers introduce rounding errors into the final result. Variances between original data values and restored data values depend on the method used to calculate DCT

STEGANOGRAPHY IN AUDIO

Implanting secrete message into an audio is the most challenging technique in Steganography. This is because the human auditory system (HAS) has such a vibrant range that it can listen over. To put this in perspective, the (HAS) recognize over a range of power greater than one million to one and a range of frequencies greater than one thousand to one making it extremely hard to add or remove data from the original data structure. The only weakness in the (HAS) comes at trying to differentiate sounds (loud sounds drown out quiet sounds) and this is what must be exploited to encode secret messages in audio without being detected.

Below are the lists of methods which are commonly used for audio Steganography.

LSB coding

Parity coding

Phase coding

Spread spectrum

Echo hiding

LSB coding

Using the least-significant bit is possible for audio, as modifications usually would not create recognizable changes to the sounds. Another method takes advantage of human limitations. It is possible to encode messages using frequencies that are indistinct to the human ear. Using frequencies above 20.000Hz, messages can be hidden inside sound files and can not be detected by human checks.

Parity coding

Instead of breaking a signal down into individual samples, the parity coding method breaks a signal down into separate regions of samples and encodes each bit from the secret message in a sample region's parity bit. If the parity bit of a selected region does not match the secret bit to be encoded, the process flips the LSB of one of the samples in the region. Thus, the sender has more of a choice in encoding the secret bit, and the signal can be changed in a more unobtrusive fashion.

Phase coding

Phase coding attends to the disadvantages of the noise inducing methods of audio Steganography. Phase coding uses the fact that the phase components of sound are not as audible to the human ear as noise is. Rather than introducing perturbations, this technique encodes the message bits as

phase shifts in the phase spectrum of a digital signal, attaining an indistinct encoding in terms of signal-to-perceived noise ratio.

Spread spectrum

In the context of audio Steganography, the basic spread spectrum (SS) method attempts to spread secret information across the audio signal's frequency spectrum as much as possible. This is comparable to a system using an implementation of the LSB coding that randomly spreads the message bits over the entire audio file. However, unlike LSB coding, the SS method spreads the secret message over the sound file's frequency spectrum, using a code that is independent of the actual signal. As a result, the final signal occupies a bandwidth in excess of what is actually required for broadcast.

Echo hiding

In echo hiding, information is implanted in a sound file by introducing an echo into the separate signal. Like the spread spectrum method, it too provides advantages in that it allows for a high data transmission rate and provides superior strength when compared to the noise inducing methods. If only one echo was produced from the original signal, only one bit of information could be encoded. Therefore, the original signal is broken down into blocks before the encoding process begins. Once the encoding process is completed, the blocks are concatenated back together to create the final signal.

STEGANOGRAPHY IN VIDEO

In video steganography, a video file would be embedded with supplementary data to hide secret messages. In the process, an intermediate signal which is a function of hidden message data and data of content signal would be generated. Content data (video file) is then combined with this intermediate signal to result encoding. The supplementary data can include copy control data which can be brains by consumer electronic device and used to disable copying.

The intermediate signal may also contain a pseudo arbitrary key data so as to hide encoding and decode needs corresponding key to extract hidden information from encoded content. In some implementations regulation data is embedded in the content signal with auxiliary data. This regulation data consists of known properties enabling its identification in the embedded content signal. This encoding is robust against scaling, resampling and other forms of content degradation, so that the supplementary data can be detected from the content which might have been degraded.

There are different approaches for video steganography apart from the above mentioned. Most widely known are listed and discussed below.

Least Significant Bit Insertion

This is the most simple and popular approach for all types of steganography. In this method the digital video file is considered as separate frames and changes the displayed image of each video frame. LSB of 1 byte in the image is used to store the secret information. Effecting changes are too small to be recognized by human eye. This method enhances the capacity of the hidden message but compromises the security requirements such as data integrity.

Real time video steganography

This kind of steganography involves hiding information on the output image on the device. This method considers each frame shown at any moment irrespective of whether it is image; text .The image is then divided into blocks. If pixel colors of the blocks are similar then changes color

characteristics of number of these pixels to some extent. By labeling each frame with a sequence number it would even be easy to identify missing parts of information. To extract the information, the displayed image should be recorded first and relevant program is used then.

STEGANOGRAPHY IN DOCUMENT

Steganography in documents just focuses on altering some of its characteristics. They can either be characteristics of text or even text formatting. Below are few ways listed and discussed to implement the same.

