Solution	Marks
Q.2 a. Discuss the various functions of a switching system.	**8**
Ans: Page No.56 &57 in text Book II	
b.List out the advantages and disadvantage of strowger switching system	**8**
Ans: Advantages: i) Inexpensive for small system ii) Highly reliable due to the distributed nature of equipment.	03
Disadvantages: 1. As this switching involves heavy mechanical displacements, regular maintenance by the skilled technicians is necessary. 2. It is not feasible to select an alternate route for interoffice calls, if all the trunks are busy as the switching is by step through various selectors. 3. Step by step switching is limited to dial pulses. For touchtone telephones, special devices have to be introduced between line finder and first selector to convert the tones into dial pulses. 4. If calling rate is high, heavy operation is performed by the system and the life time of the system is less. 5. The last two digits of the called line numbers are specifically determined by their location on the connector. Congestion could arise when the switching system is heavily loaded. 6. The capacity of switching system reduces if codes of different numbers are allotted to various subscribers, such as fire service, police ambulance, fault regorts, directory enquiry, operator assistance etc. In certain cases, the exchange capacity may be reduced from 10000 to even 6000 customer lines. 7. The strowger system can accept only 7 to 9 pulses in 1 second. Hence if we dial fast, the system cannot give correct performance.	05
Q.3 a. A group of 7 trunks is offered 4E of traffic, find (a) the grade of service (b)the probability that only one trunk is busy (c) the probability that only one trunk is free and (d) the probability that at least one trunk is free.	**8**
Ans: N = 7, A = 4E $P(N) = B(N, A) = \frac{A^N}{N! \sum_{k=0}^{N} \left(\frac{A^k}{k!}\right)}$	

(*a*) $$B(7, 4) = \frac{4^7}{7!\left[1+\frac{4}{1}+\frac{4^2}{2!}+\frac{4^3}{3!}+\frac{4^4}{4!}+\frac{4^5}{5!}+\frac{4^6}{6!}+\frac{4^7}{7!}\right]}$$ 02

$$= \frac{16384}{5040\,[1+4+8+21.3+10.6+8.5+5.7+3.25]}$$

$$B = 0.052 = \text{GOS}.$$

(*b*) The probability of only one trunk is busy 02

$$P(k) = \frac{A^k / k!}{\sum_{k=0}^{N} (A^k / k!)}$$

For $k = 1$ $$P(1) = \frac{4/1!}{62.35} = 0.064$$

(*c*) The probability that only one trunk is free 02

$$P(6) = \frac{4^6/6!}{62.35} = \frac{5.68}{62.35} = 0.0912$$

(*d*) The probability that at least one trunk is free 02

$$P(k < 7) = 1 - P(7) = 1 - B = 1 - 0.052 = 0.948.$$

b. Define loss system and delay system. **2**

Ans: The type of system by which a blocked call is simply refused and is lost is called **loss system.** In the second type of system, a blocked call remains in the system and waits for a free line. This type of system is known as **delay system.** 1+1

c. Define Cent Call Seconds (CCS) and Grade of Service (GOS). **6**

Ans: Cent call seconds:

It is also referred as hundred call seconds. CCS as a measure of traffic intensity is valid only in telephone circuits. CCS represents a call time product. This is used as a measure of the amount of traffic expressed in units of 100 seconds. Sometimes call seconds (CS) and call minutes (CM) are also used as a measure of traffic intensity. The relation between erlang and CCS is given by 03

1E = 36 CCS = 3600 CS = 60 CM

Grade of Service (GOS):

For non-blocking service of an exchange, it is necessary to provide as many lines as there are subscribers. But it is not economical. So, some calls have to be rejected and retried when the lines are being used by other subscribers. The grade of service refers to the proportion of unsuccessful calls relative to the total number of calls. GOS is defined as the ratio of lost traffic to offered traffic. 03

GOS =Blocked Busy Hour calls/Offered Busy Hour calls

Q.4 a. A three stage switching structure supports 100 inlets and 400 outlets. Find (i) the number of cross points (ii) the number of primary and secondary switches used in the design. **8**

Ans: We know that

m = M/M+N and n = N/M+N

m = 100

1. if m=5, n=20, there are :
20 primary switches of size 5 x 5 04
5 secondary switches of size 20 x 20
20 tertiary switches of size 5 x 20

