PART-A

Short Questions and Answers

(Module-I)

1. Define the term Avionics systems.
Ans:- All electronic and electromechanical systems and subsystems (hardware and software) installed in an aircraft that are dependent on electronics for its operation. Avionics Systems are essential to enable the flight crew to carry out the aircraft mission safely and to meet the mission requirements with minimum flight crew.

2. Explain briefly Flight management system (FMS)
Ans:- Outputs from the GNSS sensors, air data sensors and other on-board sensors are used by FMS to perform the necessary navigation calculations and provide information to the flight crew via a range of display units. The flight management system provides the primary navigation, flight planning, and optimized route determination and en route guidance for the aircraft and is typically comprised of the following interrelated functions: navigation, flight planning, trajectory prediction, performance computations, and guidance. To accomplish these functions the flight management system must interface with several other avionics systems.

3. Explain FBW control system.
Ans:

- ✓ Enables a lighter, higher performance aircraft designed with relaxed stability
- ✓ Good consistent handling which is sensibly constant over a wide flight envelope and range of load conditions
- ✓ Continuous automatic stabilization of the aircraft by computer control of the control surfaces
- ✓ Auto pilot integration
- ✓ Care free maneuvering characteristics
- ✓ Ability to integrate additional controls automatically such as
    - o Leading edge slats/flaps and trailing edge flaps to generate additional lift
    - o Variable wing sweep
    - o Thrust vector control nozzles and engine thrust
- ✓ Elimination of mechanical controls runs - friction, backlash
- ✓ Small control stick
- ✓ Ability to exploit aerodynamically unstable configuration

- ✓ Aerodynamics versus stealth - the concept of reducing the radar cross section
- ✓ Very high integrity, a failure survival system.

4. What do you mean by House keeping management?
Ans:- The term 'house keeping' management has been used to cover the automation of the background tasks which are essential for the aircraft's safe and efficient operation Such tasks include

- ✓ Fuel management
- ✓ Electrical power supply system management
- ✓ Cabin/cockpit pressurization systems
- ✓ Environmental control system
- ✓ Warning systems
- ✓ Maintenance and monitoring systems.

5. What are the main characteristics of touch screens?
Ans:-

- ✓ Fully Connected Speech
- ✓ Must Be Able to Operate in the Cockpit Environment
- ✓ Vocabulary size - required size is around 200-300 words
- ✓ Speech template duration - Speech Template Duration is around 5 Seconds
- ✓ Vocabulary duration - Maximum duration of the total vocabulary is around 160 seconds
- ✓ Syntax nodes - max. no. of syntax nodes required is 300
- ✓ Duration of utterance - no restriction on the max. duration of an input utterance
- ✓ Recognition response time - this must be in real time.

6. What is the function of inertial sensor systems? What are the various inertial sensor systems used in aircraft?
Ans:- They provide attitude and heading information which are essential for a/c mission. Various inertial sensor systems are-

- ❖ Gyros - mechanical - electromechanical - RLG-FOG
- ❖ Accelerometer
- ❖ AHRS(Attitude Heading Reference Systems)
  - o Strap Down
  - o Gimballed systems

7. Explain Radar systems.
Ans:-

- Installed in all civil airliners & in many general aviation aircraft
- To detect water droplets and provide warning of storms, cloud turbulence and severe precipitation-aircraft can alter course and avoid such turbulent conditions
- It should be noted that in severe turbulence, the violence of the vertical gusts can subject the aircraft structure to very high loads and stresses
- These radars can also generally operate in ground mapping and terrain avoidance modes.

- In the airborne interception mode, the radar, must be able to detect aircraft upto 100 miles away and track while scanning and keeping tabs on several aircraft simultaneously (typically at least 12 aircraft)
- The radar must also have a 'look down' capability and be able to track low flying aircraft below it.

8. What are the different methods of navigation?
Ans:- **Classic dead-reckoning navigation** using air data and magnetic, together with Doppler or LORAN-C;
Radio navigation using navigation aids – ground-based radio-frequency beacons and airborne receiving and processing equipment;
Barometric inertial navigation using a combination of air data and inertial navigations (IN) or Doppler;
Satellite navigation using a global navigation satellite system (GNSS), more usually a global positioning system (GPS);
Multiple-sensor navigation using a combination of all the above.

9. Explain briefly radio navigation.
Ans:- The primary means of navigation over land was by means of radio navigation routes defined by VHF omni ranging/distance measuring equipment (VOR/DME) beacons. By arranging the location of these beacons at major navigation or crossing points, it was possible to construct an entire airway network that could be used by the flight crew to define the aircraft flight from take-off to touchdown. Other radio frequency aids include distance measuring equipment (DME) and non-distance beacons (NDB).

