Govt. of Karnataka, Department of Technical Education
Diploma in Information Science
Sixth Semester

Subject: Information Storage and Management

Contact Hrs / week: 4 **Total hrs: 64**

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		64	**140 + 5 Objectives**

Details of Contents

1			**Introduction to Information Storage and Management**	
	1.1		Information Storage	
		1.1.1	Data	
		1.1.2	Types of Data	
		1.1.3	Information	
		1.1.4	Storage	
	1.2		Evolution of Storage Technology and Architecture	
	1.3		Data Center Infrastructure	
		1.3.1	Core Elements	
		1.3.2	Key Requirements for Data Center Elements	

		1.3.3	Managing Storage Infrastructure	
	1.4		Key Challenges in Managing Information	
	1.5		Information Lifecycle	
		1.5.1	Information Lifecycle Management	
		1.5.2	ILM Implementation	
		1.5.3	ILM Benefits	
2			**Direct-Attached Storage and Introduction to SCSI**	
	2.1		Types of DAS	
		2.1.1	Internal DAS	
		2.1.2	External DAS	
	2.2		DAS Benefits and Limitations	
	2.3		Disk Drive Interfaces	
		2.3.1	IDE/ATA	
		2.3.2	SATA	
		2.3.3	Parallel SCSI	
	2.4		Introduction to parallel SCSI	
		2.4.1	Evolution of SCSI	
		2.4.2	SCSI interfaces	
		2.4.3	SCSI -3 Architecture	
		2.4.4	Parallel SCSI Addressing	
	2.5		SCSI Command model	
		2.5.1	CDB Structure	
		2.5.2	Operation Code	
		2.5.3	Control Field	
		2.5.4	Status	
3			**Storage System Environment**	
	3.1		Components of a Storage System Environment	
		3.1.1	Host	
		3.1.2	Connectivity	
		3.1.3	Storage	
	3.2		Disk Drive Components	
		3.2.1	Platter	
		3.2.2	Spindle	
		3.2.3	Read/Write Head	
		3.2.4	Actuator Arm Assembly	
		3.2.5	Controller	
		3.2.6	Physical Disk Structure	
		3.2.7	Zoned Bit Recording	
		3.2.8	Logical Block Addressing	
	3.3		Disk Drive Performance	
		3.3.1	Disk Service Time	
	3.4		Logical Components of the Host	
		3.4.1	Operating System	
		3.4.2	Device Driver	
		3.4.3	Volume Manager	

		3.4.4	File System	
		3.4.5	Application	
4			**Data Protection: RAID**	
	4.1		Implementation of RAID	
		4.1.1	Software RAID	
		4.1.2	Hardware RAID	
	4.2		RAID Array Components	
	4.3		RAID Levels	
		4.3.1	Striping	
		4.3.2	Mirroring	
		4.3.3	Parity	
		4.3.4	RAID 0	
		4.3.5	RAID 1	
		4.3.6	Nested RAID	
		4.3.7	RAID 3	
		4.3.8	RAID 4	
		4.3.9	RAID 5	
		4.3.10	RAID 6	
	4.4		RAID Comparison	
	4.5		RAID Impact on Disk Performance	
		4.5.1	Application IOPS and RAID Configurations	
	4.6		Hot Spares	
5			**Intelligent Storage System**	
	5.1		Components of an Intelligent Storage System	
		5.1.1	Front End	
		5.1.2	Cache	
		5.1.3	Back End	
		5.1.4	Physical Disk	
	5.2		Intelligent Storage Array	
		5.2.1	High-end Storage Systems	
		5.2.2	Midrange Storage System	
6			**Storage Area Networks**	
	6.1		Fibre Channel: Overview	
	6.2		The SAN and Its Evolution	
	6.3		Components of SAN	
		6.3.1	Node Ports	
		6.3.2	Cabling	
		6.3.3	Interconnect Devices	
		6.3.4	Storage Arrays	
		6.3.5	SAN Management Software	
	6.4		FC Connectivity	
		6.4.1	Point-to-Point	
		64.2	Fibre Channel Arbitrated Loop	
		6.4.3	Fibre Channel Switched Fabric	
	6.5		Fiber Channel Ports	

	6.6		Fibre Channel Architecture	
		6.6.1	Fibre Channel Protocol Stack	
		6.6.2	Fibre Channel Addressing	
		6.6.3	FC Frame	
		6.6.4	Structure and Organization of FC Data	
		6.6.5	Flow Control	
		6.6.6	Classes of Service	
	6.7		Zoning	
	6.8		Fibre Channel Login Types	
	6.9		FC Topologies	
		6.9.1	Core-Edge Fabric	
		6.9.2	Mesh Topology	
7			**Network-Attached Storage**	
	7.1		1General-Purpose Servers vs. NAS Devices	
	7.2		Benefits of NAS	
	7.3		NAS File I/O	
		7.3.1	File Systems and Remote File Sharing	
		7.3.2	Accessing a File System	
		7.3.3	File Sharing	
	7.4		Components of NAS	
	7.5		NAS Implementations	
		7.5.1	Integrated NAS	
		7.5.2	Gateway NAS	
		7.5.3	Integrated NAS Connectivity	
		7.5.4	Gateway NAS Connectivity	
	7.6		NAS File-Sharing Protocols	
		7.6.1	NFS	
		7.6.2	CIFS	
	7.7		NAS I/O Operations	
		7.7.1	Hosting and Accessing Files on NAS	
		7.7.2	Factors Affecting NAS Performance and Availability	
8			**Content Addressed Storage**	
	8.1		Fixed Content and Archives	
	8.2		Types of Archives	
	8.3		Features and Benefits of CAS	
	8.4		CAS Architecture	
	8.5		Object Storage and Retrieval in CAS	
	8.6		CAS Example	
		8.6.1	Health Care Solution: Storing Patient Studies	
9			**Storage Virtualization**	
	9.1		Forms of Virtualization	
		9.1.1	Memory Virtualization	
		9.1.2	Network Virtualization	
		9.1.3	Server Virtualization	