2. if m = 4, n =16, there are:
25 primary switches of size 4 x 4
4 secondary switches of size 25 x 25 04
25 tertiary switches of size 4 x 16

b. What are single stage and multistage switching networks? Compare the strengths and weaknesses of each. **8**

Sr. No.	Single stage	Multistage
1	Inlet to outlet connection is through a single cross point.	Inlet to Outlet connection is through multiple cross points
2	Use of single cross point per connection results in better quality link.	Use of multiple cross points may degrade the quality of a connection.
3	Each individual cross point can be used for only one inlet/outlet pair connection.	Same cross point can be used establish connection between a number of inlet/outlet pairs.
4	A specific cross point is needed for each specific connection.	A specific connection may be established by using sets of cross points.
5	If a cross points fails, associated connection cannot be establish- There is no redundancy.	Alternative cross-points and paths are available.
6	Cross points are inefficiently used. Only one cross point in each row or column of a square or triangular switch matrix is even in use, even if all the lines are active.	Cross points are used Efficiently
7	Number of cross points is Prohibitive	Number of cross points is reduced significantly
8	The network is non blocking in character	The network is blocking in character

08

Q.5 a. Draw and explain Space Division Switching in detail. **8**

Ans: Space Switches:

Connections can be made between incoming and outgoing PCM highways by means of a cross point matrix of the form shown in Fig. However, different channels of an 04

incoming PCM frame may need to be switched by different cross points in order to reach different destinations. The cross point is therefore a two-input AND gate. One input is connected to the incoming PCM highway and the other to a connection store that produce a pulse at the required instant. A group of cross points gates can be implemented as an integrated circuit, for example by using a multiplexer chip.
Fig. shows a space switch with k incoming and m outgoing PCM highways, each carrying n channels. The connections store for each column of cross points is a memory with an address location for each time-slot, which stores the number of the cross points to be operated in that time slot. This number is written into the address by the controlling processor in order to setup the connection. The numbers are read out cyclically, in synchronism with the incoming PCM frame. In each time slot, the number stored at the corresponding store address is read out and decoding logic converts this into a pulse or a single lead to operate the relevant cross point.
Since a cross point can make a different connection in each of the n time-slots, it is equivalent to n cross points in a space division network. The complete space switch is thus equivalent to n separate k x m switches in a space division switching network. 04

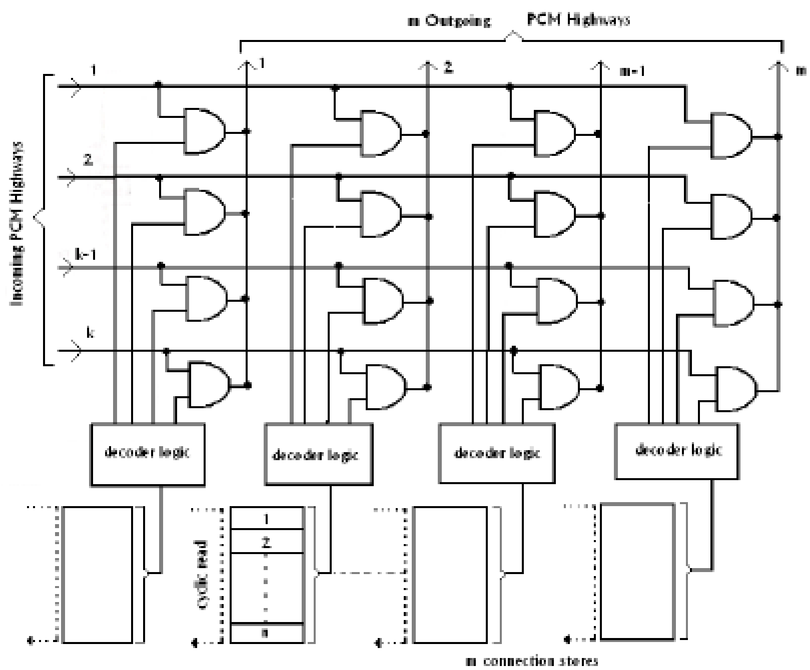
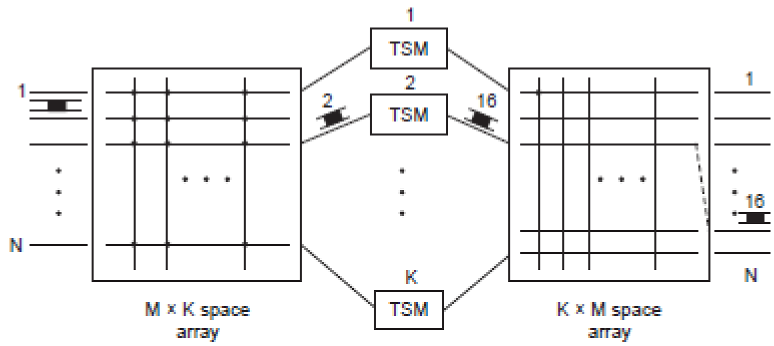