10. Describe briefly inertial navigation
Ans:- Using inertial navigation systems (INS), flight crew are able to navigate by autonomous means using an on-board INS with inertial sensors. By aligning the platform to earth-referenced coordinates and present position during initialization, it is possible to fly for long distances without relying upon LORAN, VOR/DME or TACAN beacons. Waypoints could be specified in terms of latitude and longitude as arbitrary points on the globe, more suited to the aircraft's intended flight path rather than a specific geographic feature or point in a radio beacon network.

11. What do you mean by Engine control and management?
Ans:-

- Control and the efficient management and monitoring of the engines
- Automatically controls the flow of fuel and respond to throttle command
- Control system ensures the engine limits in terms of temperatures, engine speeds and accelerations are not exceed and the engine respond in an optimum manner to the throttle command
- Full authority in terms of the control it can exercise on the engine and a high integrity failure survival control system is essential.

(Module-II)

12. What is the purpose of accumulator in Intel 8085 microprocessor?
Registers are small memories within the CPU. They are used by the microprocessor for temporary storage and manipulation of data and instructions. The register A is the accumulator in Intel 8085 microprocessor. This is for temporary storage used during the execution of a program. It holds one of the operands. The other operand may be either in the memory or in one of the registers.

13. What are the status flags in 8085 microprocessor?
Ans:- The following status flags have been provided in Intel 8085:

(i) Carry(CS):- If there is a carry from addition or a borrow from subtraction or comparison, the carry flag CS is set to 1; otherwise 0.
(ii) Zero(Z):- The zero status flag Z is set to 1 if the result of an arithmetic or logical operation is zero. For non-zero result it is set to 0.
(iii) Sign(S):- The sign status flag is set to 1 if the most significant bit of the result of an arithmetic or logical operation is 1, otherwise 0.
(iv) Parity(P):- The parity status flag is set to 1 when the result of the operation contains even number of 1s. It is set to 0 when there is odd number of 1s.
(v) Auxillary Carry(AC):- The auxillary carry status flag holds carry out of bit 3 to 4 resulting from the execution of an arithmetic operation.

14. What is the purpose of the ALE output line in 8085 μP?
Ans:- ALE is an address latch enable signal. The 8085 microprocessor, to work properly, needs one or more memory chips connected to it. Each memory chip has its own MAR(Memory address register), usually called an address latch. This latch stores the incoming address from the address bus and address-data bus. The falling edge of the ALE signal loads the address on the address bus into the MAR or address latch of the memory chips.

15. What is the size of the memory space for an 8-bit microprocessor with a 16-bit address word?
Ans:- 2^{16} (= 65536=64Kilobytes(K), where 1K=1024 bytes) memory locations can be addressed by an 8-bit microprocessor with a 16-bit address word. Each memory location contains 1 byte of data.

16. State the functions of the following lines in 8085 μP chip, (i) SOD, SID
(ii) READY
Ans:- (i) Some times, I/O devices work with serial data rather than parallel. SOD stands for serial out data. This serial data comes out of pin 4, can be connected to a serial output device. SID stands for serial in data.
(ii) Some peripheral devices are slow; they are unable to run at the same speed as 8085. One way to slow down the 8085 is with the READY signal. If the device is not ready, it will return a low READY bit to the 8085. The 8085 then generates a number

of WAIT states. When the peripheral device is ready, it will send a high READY signal to μP. Then μP can complete the data transfer.

17. How is address information outputted in 8085 microprocessor?
Ans:- The Intel 8085 requires a 16-bit wide address bus as the memory addresses are of 16 bits. The 8 most significant bits of the address are transmitted by the address bus, A-bus(pins A8 to A15). The 8 least significant bits of the address are transmitted by address/data bus, AD-bus (pins AD0 to AD7). The AD-bus operates in time-shared mode. At a particular moment, it transmits either data or address. This technique is called multiplexing. First of all 16-bit memory address is transmitted by the microprocessor; the 8 MSBs of the address on the A-bus and the 8 LSBs of the address on AD-bus. Then the 8 LSBs of the address is latched so that the complete 16-bit address remains available for further operation.

18. Define Opcode and Operand, and specify the Opcode and the Operand in the instruction MOV A, B.
Ans:- Each instruction contains two parts: operation code(opcode) and operand. The first part of an instruction which specifies the task to be performed by the computer is called opcode. The second part of the instruction is the data to be operated on, and it is called operand. The operand given in the instruction may be in various forms such as 8-bit or 16-bit data, 8-bit or 16-bit address, internal registers or a register or memory location. In the instruction, MOV A, B, MOV is the opcode and A & B are operands.