Since everyone can read, encoding text in neutral sentences is doubtfully effective. But taking the first letter of each word of the previous sentence, one can see that it is possible and not very difficult. Hiding information in plain text can be done in many different ways. One way is by simple adding white space and tabs to the ends of the lines of the document .The last technique was successfully used in practice and even after a text has been printed and copied on paper for ten times, the secret message could still be retrieved.

Another possible way of storing a secret inside a text is using a publicly available cover source, a book or a newspaper, and using a code which consists for example of a combination of a page number, a line number and a character number. This way, no information stored inside the cover source leads to the hidden message. Discovering it depends exclusively on gaining knowledge of the secret key.

Setting background color and font color is one of the mainly used staganographic approach. This method is focused for Microsoft word documents. Choose predefined colors and set font and background colors of invisible characters such as space, tab or the carriage return characters. R,G,B values are 8 bits means we have allowed range of 0 to 255.Most of the viewers would not feel interested about color values of these invisible characters hence 3 bytes of information is easily hidden in each occurrence of space,tab or carriage return.This approach needs no extra information to hide required bits.

University of Mumbai

Examination 2020 under cluster 4 (Lead College: PCE, New Panvel)

Examinations Commencing from 7th January 2021 to 20th January 2021

Program: **Computer Engineering**

Curriculum Scheme: Rev 2016

Examination: TE Semester V

Course Code: CSDLO5012 and Course Name: Advanced Operating Systems

Time: 2 hour Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	Various Models are used for building distributed computing system.From the following statement which is true i)MiniComputer Model ii)Workstation Model iii)Process Pool Model iv)Hybrid Model
Option A:	i,ii,iii,iv
Option B:	i and ii
Option C:	iii and iv
Option D:	i and iv
2.	What are the advantages of Batch Operating Systems? Choose the correct option i)It is very difficult to guess or know the time required by any job to complete. Processors of the batch systems know how long the job would be when it is in queue ii)Multiple users can share the batch systems iii)The idle time for batch system is very less iv)It is easy to manage large work repeatedly in batch systems
Option A:	i and ii
Option B:	ii and iii
Option C:	i,iii,iv
Option D:	i, ii,iii,iv
3.	Various autonomous interconnected computers communicate with each other using a shared communication network. Independent systems possess their own memory unit and CPU. These are referred as
Option A:	loosely coupled systems

Option B:	Tightly coupled system
Option C:	Network Operating system
Option D:	Batch Operating System
4.	---------- types of systems, each processor contains a similar copy of the operating system and they all communicate with each other.
Option A:	Multiprocessors operating System
Option B:	Symmetric Multiprocessors
Option C:	Asymmetric Multiprocessors
Option D:	Symmetric Multiprocessors and Asymmetric Multiprocessors
5.	How many fields are there in Process Table
Option A:	1
Option B:	4
Option C:	5
Option D:	7
6.	Which field in U-area restrict the size of the process and size of the file
Option A:	Error Field
Option B:	UID
Option C:	Limit
Option D:	An array
7.	The UNIX system divides its virtual address space in logically separated -------
Option A:	Page
Option B:	Process
Option C:	Segment
Option D:	Region
8.	If the kernel executes in the context of a process, its virtual address space is
Option A:	dependent of Process
Option B:	Independent of Processes.
Option C:	Dependent of operating system
Option D:	Independent of operating system
9.	The register context consists components: i)Program counter ii)The processor status register (PS) iii)The stack pointer iv)The general purpose registers Choose the correct options
Option A:	i,iv
Option B:	i,ii,iii,iv
Option C:	i,ii,iii
Option D:	iii iv

10.	The algorithm “allocreg” used for
Option A:	Allocation of Process
Option B:	Allocating a Region
Option C:	Allocation of Memory
Option D:	Allocation of pages
11.	What happens, if the sleep priority is above a threshold value,
Option A:	A process will not wake up on receiving a signal,
Option B:	A process will wake up on receiving a signal,
Option C:	A process become zombie
Option D:	A process will be terminated
12.	The open and create system calls return an integer called a ----------
Option A:	file Table
Option B:	file descriptor
Option C:	file id
Option D:	file UID
13.	Data structure used in kernel of unix operating system
Option A:	File table and the user file descriptor table
Option B:	Inode Table and file table
Option C:	Process Control Block and File descriptor Table
Option D:	Super Block and Boot Block
14.	The kernel caches data in the buffer pool according to a
Option A:	First in First out algorithm
Option B:	Least recently used algorithm
Option C:	Round Robin algorithm
Option D:	Priority Algorithm
15.	Which statement is not correct about “init” process in Unix?
Option A:	It is generally the parent of the login shell
Option B:	It has PID 1.
Option C:	It is the first process in the system
Option D:	Init forks and execs a ‘getty’ process at every port connected to a terminal.
16.	What is a shell script?
Option A:	group of commands
Option B:	a file containing special symbols
Option C:	a file containing a series of commands
Option D:	group of functions
17.	A process is an instance of _____ program.
Option A:	Waiting
Option B:	Executing
Option C:	Terminated
Option D:	Halted
18.	What is cron?