FIG – Space Switch.

b. Explain and compare T-S-T and S-T-S switching techniques. **8**

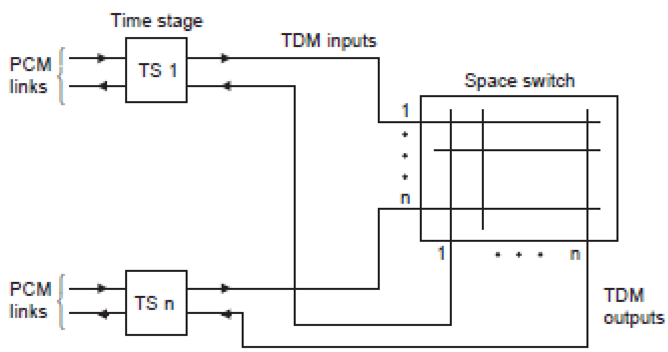
Ans: STS Switching.
In STS switching, the time stage is sandwiched between two space arrays. The digital switching system ITS 4/5 of USA (1976) uses the STS switching configuration. It handles 3000 trunks and accommodates 1500 Erlangs of traffic. Fig. shows the space time- space (S-T-S) switching network for M incoming and outgoing PCM highways. 03



Establishing a path through an STS switch requires finding a time switch array with an available unit's access during the incoming time slot and an available read access during the desired outgoing time slot. The input side space stage as well as the output side space stage is free to utilise any free time switch modules. In the diagram shown in Fig the time slot 2 is connected to the TSM 2 where the time slot allotted is 16 and passed to the (M – 1)th line of output space array. Thus the path is provided. This structure is of non-blocking nature.

TST Switching:

In TST switching the space stage is sandwiched between two time stage switches. Of all the multistage switching, TST is a popular one. The principle of operation of TST switching is shown in Fig. In figure, two flows of time slots, one for each direction are connected together. 03

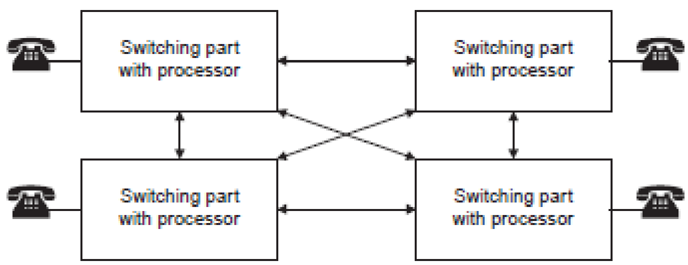


The information arriving at the incoming link of TDM channel is delayed in the· inlet times stage until an appropriate path through the space stage is available. Then the information is transferred through the space stage to the appropriate outlet time stage. Here the information is held until the desired outgoing time slot occurs. Any space stage time slot can be used to establish a connection. The space stage operates in a time divided fashion, independently of the external TDM links. There are many alternative paths between a prescribed input and output unlike a two stage network which has only one fixed path. 02

Q.6 a. Define Stored Program Control (SPC) and explain the distributed SPC in detail with the help of a diagram. **8**

Ans: In stored program control systems, a program or set of instructions to the computer is stored in its memory and the instructions are executed automatically one by one by the processor. Carrying out the exchange control functions through programs 02 stored in the memory of a computer led to this name.

Distributed SPC:
The introduction of distributed SPC enabled customers to be provided with a wider range of services than those available with centralised and electromechanical switching system. Instead of all processing being performed by a one or two processor in centralised switching, functions are delegated to separate small processors (referred as regional processors). But central processors are still required to direct the regional 04
processors and to perform more complex tasks. The distributed SPC offers better availability and reliability than the centralised SPC. Entire exchange control functions may be decomposed either horizontally or vertically for distributed processing. In vertical decomposition, the exchange environment is divided into several blocks and each block is assigned to a processor that performs all control functions related to that block of equipments. In horizontal decomposition, each processor performs one or some of the exchange control functions. Figure shows the distributed control where switching equipment is divided into parts, each of which has its own processor.