19. Explain (i) One byte instruction (ii) Two byte instruction
Ans:- A digital computer understands instructions written in binary codes or machine codes. The machine codes of all instructions are not of the same length. The instructions whose word size is of one byte (8 bits) are called one byte instructions.
Eg:- MOV A,B
The instructions whose word size is of two bytes (16 bits) are called two byte instructions.
Eg:- MVI A, 05

20. Differentiate between Direct and indirect addressing.
Ans:- In direct addressing mode, the address of the operand is given in the instruction itself.
Eg: STA 2400H--------Store the content of accumulator in location 2400H.
In indirect addressing mode, the address of the operand is not given in the instruction explicitly.

Eg: RST 4----------This instruction takes the program to the address 0020(4 x8=32)-------> (0020)hex.

21. What operations can be performed with the following instructions, (i) DAA
(ii) DAD

Ans:- (i) DAA instruction is used in the program after ADD or ADC instruction. After the execution of ADD or ADC instruction, the result is in hexadecimal and it is placed in the accumulator. DAA instruction operates on this result and gives the final result in decimal system.
(ii) During the execution of DAD B instruction, the contents of B-C register pair are added to the contents of H-L pair and the sum is placed in H-L pair.

22. Differentiate between hold and halt states of the 8085 microprocessor.
Ans:- If the HOLD line of 8085 found high, the μP enters a HOLD state and issues out a HLDA(Hold acknowledge) signal. After recognizing the HOLD signal, the μP suspends executing any further machine cycles and tri-states the A and AD buses and also the IO/M, RD and WR lines. During the HOLD state, the peripheral devices can gain control of the data and address buses for transferring data to or from the memory directly. This mode of operation is called Direct memory access(DMA).
When a HLT instruction is executed, the μP enters a HALT state. It will stops the microprocessor. The registers and status flags remain unaffected. The μP can get out of this state only one clock cycle after a valid interrupt is recognized or a RESET occurs.

23. What is WAIT state?
Some peripheral devices are slow; they are unable to run at the same speed as 8085. One way to slow down the 8085 is with the READY signal. If the device is not ready, it will return a low READY bit to the 8085. The 8085 then generates a number of WAIT states. When the peripheral device is ready, it will send a high READY signal to μP. Then μP can complete the data transfer.

24. What are the major components of a CPU?
Ans: - The major components of CPU are:-
(1) Arithmetic and Logic Unit (ALU):- The function of ALU is to perform arithmetic operations such as addition and subtraction; logical operations such as AND, OR and EX-OR.
(2) Timing and control unit:- It generates timing signals for the execution of instruction and control of peripheral devices.
(3) Accumulator and General purpose registers:- The accumulator is a register which contains one of the operands and stores results of most arithmetic and logical operations. General purpose registers are used for temporary storage of data and intermediate results while computer is making execution of a program.

25. List the different categories of instructions that manipulate data.
Ans: - Data transfer group, Arithmetic group, Logical group, Branch control group and I/O and Machine control group.
Data transfer group:- Instructions which are used to transfer data from one register to another register, from a memory location to a register or register to memory, between an I/O device and accumulator or between a register pair and stack come under this group.

Arithmetic group: The instructions of this group perform arithmetic operation such as addition, subtraction, increment or decrement data in register or memory.
Logical group:- The instructions under this group perform logic operations such as AND, OR, compare, rotate etc.
Branch Control group:- It includes the instructions for conditional and unconditional jump, subroutine call and return and restart.
I/O and machine control group:- This group includes the instructions for input/output ports, stack and machine control.

26. Explain subroutines
Ans:- While writing a program, certain operations may occur several times and they are not available as individual instruction. The program of such operations is repeated again and again in the main program. The concept of subroutines is used to avoid the repetition of smaller programs. The small programs for particular tasks are called subroutines. They are written separately and stored in the memory. They are called at various points of the main program by CALL instruction where they are required. After the completion of a subroutine, the main program begins from the instruction immediately following the CALL instruction.

27. Differentiate between maskable and non-maskable interrupts.
Ans:- At many occasions, the programmer may like to prevent the occurrence of a few of several interrupts while μP is performing certain tasks. This is done by masking off those interrupts which are not required to occur when certain task is being performed. The interrupts which can be masked off are called maskable interrupts. Eg:- RST 7.5, RST 6.5 & RST 5.5.
The TRAP is a non-maskable interrupt. It need not be enabled. It cannot be disabled. It is not accessible to user. It is used for emergency situation such as power failure and energy shut off.