Option A:	a simple process
Option B:	an orphan process
Option C:	a daemon
Option D:	a zombie process
19.	Which of the following is not an OS for mobile?
Option A:	Palm
Option B:	Windows
Option C:	Mango
Option D:	Android
20.	For real time operating systems, interrupt latency should be _____
Option A:	Minimal
Option B:	Maximum
Option C:	Zero
Option D:	Dependent on the scheduling

Q2 **(20 Marks)**	**Solve any Four out of Six** **5 marks each**
A	Explain the U-area
B	Explain the context of a process.
C	Explain different types of kernel.
D	Explain the region table.
E	When attaching a region to a process how can the kernel check the region does not overlap virtual address in regions already to the process?
F	Compare NOS with DOS

Q3. **(20 Marks)**	**Solve any Two Questions out of Three** **10 marks each**
A	Explain the architecture of Unix OS
B	Explain the structure of file directories.
C	Write and explain the ialloc algorithm

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Curriculum Scheme: Rev2016

Examination: TE Semester: V

Course Code: CSDLO5012 and Course Name: Advanced Operating System

Time: 2 hours Max. Marks: 80

==========

Question Number	Correct Option (Enter either 'A' or 'B' or 'C' or 'D')
Q1.	A
Q2.	D
Q3.	A
Q4	C
Q5	D
Q6	C
Q7	D
Q8.	B
Q9.	B
Q10.	B
Q11.	A
Q12.	C
Q13.	A
Q14.	B
Q15.	B
Q16.	C
Q17.	B
Q18.	C
Q19.	C
Q20.	A

Q. 2 A. Explain the U-area

Solution: only Definition----2 marks

Explain all the filed with diagram---5 marks

Q. 2 B. Explain the context of a process.

Solution: The context of a process consists of:

- Contents of its (user) address space, called as user level context
- Contents of hardware registers, called as register context
- Kernel data structures that relate to the process, called as system context

if explain only 2 points------3marks

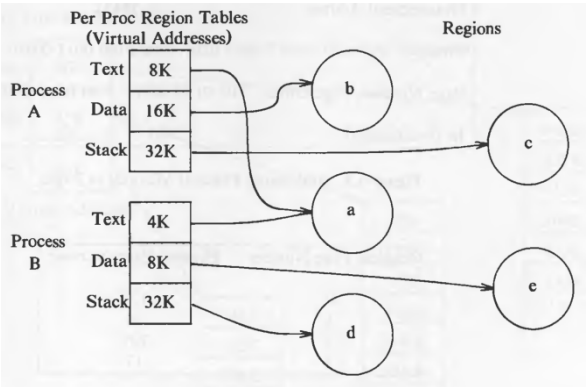
if explain all points---------5 Marks

Q.2 C Explain different types of kernel.

Solution: If explain Monolithic and micro kernel with diagram-----5 marks

Q. 2 D Explain the region table.

Solution: If explain with diagram-----5 marks



Q.2 E When attaching the a region to a process how can the kernel check the region does not overlap virtual address in regions already to the process?

Solution.