		9.1.4	Storage Virtualization	
	9.2		SNIA Storage Virtualization Taxonomy	
	9.3		Storage Virtualization Configurations	
	9.4		Storage Virtualization Challenges	
		9.4.1	Scalability	
		9.4.2	Functionality	
		9.4.3	Manageability	
		9.4.4	Support	
	9.5		Types of Storage Virtualization	
		9.5.1	Types of Storage Virtualization	
		9.5.2	Block-Level Storage Virtualization	
		9.5.3	File-Level Virtualization	
10			**Backup and Recovery**	
	10.1		Backup Purpose	
		10.1.1	Disaster Recovery	
		10.1.2	Operational Backup	
		10.1.3	Archival	
	10.2		Backup Considerations	
	10.3		Backup Granularity	
	10.4		Recovery Considerations	
	10.5		Backup Methods	
	10.6		Backup Process	
	10.7		Backup and Restore Operations	
	10.8		Backup Topologies	
		10.8.1	Serverless Backup	
	10.9		Backup in NAS Environments	
	10.10		Backup Technologies	
		10.10.1	Backup to Tape	
		10.10.2	Physical Tape Library	
		10.10.3	Backup to Disk	
		10.10.4	Virtual Tape Library	

Text book:

1. Information Storage and Management Storing, EMC education Servies, Wiley India Edition, ISBN: 9788126521470

Reference

1. Storage Networks Explained, Ulf Tropan, Rainer Erkens, Wofgang Muller, Wiley, ISBN: 9788126518326

General Objectives:

1. To Understand the Concept of Information Storage, Environment & Protection
2. To Know Direct Attached Storage & Intelligent Storage System
3. To Understand SAN with NAS & CAS
4. To Understand Storage Virtualization
5. To Know the Back up Recovery Technologies

Specific Objectives:

1	**Introduction to Information Storage and Management**
	Learn information storage types
	Evolution storage technologies
	What is the data center infrastructure
	To learn Challenges information management and Life cycle
2	**Direct-Attached Storage & Introduction to SCSI**
	Learn the Different types of DAS
	Narrate benefits & limitations DAS
	Classification of Disk Drive Interfaces
	Learn parallel SCSI with its Types & Command model
3	**Storage System Environment**
	Listing out Components of Storage System Environment
	Elaborate Disk Drive Component
	Learn the fundamentals Laws of governing Laws of Disk Performance
	Illustrates logical components of the host
4	**Data Protection: RAID**
	Learn implementation of RAID
	Classification RAID Levels
	RAID impact performance Analysis
5	**Intelligent Storage System**
	Learn component of Intelligent Storage System
	List the Intelligent Storage Array
6	**Storage Area Networks**
	Learn SAN its Evolution
	Learn Components of SAN
	FC connectivity
	Learn Fiber Channel Architecture
	FC Topologies
7	**Network-Attached Storage**
	General Purpose Server

	Benefits of NAS
	NAS file I/O
	What are the Components of NAS
	Different Types of NAS implementation
	Types of NAS , File Sharing Protocols
	I/O Operation of NAS
8	**Content Addressed Storage**
	Learn the types of Archives
	Learn features & Benefits of CAS
	Architecture of CAS
	Learn Object Storage & Retrieval in CAS
	AN Example case Study on CAS
9	**Storage Virtualization**
	Learn Different forms of Virtualization
	Virtualization Taxonomy
	Virtualization Configuration
	Virtualization Challenges
	Storage Virtualization Types
10	**Backup and Recovery**
	Learn Purpose of Back up
	Back up consideration & Granularity
	Recovery consideration , methods & Process
	Restore operation
	Topologies of Back up
	NAS Environment Back up
	Learn Backup Technologies

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Model Question Paper

Note: 1. Section –I is compulsory.
2. Answer any TWO questions from each remaining Sections.

Section - I

1 a. Fill in the blanks
5x1=5

i.

ii.

iii.

iv.

v

b).Write a note on Key requirement for data center elements 5

Section – II

2. a).What are the characteristics of ILM? Explain. 5

b).What are the Benefits & limitation of DAS 5

c).Explain SCSI-3 Architecture 5

3 a). Write a note on the Physical component of Connectivity 5

b). What is meant by Zoned bit Recording? 5

c). How to measure the Disk Drive Performance? Explain 5

4 a). Explain the concept of mirroring in RAID 5

b). what is the significance of Parity in RAID ? 5

c). Explain how RAID 4 is different from RAID 3 5

Section-III

5	a). Explain the components of Intelligent storage System	10
	b). Write a note on Mid range storage System	5
6	a). Define SAN. Explain its Evolution	5
	b). Write a note on Fiber Channel Arbitrated loop	5
	c). What is meant by Zoning ? Explain	5
7.	a). Explain Fiber Channel Protocol Stack	10
	b). What are the Benefits of NAS ? Explain	5
	c). Compare NFS with CIFS	5

Section -IV

8.	a). Explain the steps involved in hosting & accessing files on NAS	5
	b). Explain CAS Architecture	10
9.	a). Write a note on Server Virtualization	7
	b). Explain file level Virtualization	8
10.	a).Explain three Back up Topologies	10
	b). Write a note on Virtual tape library	5