28. What is memory mapped I/O scheme?
Ans: - In this scheme, the addresses for I/O devices are different from the addresses which have been assigned to memories. The memory addresses which have not been assigned to memories can be assigned to I/O devices. In this scheme, all the data transfer instructions of the μP can be used for both memory as well as I/O devices.
Eg:- MOV A,M will be valid for data transfer from the memory location or I/O device whose address is in H-L pair. If the H-L pair contains the address of a memory location data will be transferred from the memory location to the accumulator. If the H-L pair contains the address of an I/O device, data will be moved from the I/O device to the accumulator.

29. Describe flip flop as a storage element.
Ans:- A digital computer needs devices which can store information. A flip flop is a binary storage device. It can store binary bit either 0 or 1. It has two stable states: HIGH and LOW, ie 1 and 0. It has the property to remain in one state indefinitely until it is directed by an input signal to switch over to other state. It is a basic memory

element. In the case of D-flip flop, when CLK is high, the flip flop sets. When CLK is low, the flip flop resets.

30. Explain briefly magnetic bubble type memories.
Ans:- Magnetic bubble type memory is a solid state device having high reliability, small size, light weight, ruggedness and limited power dissipation. It is a static device. It has no rotary parts. It has very high storage capacity in compact space. It is a non-volatile semi-random access type memory. It possesses the property of non-destructive read-out, which means that the read operation does not alter the stored information. It stores the data in magnetic bubbles created in a thin film of magnetic material. The presence of bubble is interpreted as logic 1 and absence of bubble as 0.

31. Differentiate between semiconductor and magnetic memories.
Ans:- Semiconductor memories are used as the main memory of a computer. They are faster, smaller, and lighter and consume less power.
Magnetic memories are used as the secondary memories of a computer for bulk storage of data and information. They are slower, but cheaper than semiconductor memories.

(Module-III)

32. What is the need for Manchester II bi-phase encoding?
Ans: - In MIL-STD 1553 data bus, all words are constructed using Manchester coding. A logical 1 begins +ve and transitions to -ve at mid-bit and a logical 0 begins –ve and transitions to +ve at mid-bit. Manchester coding is chosen since it is compatible with transformer coupling and is self clocking.

33. Differentiate between Disjoint and Centralized Architectures.
Ans:- In disjoint architecture, the system was integrated by the air-crew who had to look at various dials and displays connected to disjoint sensors, correlate the data provided by them, apply error corrections, orchestrate the functions of the sensors and perform mode and failure management in addition to flying the aircraft.

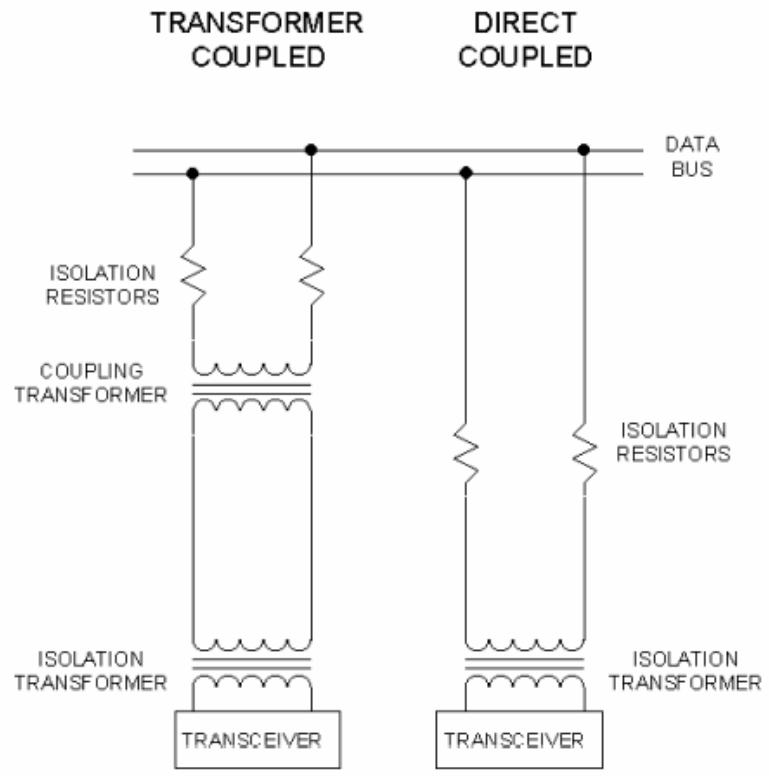
In centralized architecture, a central computer was added to integrate the information from the sensors and subsystems. Data is transmitted from the systems to the central computer and the data conversion takes place at the central computer.

34. What are the three types of terminals in MIL-STD 1553 data bus?
Ans:- The three terminals in MIL-STD 1553 data bus are Bus Controller, Remote Terminal and Bus monitor.
The bus controller is responsible for directing the flow of data on the bus.
It initiates all information transfers. Bus controller also monitors the status of the system.
A bus monitor receives and stores selected bus traffic. It will not respond to any traffic received, unless the traffic is specifically addressed to it. They are generally used to receive and extract data for off-line purposes such as flight test, maintenance or mission analysis.