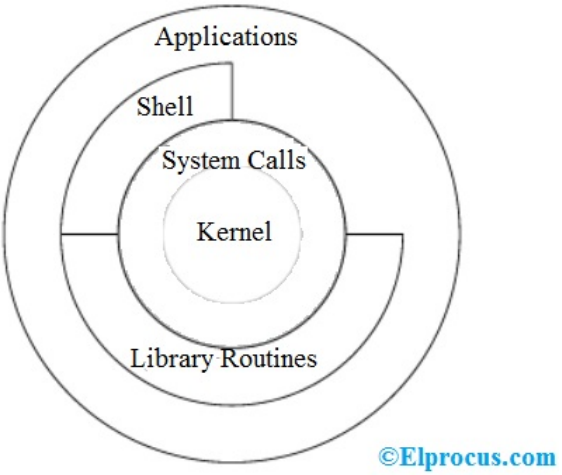
Explain the load region algorithm -----5 marks

Q. 2 F Compare NOS with DOS

Solution: If students write 5 to 6 valid points ----5 marks

Q. 3 A Explain the architecture of Unix OS

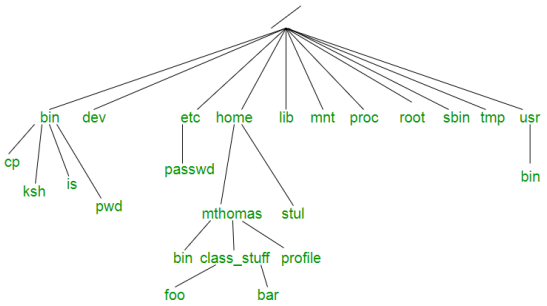
Solution:



Explain with the above diagram with details------10 marks.

Q.3 B Explain the structure of file directories.

Solution:



Explanation for above diagram is expected

Q. 3 C Write and explain the ialloc algorithm

Solution:

```
algorithm ialloc        /* allocate inode */
input:   file system
output: locked inode
{
        while (not done)
        {
                if (super block locked)
                {
                        sleep (event super block becomes free);
                        continue;       /* while loop */
                }
                if (inode list in super block is empty)
                {
                        lock super block;
                        get remembered inode for free inode search;
                        search disk for free inodes until super block full,
                                or no more free inodes (algorithms bread and brelse);
                        unlock super block;
                        wake up (event super block becomes free);
                        if (no free inodes found on disk)
                                return (no inode);
                        set remembered inode for next free inode search;
                }
                /* there are inodes in super block inode list */
                get inode number from super block inode list;
                get inode (algorithm iget);
                if (inode not free after all)       /* !!! */
                {
                        write inode to disk;
                        release inode (algorithm iput);
                        continue;       /* while loop */
                }
                /* inode is free */
                initialize inode;
                write inode to disk;
                decrement file system free inode count;
                return (inode);
        }
}
```

Algorithm with explanation is expected

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Curriculum Scheme: Rev2016

Examination: TE Semester V

Course Code: CSDLO5013 and Course Name: Advanced Algorithm

Time: 2 hour Max. Marks: 80

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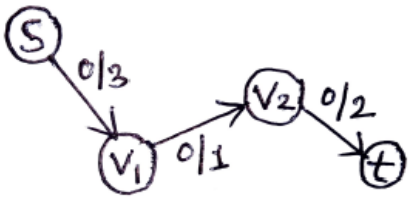
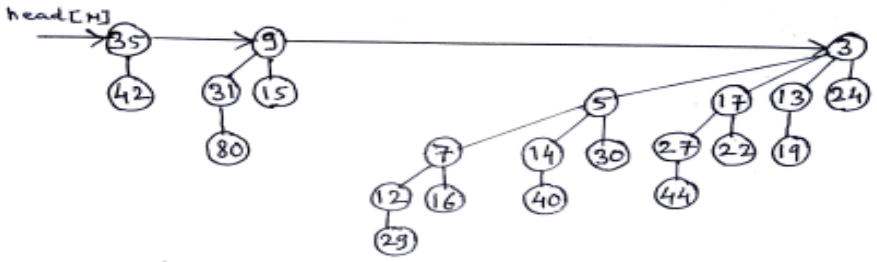
Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	In dynamic table, the amortized cost of the single operation is at the most -------
Option A:	2
Option B:	1
Option C:	3
Option D:	4
2.	In Hiring Problem, how many times a new office assistant will be hired if the input is considered in the order of rank of candidates where the order is <4, 5, 2, 6, 3, 7, 8, 9, 10, 1>
Option A:	5
Option B:	6
Option C:	8
Option D:	7
3.	A binomial tree B_k has ---
Option A:	K^2 nodes and the height of the tree is 2k
Option B:	(k+2) nodes and the height of the tree is (lg k)
Option C:	K nodes and the height of the tree is (k +2)
Option D:	2^k nodes and the height of the tree is k
4.	Let the capacity of the edge from vertex u to vertex v is 30 and flow from vertex u to vertex v is -10 (minus 10). The residual capacity C_f is ---------
Option A:	20
Option B:	30
Option C:	40
Option D:	50