02

b. Enlist & explain the various steps involved in processing a call.

Ans:

1. **Idle state.** At this state, the subscriber handset is in 'on-hook' condition. The exchange is ready to detect the call request from the subscriber. **8**
2. **Call request identification.** The exchange identifies a line requiring for a service. When the handset is lifted, current flows in the line called seize signal indicates the call request.
3. **Providing dial tone.** Once the seize signal is received, an exchange sends a dial tone to the calling subscriber to dial the numbers.
4. **Address analysis.** Once the first digit received, the exchange removes the dial tone and collects all numbers. Then the address is analysed for the validity of the number, local, STD or ISD etc. If the number is invalid, a recorded message may be sent to the 08
calling subscriber and terminates call request.
5. **Called line identification.** The exchange determines the required outgoing line termination from the address that it has received.
6. **Status of called subscriber.** The called line may be busy or free or unavailable or even out of service. In the case of PBX, where the customer have a group of lines, the exchange tests each termination until either it finds a free one or all one found busy. For busy, number unobtainable or the handset off hook, a status signal or call progress signal is sent to the calling subscribers for line termination. Now the exchange resumes idle state.
7. **Ringing.** Once, the exchange finds the called subscriber is free, power ringing is

provided to the called subscriber and audible ringing to the calling subscriber.

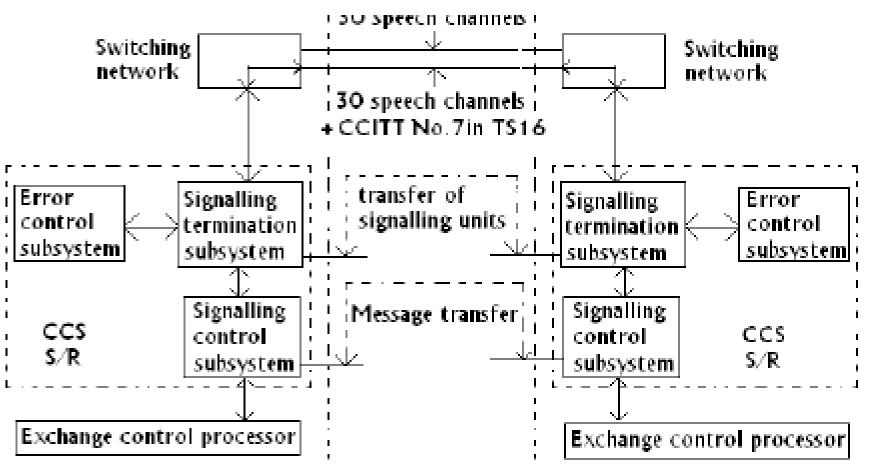
8. **Path setup.** When the called subscriber lifts his handset, the line is looped and ringing is removed. Once the conversation started, the exchange completes the connections between the subscribers.

9. **Supervision.** The exchange supervises the connection to detect the end of the call for charging.

10. **Clear signal.** Once the need for connection is over, either customer may replace his handset. It causes the line current seize and provides a clear signal to exchange. If the calling subscriber replaces his phone set, the clear signal sent to the exchange is called clear forward signal. If called subscriber do first, the clear signal is called clear backward signal.

Q.7 a. Describe the architecture of SS7 common channel signalling network with the help of a neat labelled diagram. **8**

Ans: A block schematic diagram of the CCITT no. 7 signalling system is shown in fig. Signal messages are passed from the central processor of the sending exchange to the CCS system. This consists of the microprocessor based subsystem. The signalling control subsystems, the signalling termination subsystem and the error control subsystem. The signalling control subsystem structures the messages in the appropriate format and queues them for transmission. When there are no messages to send, it generates filler messages to keep the link active. Messages then passed to the signalling termination sub system, where complete signal units (SU) are assembled using sequence numbers and check bits generated by the error control subsystem. At the receiving terminal, the reverse sequence is carried out. The levels are as follows: 04



04

Level 1: The Physical Layer
Level 2: The Data Link Level
Level 3: The signalling network level
Level 4: The User Part