Remote terminals (RTs) are the largest fraction of units in a 1553 bus system. Because of the 5-bit address field, there can be only upto 31 RTs on a given bus. RTs respond only to valid commands specifically addressed to them or to valid broadcast commands.(all RTs simultaneously addressed)

35. What are the two coupling methods used in MIL-STD 1553 data bus?

Ans:- Figure shows the two methods, the primary difference between the two being that the transformer coupled method utilizes an isolation transformer for connecting the stub cable to the main bus cable. In both methods, two isolation resistors are placed in series with the bus. In the direct coupled method, the resistors are typically located within the terminal, where as in the transformer coupled method, the resistors are typically located with the coupling transformer in boxes called data bus couplers. Another difference between the two coupling methods is the length of the stub. For the direct coupled method, the stub length is limited to a maximum of 1 ft. For the transformer coupled method, the stub can be up to a maximum length of 20 ft.



36. Differentiate between command word and status word.

Ans:- A command word is always the first word in a message and is transmitted only by the bus controller. Following the synchronization code, which is a $+1\frac{1}{2}$ bit times followed by a $-1\frac{1}{2}$ bit times, there are 5 address bits. Every RT must have a unique address. The transmit/receive bit is set to logical 0 if the RT is to receive and to logical 1 if the RT is to transmit. The next 5 bits(10-14) are used to designate a subaddress to the RT or use of mode codes to the equipment on the bus. If bits 10

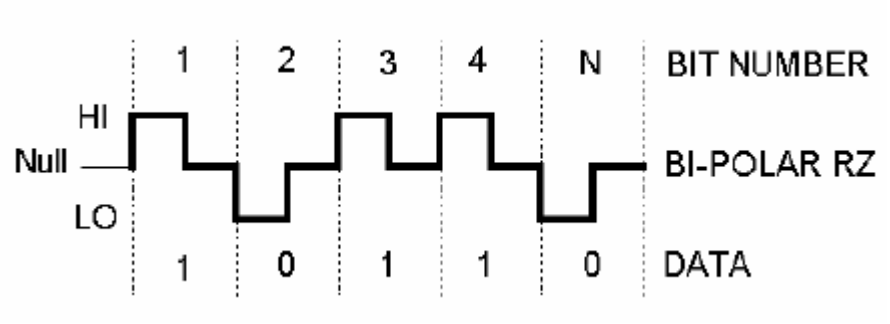
through 14 are subaddresses, bits 15 through 19 are the data word count. f bits 10 through 14 are either 00000 or 11111, bits 15 through 19 are mode codes. Bit 20 is parity bit.
A status word is always the first word in a response by a remote terminal. Bit positions 1 through 3 are the synchronization code that is identical to that of a command word. Bits 4 through 8 are the address of the terminal transmitting the status word. Bits 9 through 19 are the RT status field. If the instrumentation bit in the status word is used, the available subaddresses are reduced to 15. Bit 20 is parity bit.

37. What is the function of bus controller in MIL-STD 1553 data bus?
Ans:- The bus controller is responsible for directing the flow of data on the bus. It initiates all information transfers. Bus controller also monitors the status of the system.

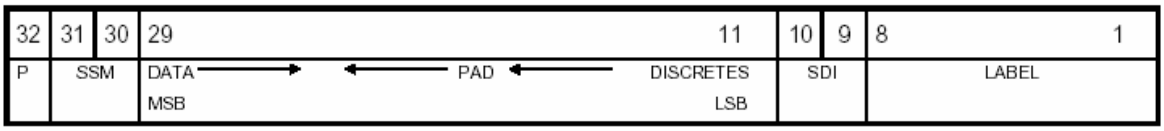
38. What is the function of bus monitor in MIL-STD 1553 data bus?
Ans:- A bus monitor receives and stores selected bus traffic. It will not respond to any traffic received, unless the traffic is specifically addressed to it. They are generally used to receive and extract data for off-line purposes such as flight test, maintenance or mission analysis.

39. What is the need of two different data rates in ARINC 429?
Ans:- Two different data rates are used in ARINC-429. They are 12-14.5 Kbits/sec(Low speed bus) and 100 Kbits/sec(High speed bus). Low speed bus is used for general-purpose, low criticality applications. High speed bus is used for transmitting large quantities of data or flight critical information.

40. Differentiate between Manchester encoding and bipolar-RZ encoding. Which encoding format is used in ARINC-429?
Ans:- In Manchester coding, a logical 1 begins +ve and transitions to -ve at mid-bit and a logical 0 begins –ve and transitions to +ve at mid-bit. In bipolar return-to-zero encoding format, the voltage levels are used for representing logic 1 and 0 as shown in the figure.