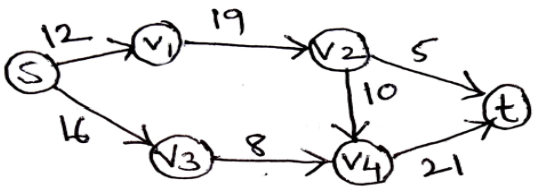
5.	In bipartite graph G = (V E), vertex set can be partitioned into V = P U Q where ---------- and all edges in E go between P and Q.
Option A:	P is subset of Q
Option B:	Q is subset of P
Option C:	$P \cap Q = \Phi$
Option D:	$P \cap Q \neq \Phi$
6.	The sweeping algorithm which takes n line segments as input and considers endpoints in sorted order have runtime complexity of ---------- to determine any pair of line segments intersects.
Option A:	O(n)
Option B:	O(n lg n)
Option C:	$O(n^2)$
Option D:	O(lg n)
7.	Let $A \leq p$ B. Which of the following statement is true?
Option A:	problems A and B are polynomial time equivalent
Option B:	problem B is polynomial time reducible to problem A
Option C:	problem A is polynomial time reducible to problem B.
Option D:	problem A cannot be reducible to Bin polynomial-time.
8.	In Aggregate analysis for sequence of n operations worst case time is T(n). In the worst case the amortized cost per operation is given by ----------
Option A:	n /T(n)
Option B:	T(n)/n
Option C:	T(n) * T(n)
Option D:	n * n
9.	In Red-Black tree, RB-DELTE_FIXUP procedure takes time ------- and performs at the most ----------rotations.
Option A:	O(n) and 2 rotations
Option B:	O(n) and 4 rotations
Option C:	O(lg n) and 3 rotations
Option D:	O(n lg n) and 1 rotations
10.	In relabel-to-front algorithm let f is preflow. The edge from vertex u to vertex v is admissible if and only if ----------

Option A:	Residual capacity of edge u to v is greater than zero and height of vertex u is larger than vertex v.
Option B:	Residual capacity of edge v to vertex u is greater than zero and height of vertex u is less than vertex v.
Option C:	Residual capacity of edge u to v and height of vertex u and vertex v is equal.
Option D:	Residual capacity and height both conditions need not be fulfilled.
11.	Those problems that can be solved in polynomial time known as ---------- problems.
Option A:	Decision
Option B:	Intractable
Option C:	Tractable
Option D:	Complete
12.	The convex hull of a set Q of points, denoted by CH(Q). If $\|Q\| \geq 3$ then at termination of Graham scan algorithm bottom to top content of stack is ---------
Option A:	Exactly the vertices of CH(Q) in counterclockwise order
Option B:	Exactly the vertices of CH(Q) in clockwise order
Option C:	All the vertices in CH(Q)
Option D:	All the vertices having same polar angle.
13.	The time complexity of the recurrence T(n) = 3T (n/3)+ n/2 by using master theorem is -----
Option A:	ɵ (n^2)
Option B:	ɵ(n log n)
Option C:	ɵ(log n)
Option D:	ɵ(n)
14.	Let Red-Black has n number of internal nodes. Then this tree has height at most ---------
Option A:	lg(n +1)
Option B:	n
Option C:	2 lg(n^2)
Option D:	2 lg(n+1)
15.	Which of the following statement is correct in case of hiring problem?
Option A:	Interviewing has higher cost than hiring.

Option B:	Interviewing and hiring both have equal cost.
Option C:	Interviewing has lower cost whereas hiring is expensive
Option D:	hiring has lower cost than Interviewing
16.	In Push-relabel algorithm the basic operation PUSH(u, v) that pushes flow from vertex u to vertex v applies if ----------
Option A:	u is an overflowing vertex, $C_f(u, v)>0$ and vertex u height = vertex v height + 1.
Option B:	v is an overflowing vertex, $C_f(v, u)>0$ and vertex v height = vertex u height + 1.
Option C:	u is an underflowing vertex, $C_f(u, v)>0$ and vertex u height = vertex v height + 1.
Option D:	v is an underflowing vertex, $C_f(v, u)>0$ and vertex v height = vertex u height + 1.
17.	Let M and N are the two vectors. If the cross product M X N = 0 then --------
Option A:	M and N are said to be colinear
Option B:	M is clockwise from N with respect to the origin (0,0)
Option C:	M is counterclockwise from N with respect to the origin (0,0)
Option D:	M and N are not related to each other.
18.	Suppose two problems A and B not known to be in NP. Let problem C be an NP-Complete problem. Problem A is polynomial-time reducible to C and problem C is polynomial-time reducible to problem B. Which one of the following statements is true?
Option A:	Problem A is NP-hard
Option B:	Problem A is NP-Complete
Option C:	Problem B is NP-hard
Option D:	Problem B is NP-Complete
19.	In the union of two binomial heaps H1 and H2, the root list of H1 and H2 is merged into a single linked list which is sorted by ----------
Option A:	Increasing order of the key value of the root nodes.
Option B:	Decreasing order of the key value of the root nodes.
Option C:	Decreasing order of the degree of the root nodes.
Option D:	Increasing order of the degree of the root nodes
20.	Deletion of a node in Red-Black tree takes ---------- time
Option A:	O(lg n)
Option B:	O(n)
Option C:	O(lg n)
Option D:	O(lg (lg n))