The relationship between these levels and the layers of the OSI model is shown in Fig. The user part encompasses layers 4 to 7 of the OSI model. Level 1 is the means of sending bit streams over a physical path. It uses times lot 16 of a 2 Mbit/s PCM system or times slot 24 of a 1.5 M bit/s system. Level 2 performs the functions of error control, link initialization, error rate monitoring, flow control and delineation of messages. Level 3 provides the functions required for a signalling network. Each node in the network has a single point odd, which is a 14 bit address. Every message contains a point code of the originating and terminating nodes for that messages. Levels 1 to 3 form the message transfer part (MTP) of CCITT no. 7. Level 4 is the user part. This consists of the processes for handling the service being supported by the signalling system. The message transfer part is capable of supporting many different user parts. So far, three have been defined: the telephone user part(TUE), the data user part (DUP) and the (ISDN) user part (ISDN-UP).

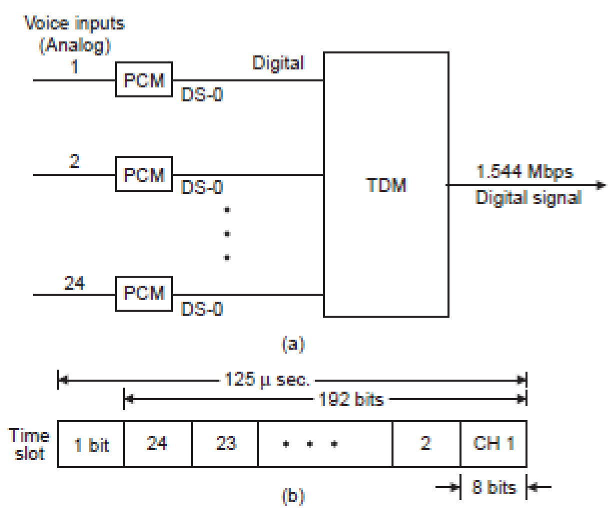
b. Explain architecture of T1 link and DS-1 frame format in relation to the PCM signalling **8**

Ans:

In PCM systems, signalling and speech are sampled, coded and transmitted within the frame of PCM channels. Thus, with PCM, a convenient way of transmission is possible. The signalling information and speech information carried in the same time slot is referred as inslot signalling. The signalling information carried in a separate time slot is referred as outslot signalling. The timeslot of the inslot signalling is fixed at eight bits. As one bit is used for signalling, the speech bit rate is reduced to 56 kbps from 64 kbps and the bandwidth is reduced. Telephone channels are combined by time division multiplexing to form an assembly of 24 or 30 channels. This is known as primary multiplex group. 04

DS1 24 channel system.

DS0 is a 64-kbps signal that makes up the basis for the DS1. Twenty four DS0s combined to produce DS1. Fig shows the architecture of a T1 link and DS-1 frame format.



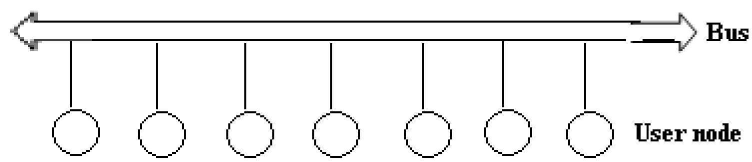
04

Incoming analog signals were time division multiplexed and digitized for transmission. Each individual TDM channel is assigned 8 bits per time slot. Each frame is made of 24 × 8 bits = 192 bits plus one additional bit added to each frame to identity the fame boundaries. Thus each frame contains 193 bits. The frame interval is 125 micro sec. Hence the basic T1 line rate is 1.544 Mbps. This line rate has been established as the fundamental standard for digital transmission.

Q.8 a. Explain and compare bus and ring topology used in LAN technology.	**8**

Ans: Bus Topology:

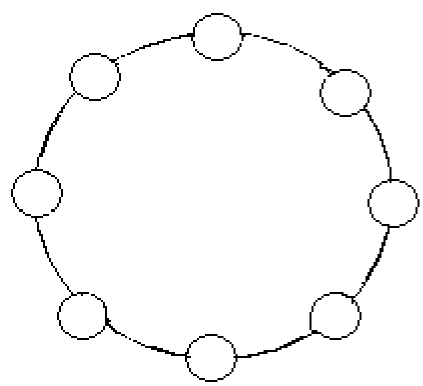
This topology shares a single link or path way among all users. This common single path way is known as bus. In this topology, the link serves as a high way for all data signals, and users connect on to the bus at their node location. In bus configurations, network control is not centralized to a particular node. Here control is distributed among all nodes connected to the LAN. Data transmission on a bus network is usually in the form of small packets containing user addresses and data. When one node/user desires to transmit data to another station, it monitors the bus to determine if it is currently being used. If no other nodes/users are communicating over the network, the monitoring node/user can start to transmit its data. Each node must monitor all transmission on the network and determine which are intended for them. 04