41. What are the five primary fields in ARINC 429 word format?
Ans:- ARINC-429 word format includes five primary fields, namely Parity, SSM, Data, SDI, and Label.



Parity:- The MSB is always the parity bit for ARINC 429. Parity is normally set to odd except for certain tests.

SSM:- Bits 31 and 30 contain the Sign/Status Matrix or SSM. This field contains hardware equipment condition, operational mode, or validity of data content.
Data:- Bits 29 through 11 contain the data, which may be in a number of different formats such as BCD, BNR etc.
SDI:- Bits 10 and 9 provide a Source/Destination Identifier or SDI. This is used for multiple receivers to identify the receiver for which the data is destined.
Label:- The label is an important part of the message. It is used to determine the data type of the remainder of the word. All BCD and BNR data words have a five-character label assigned in 429.

42. How is ARINC-629 different from MIL-STD 1553?
Ans:- ARINC-629 uses word formats that are very similar to those in MIL-STD-1553, but it does not have a bus controller. Instead, ARINC-629 gives each terminal autonomous access to the bus based upon meeting three timing conditions stored in a Transmit Personality programmable read-only memory, or PROM (XPP) in the host terminal. One of these timing conditions is unique to the terminal. Another difference from MIL-STD-1553 is the use of a Receive Personality PROM (RPP) to identify the labels of messages to be recorded from the bus.

43. Why we need different standards for military and civil aircraft data buses?
Ans:- Once the equipments are standardized, equipments are easily available, maintainable, reinstalled and reconfigured (Interchangeability). Also safety measure is different for military and civil aircrafts. So we need different standards for military and civil aircrafts. Standardization of equipments are based on the document Military Standard (MIL-STD) and Aeronautical Radio Inc. (ARINC) specifications and Reports.

44. What are the functions of Terminal controller in ARINC-629?
Ans:- Terminal controller provides Protocol Function and Data Validation. It acts as Subsystem/SIM Interface. It converts subsystem data to Manchester for SIM and decode Manchester data from SIM for subsystem. It also provides message and word sync pulses. It provides inter-word string gaps.

45. What are the functions of Serial Interface Module (SIM)?
Ans:- Convert between Manchester < ----- > Doublets
Transmit /Receive Doublets to/from Coupler
Power Management
- Apply /remove/reverse power
- Over current detection and shutdown
Fault Monitoring and Management

- Checks its own output waveform
- Checks received waveform
- Causes/verifies coupler channel switching
- Inhibits coupler transmission, if necessary
- Outputs fault information to Terminal Controller

46. What are the functions of current mode coupler in ARINC-629?

Ans:- Provides Non-intrusive connection to the Bus
Transmits/Receives Doublets onto/from the Bus
Provides Low Impedance to Bus under all conditions
Decodes SIM Doublet Polarity for Channel selection
Provides appropriate Receive Doublet Polarity for SIM
Shuts Down Transmitters on Power Reversal

47. Differentiate between Basic protocol and combined protocol.

Ans:- **Basic Protocol (BP)**

- Periodic Mode or Aperiodic Mode

It provides an equal priority access for each terminal to transmit either periodic or aperiodic data. If no bus overload exists and transmission lengths are constant, terminals transmit at a constant interval (Periodic Mode). If the bus is overloaded, it will automatically switch to an aperiodic mode with no loss of data

Combined Protocol (CP)

- Periodic and Aperiodic Mode
- Allows Prioritized Data

It Provides Priority Access for Periodic data transmission (Priority 1) and two levels of lower priority access for Aperiodic data transmission (Levels 2 & 3). At each level all terminals are given equal opportunity to access the bus. It allows substantial levels of aperiodic data to be transmitted without risk of affecting the frequency of periodic transmission.

48. The unique feature of ARINC 629 is that access to the bus to transmit by a given terminal is based on meeting three timing conditions. What are they?

Ans:- The three timing conditions are Transmit Interval (TI), Terminal Gap (TG) and Synchronization Gap (SG).

Transmit Interval (TI) is a global Bus Parameter. For a particular terminal, TI begins the moment the terminal starts transmitting. Once it has transmitted, it must wait the length of time specified by the TI before it can transmit again (0.5 to 64 ms).

Terminal Gap(TG) is an unique timer assigned to each terminal on the Bus**.** TG begins only after the SG has elapsed and only if no carrier is present. TG and SG cannot overlap in time, they must run consecutively(4 to 128 μs).

Synchronization Gap(SG) is a global access parameter. SG is the second longest timer and is set to the same value in all terminals. SG starts the moment the bus is quiet, it is reset if a carrier appears on the bus before it has elapsed.