Q2 **(20 Marks)**	**Solve any Four out of Six (5 marks each)**
A	Show the red-black tree that result after successively inserting the keys 11, 10, 9, 4, 6, 1 into an initially empty red-black tree.
B	Explain how accounting method of amortized analysis is used to analyze the increment operation on a binary counter that starts at zero.
C	Use master method to find run time complexity of the following recurrence. $T(n) = 6T(n/3) + n^2 \log n$
D	Prove that vertex-cover problem is NP-complete
E	Consider the initial flow network as shown below. Find maximum flow from source vertex s to sink t using Relabel-to-front Algorithm. Consider initial vertex V_1 for discharge operation. 
F	Explain analysis of hiring problem using indicator random variable.

Q3. **(20 Marks)**	**Solve any Two Questions out of Three (10 marks each)**
A	Write steps to extract the node with minimum key from binomial heap. Extract the node with minimum key from following binomial heap. Show each step clearly. 
B	Use recursion tree method to find time complexity of the following recurrence. $T(n) = T(n/4) + T(n/2) + cn^2$
C	What is maximum flow in the given network from source s to sink t by Ford Fulkerson algorithm? Show all the flow networks, residual networks and augmented paths.

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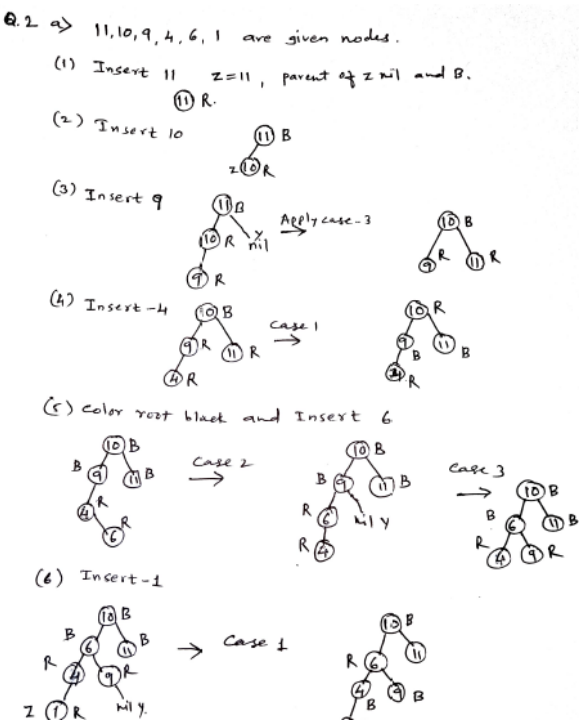
Question Number	Correct Option (Enter either 'A' or 'B' or 'C' or 'D')
Q1.	C
Q2.	D
Q3.	D
Q4	C
Q5	C
Q6	B
Q7	C
Q8.	B
Q9.	C
Q10.	A
Q11.	C
Q12.	A
Q13.	B
Q14.	D
Q15.	C
Q16.	A
Q17.	A
Q18.	C
Q19.	D
Q20.	A

Q. 2 A. (For correct tree after each element insertion 1 Mark.)

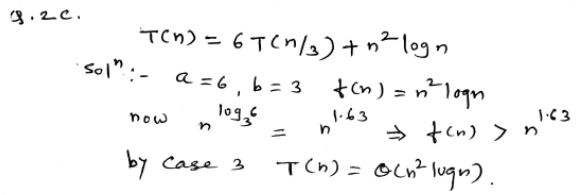


B. (Explanation of cost considered for operation – 2 Marks. Explanation of amortized analysis with example- 3 Marks)

The running time of this operation is proportional to the number of bits flipped. Use this as cost. For the amortized analysis, let us charge an