Bus network

Ring Topology:

In ring topology, all user nodes are connected with the physical path acting as links of a chain and the last user node is connected back to the first node. A signal going on to the next node must be processed by the first node, which then passes it through to the next node. Adding a new user requires breaking the ring temporarily, inserting the new node and then re-establishing the complete ring path. 04



(d) ring network

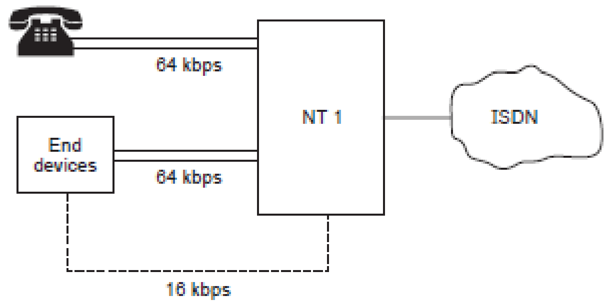
b. Explain the advantages and services offered by Asynchronous Transfer Mode (ATM)	**8**

Ans:

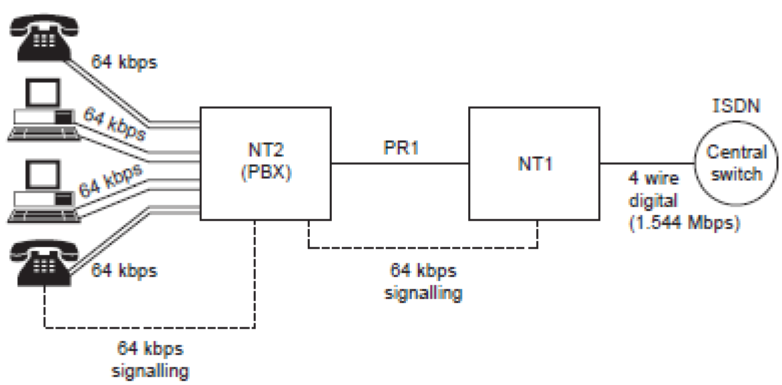
The most important advantages or benefits of the ATM are:

1. A much wider array of information can be transmitted using ATM technology, for example, voice, data, images, CATV scans, MRI images and video conferencing.
2. ATM delivers bandwidth on demand, is not dependent on applications and works at a data rate from 1.5 Mbps to 2 Gbps.

3. All types of networking, from LANs to WANs and from backbone to desktop can be integrated by ATM technology. 4. The service is connection oriented, with data transferred over a virtual circuit. 5. ATM switches are statistical multiplexing. 6. Higher quality of service. 7. Wider array of information can be handled. 8. Accepts variety of transmission media such as optical fiber or twisted pair cable. 9. Works with current LAN and WAN technologies and supports current protocols such as TCP/IP.	04
ATM Services. ATM forum specifies five types of services. They are: 1. **Constant bit rate (CBR).** This is used for emulating circuit switching. The cell rate is constant with time. Telephone traffic, videoconferencing and television are the examples that use CBR. 2. **Variable bit rate–non real time (VBR–NRT).** This service allows users to send traffic at a rate that varies with time depending on the availability of user information. Multimedia email is an example of VBR–NRT. 3. **Variable bit rate–real time (VBR–RT).** This service is similar to VBR–NRT, but it is designed for applications that are sensitive to cell delay variation. Examples for real time VBR are voice with speech activity detection (SAD) and interactive compressed video. 4. **Available bit rate (ABR).** This service provides rate based flow control and is aimed at data traffic such as file transfer and e-mail. 5. **Unspecified bit rate (UBR).** This class is widely used today for TCP/IP.	04
Q.9 a. Explain Primary Rate Interface (PRI) and Basic Rate Interface (BRI) of ISDN.	**6**
Ans: **Basic Rate Interface (BRI):** BRI is made up of two B-channels (Bearer channels) and one D channel. Therefore the total rate is 2B + D. B channels are 64 kbps and can be used for voice and data communications. The D channel is 16 kbps and is used for call initialization and signalling connections. Fig. 12.2 shows ISDN BRI. BRI is the most appropriate type of ISDN service for computer connections and individual use. Of three digital channels (2B + D), of each of the channels can be used simultaneously. Thus a subscriber can perform several communications tasks at the same time. BRI is designed to carry the most data possible to the home through existing copper phone lines.	03