49. Explain Synchronization gap.

Ans:- The unique feature of ARINC 629 is that access to the bus to transmit by a

given terminal is based on meeting three timing conditions. They are
Transmit Interval (TI), Terminal Gap (TG) and Synchronization Gap (SG).
Synchronization Gap is a Global Access Parameter. It is the second longest timer and is set to the same value in all terminals. SG starts the moment the bus is quiet, it is reset if a carrier appears on the bus before it has elapsed.

50. What do you mean by CID(Source channel identification)?
Ans:- In ARINC-629, messages are composed of a series of word strings. The first word of any word string is the label word with its unique synchronization pattern followed by the Source channel identification (CID), the word string label and the parity bit. CID is used to identify a unique unit when there are two or more identical, redundant units on the same bus such as triple redundant inertial reference units.

51. Explain Label word
Ans:- Label word is characterized by a synchronization pattern that starts in a high state and transitions to a low state in the middle of the second bit time. All other words follow the reverse pattern; thus the synchronization pattern alone is sufficient to identify a label word. For label words, the 16 bits between the synchronization pattern and the parity bit are designated as label bits (LBs). Label bits are numbered in reverse order from the basic word bit positions

(Module-IV)

52. Explain briefly about Light Emitting Diode (LED).
Ans: - An LED is a solid- state device comprising a forward –biased p-n junction transistor formed from a slice or chip of gallium arsenide phosphate (GaAsP) mounted into a transparent covering. When the current flows through the chip it emits light which is in direct proportion to the current flow. Light emission in different colors of spectrum can be obtained by varying the proportions of the elements comprising the chip, and can also be obtained by using the technique called doping with other elements, e.g. Nitrogen.

53. What do you know about Liquid Crystal Display (LCD)?
Ans: - LCD consists of two glass plates coated on their inner surfaces with a thin film of transparent conducting material such as indium oxide. The material on the front plate is etched to form the seven segments, each of which forms an electrode. A mirror image is also etched into the oxide coating of the back glass plate. The space between the plates is filled with a liquid crystal compound, and the complete assembly is hermitically sealed with a special thermoplastic material to prevent contamination.

54. Explain the working of HUD.
Ans: - A head-up display (HUD) is one in which vital in-flight data are presented at the same level as a pilot's line of sight when he is viewing external references ahead

of the aircraft. The principle adopted in a HUD system is to display the required data on the face of a CRT and to project them through a collimating lens as a symbolic image on to a transparent reflector plate, such that the image is superimposed on a pilot's normal view, through the window screen, of the terrain ahead. The display is a combined alphanumeric and symbolic one, and since it is focused at infinity it permits simultaneous scanning of the 'outside world' and display without refocusing the eyes.

55. What are the properties of a Combiner? How it is constructed?
Ans: The combiner is a mirror with several unusual properties: The reflective coating is highly wavelength selective, centered on the wavelength of the emission from the CRT phosphor and clear to other wavelengths, and the coating is also highly selective in angle of incidence so that only that light impinging within a very narrow range of angles will be reflected.
Combiners are constructed photographically by exposing a film of dichromated gelatin to crossed laser beams and then developing the resulting diffraction pattern image. Since the gelatin is organic, it must be protected from the environment, especially from high temperatures.

56. Designing an HMD requires careful consideration of two factors. What are they?
Ans: Two factors are:- Weight and Helmet aerodynamics. During high vertical acceleration maneuvers such as tight turns and ejection from the aircraft, the helmet can become a very heavy object, which leads to the mandate to design absolutely minimum-weight helmet mounted optics. Immediately following ejection, the helmet is exposed to a high-speed airflow which can generate substantial lift when flowing over a properly shaped object. Thus, the designer must ensure that the helmet is poorly designed from an aerodynamics perspective to ensure that it does not generate any lift and thereby suddenly pull on the pilot's neck immediately following ejection.

57. How multifunction keyboards can be designed using LEDs?
Ans: Designs using LEDs have arrays of standard-sized push button switches with legends built into the surface of the switches. These legends are generated by small arrays of matrix addressable LEDs in the switch cover. Color can be used if desired. The legends are changed by the user or automatically by the aircraft as the mission phase changes.

58. How multifunction keyboards can be designed using LCDs?
Ans: For MFKs designed using LCDs, the panel is usually a continuous smooth surface with the individual switch function and area established by the matrix addressed LCDs. Since LCDs have a graphics capability, it is also possible to enter a numerical value by pressing the surface of an LCD panel in the area where a portion of a curve is displayed rather than entering a numerical value by using a keyboard.