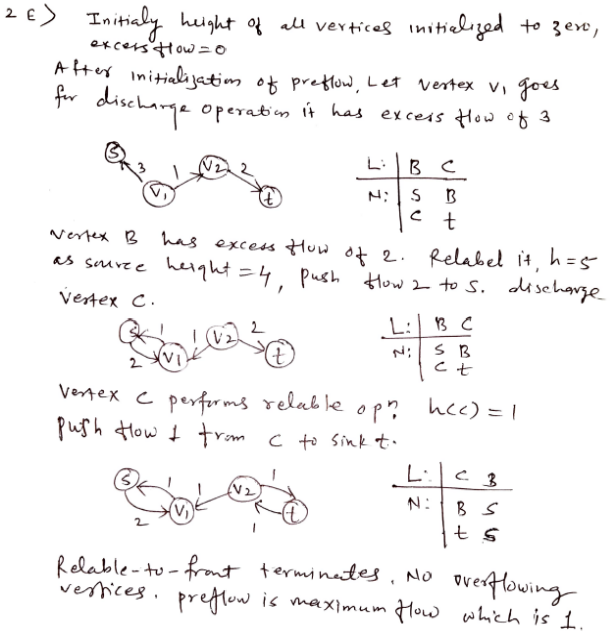
amortized cost of 2 dollars to set a bit to 1. When a bit is set, we use 1 dollar (out of the 2 dollars charged) to pay for the actual setting of the bit, and we place the other dollar on the bit as credit to be used later when we flip the bit back to 0. At any point in time, every 1 in the counter has a dollar of credit on it, and thus we needn't charge anything to reset a bit to 0; we just pay for the reset with the dollar bill on the bit.
The amortized cost of INCREMENT can now be determined. At most one bit is set, therefore the amortized cost of an INCREMENT operation is at most 2 dollars. The number of 1's in the counter is never negative, and thus the amount of credit is always nonnegative. Thus, for *n* INCREMENT operations, the total amortized cost is *O(n)*, which bounds the total actual cost.

C. (For correct answer-5 marks)



D.
(For proving VERTEX-COVER ∈ NP. (1 M). For proving vertex-cover problem is NP-hard by showing that CLIQUE ≤P VERTEX-COVER based on the notion of the "complement" of the graph (4 M))

2. E. (Initialization of height and excess flow – 1 marks, For discharge operation and showing linked list and neighbor list- 4 marks)



2 F. (Defining random variable – 1 Mark, Defining indicator random variable for candidate i- 2 marks, E[X] calculation for n variables-2 marks)

Let *X* be the random variable whose value equals the number of times we hire a new office assistant.

$$\mathrm{E}[X] = \sum_{x=1}^{n} x \Pr\{X = x\}$$

Define n variables related to whether or not each particular candidate is hired. Suppose X_i be the indicator random variable associated with the event in which the i^{th} candidate is hired.

$$X_i = \mathrm{I}\{\text{candidate } i \text{ is hired}\} = \begin{cases} 1 & \text{if candidate } i \text{ is hired}, \\ 0 & \text{if candidate } i \text{ is not hired}, \end{cases}$$