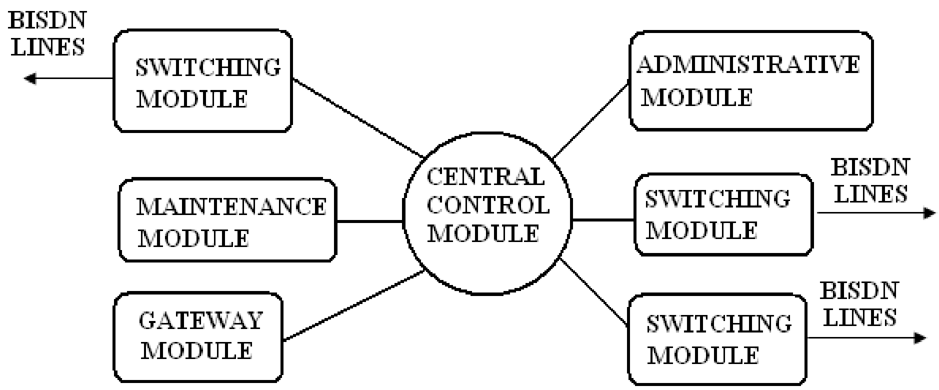
Primary Rate Interface (PRI):
PRI in North America has 23 B channels and one 64 K D channel or the total rate is 23 B + 1D, having a total bandwidth 1.544 Mbps. (including 8 kbps of overhead) PRI in rest of the world uses 30 B channels and one D channel or 30 B + D with total rate of 2.048 Mbps. The number of B channels is limited by the size of the standard trunk line used in the region. Fig shows the ISDN PRI interface. Unlike BRI, PRI does not support a bus configuration and only one device can be connected to a PRI line. A PBX, however can reallocate ISDN PRI resources on to multiple BRI buses. Fig shows the ISDN PRI concept. A single PRI connection is usually much less expensive than obtaining the equivalent number of B channels through multiple BRI connections. The 1.544 Mbps of a PRI can be divided up in many ways to meet the requirements of many users. This indicates combination of 64 kbps B channels or all capacity of B channels (In LAN to LAN case) can be used. 03



b. Write short notes on the following: **2x5=10**
(i) B-ISDN
(ii) Alternative routing

Ans: B-ISDN
BISDN Configuration: Fig. shows how access to the BISDN network is accomplished. Each peripheral device is interfaced to the access node of a BISDN network through a broadband distant terminal (BDT). The BDT is responsible for electrical to optical conversion, multiplexing of peripherals, and maintenance of the subscriber's local system. Excess nodes concentrate several BDT's into high speed optical fiber line directed through a feeder point into a service node. Most of the

control function for system excess is managed by the service node, such as call processing, administrative function and switching and maintenance functions. The functional modules are interconnected in a star configuration and include switching, administrative, gateway, and maintenance modules. The interconnection of the function module is shown in Fig. The central control hub acts as the end user interface for control signalling and data traffic maintenance. In essence, it oversees the operation of the modules.	05



Subscriber terminal near the control office may by pass the excess nodes entirely and the directly connected to the BISDN network through a service node. BISDN nodes that used optical fiber cables can utilize much wider band width and consequently, have higher transmission rates and offer more channel handling capacity than ISDN systems.	
ii) **Alternative Routing:** Based on the assumption that the routing is made only by direct routing or tandom routing, it is found that to route a stream of traffic, tandom route is more economical. In fact, even greater economics are often possible if just a proportion of the traffic is routed directly. This approach is known as alternative routing. In alternative routing, connections should use the direct trunks (referred as high usage route), because direct route provides better transmission quality and use fewer network facilities. If all the direct trunks are busy, calls are routed via a tandom exchanges or alternate routes to maintain suitably low blocking probabilities. Thus, the networks are designed to allocate a limited number of heavily utilized trunks in the direct route and provide alternate routes for over flow.	05

TEXT BOOK

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