and

$$X = X_1 + X_2 + \cdots + X_n .$$

$$\mathrm{E}[X_i] = \Pr\{\text{candidate } i \text{ is hired}\}$$

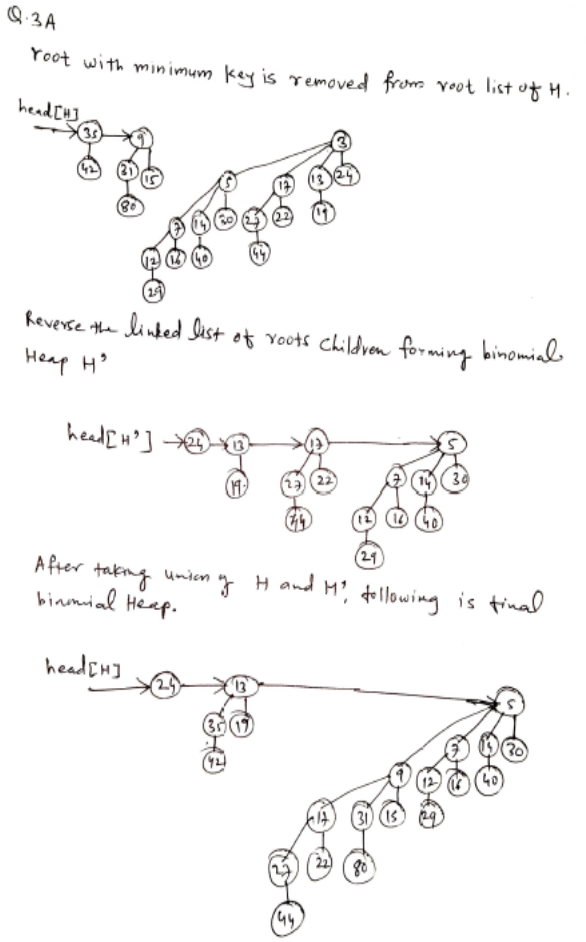
$$\mathrm{E}[X_i] = 1/i .$$

Now we can compute $\mathrm{E}[X]$:

$$\begin{aligned} \mathrm{E}[X] &= \mathrm{E}\left[\sum_{i=1}^{n} X_i\right] \\ &= \sum_{i=1}^{n} \mathrm{E}[X_i] \\ &= \sum_{i=1}^{n} 1/i \\ &= \ln n + O(1) \end{aligned}$$

Q. 3 A. (For each step – 1 mark. 4 marks for writing steps. In example, for removal of minimum key element and making binomial heap H'- 2 Mark, Showing heap after reversing order of the linked list of removed minimum keys children. For final Heap- 2 marks)

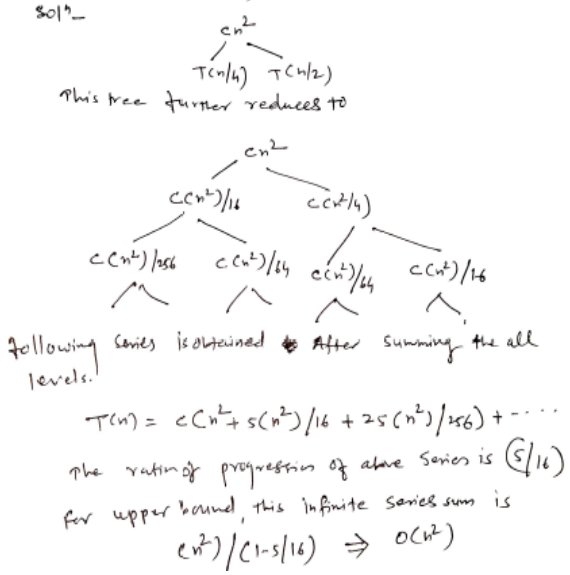
1 find the root x with the minimum key in the root list of H, and remove x from the root list of H
2 Make Binomial Heap H'
3 Reverse the order of the linked list of x's children, and set head[H'] to point to the head of the resulting list
4 H ← BINOMIAL-HEAP-UNION(H, H')
5 return x



Q.3 B. Recursion-Tree-Method

$T(n) = T(n/4) + T(n/2) + cn^2$

Soln-



$T(n) = c(n^2 + 5(n^2)/16 + 25(n^2)/256) + \cdots$

The ratio of progression of above series is $(5/16)$

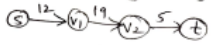
For upper bound, this infinite series sum is

$(n^2)/(1-5/16) \Rightarrow O(n^2)$

Q. 3. C.

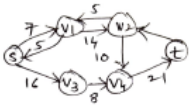
(For selecting each augmenting path and showing flow network and residual network – 3 marks. For three augmenting path total 9 marks. For maximum flow answer 1 mark.

(i) Consider augmenting path



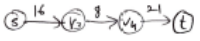
max flow = 5

flow network

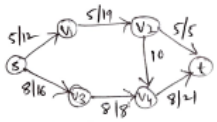


Residual network

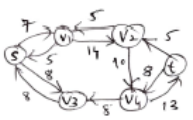
(2) consider the augmenting path in Residual network



max flow = 8



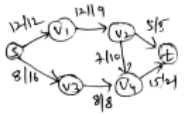
flow network



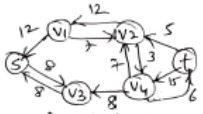
Residual network

(3) consider augmenting path in Residual network

max flow = 7



flow network



Residual n/w.

Maximum flow = 5 + 8 + 7 = 20