59. Explain multifunction displays.
Ans: In multifunction displays, CRT displays serve as MFKs. The most common way is for the CRT face to contain function labels correlated with adjacent switches mounted in the bezel surrounding the CRT. It is easy through software to change the

switch function and the associated label on the CRT. The second method of implementing MFKs on CRTs is to overlay the CRT face with a touch-sensitive screen. The CRT face contains various switch function legends and the corresponding function is selected by touching that portion of the screen over the switch label.

60. Explain DVI concept in cockpit.
Ans: - Speech recognition systems are capable of performing non-critical tasks such as requesting system status, tuning radios, and requesting maps to be displayed on a CRT. The most important figure of merit in a speech recognition system is the fraction of correct word recognitions. When a word is spoken, there are three possible responses by the system: correct recognition, confusion with a rhyming word and rejection. Most systems can achieve correct recognition rates in the mid-90 percent in the case of a pilot experienced in interacting with a speech recognition system in a benign flight environment. As acceleration increases, the recognition rate decreases to less than 80% for a 9-g load on the pilot. Another important consideration in using speech recognition systems is that the words must be spoken individually, with a pause between successive words.

61. Explain voice synthesis systems.
Ans: - The preferred use of voice synthesis systems is during high-work load periods. Messages should be brief and in a telegraphic format. Messages should be restricted to conditions that (1) require immediate corrective action or have an immediate impact on the safety of flight or (2) will soon reach this condition if not corrected by the pilot. These messages should be preceded by a warning tone and have a concurrent visual display. Voice synthesis systems must include logic in the central processor that will resolve conflicts between nearly simultaneously received messages to be converted into synthetic voice. This resolution is generally achieved by a first in first out protocol.

62. Explain Head Level displays?
Ans: An HLD avoids the physiological limitation on eye refocusing time by placing directly below the HUD or top edge of the instrument panel a display in which an image and supplemental alphanumeric information are focused at a long distance. Thus, the need for the pilot to refocus his or her eyes to scan at least some information inside the cockpit is eliminated. Typically the HLD will contain a radar or infrared image of the outside scene. An HLD uses a high-intensity lamp coupled with dichroic filters to sort the white light into red, green and blue and with optics to collimate and fold the light. The red and green bands are each modulated by liquid crystal shutters in which each pixel is either opaque or transparent as required to generate a color image.

(Module-V)

63. Explain Weather radar.
Ans:

- Installed in all civil airliners & in many general aviation aircraft

- To detect water droplets and provide warning of storms, cloud turbulence and severe precipitation-aircraft can alter course and avoid such turbulent conditions
- It should be noted that in severe turbulence, the violence of the vertical gusts can subject the aircraft structure to very high loads and stresses
- These radars can also generally operate in ground mapping and terrain avoidance modes.
- In the airborne interception mode, the radar, must be able to detect aircraft upto 100 miles away and track while scanning and keeping tabs on several aircraft simultaneously (typically at least 12 aircraft)
- The radar must also have a 'look down' capability and be able to track low flying aircraft below it.

64. Explain the principle of Electronic Warfare.
Ans: Most communications and radar systems are designed for use in specific bands. The main role of electronic warfare is to search these radio-frequency bands in order to gather information that can be used by intelligence analysts or by front-line operators. The information gained may be put to immediate effect to gain a tactical advantage on the battlefield; it may be used to picture the strategic scenario in peace time, in transition to war, or during a conflict. It may also be used to devise countermeasures to avoid a direct threat or to deny communications to an enemy. The cycle of intelligence begins with a requirement to gather information on a particular scenario. Intelligence is collected from a number of different sources to form a strategic picture.

65. Explain the need of accurate navigation.
Ans:-
- ❖ Effective operation of any a/c
- ❖ Automatic because of speed
- ❖ Density of air traffic on major air routes to fly in a specified corridor defined by ATC authorities - high accuracy NAV is essential & forms part of FMS
- ❖ For military operation - to enable the a/c to fly low & take advantage of terrain screening from enemy radar
- ❖ Use of weapon - released from several Kms away from target also requires an accurate knowledge of the a/c position in order to indicate the mid course inertial guidance of the missile.

66. Describe the various dead reckoning navigation systems used in aircraft.
Ans:- DR navigation systems used in aircraft are
Air data/heading reference system - lower accuracy
Doppler/heading reference systems - widely used in helicopters
Inertial Navigation systems - most accurate and widely used systems
Doppler/Inertial navigation system - combination

67. Explain radio navigation systems
Ans:- Two types of radio navigation systems are position fixing systems and hyperbolic radio navigation systems

POSITION FIXING SYSTEMS

Range and bearing (R/θ) radio navigation aids

- VOR/DME
- TACAN- Accuracy of 1-2 miles

HYPERBOLIC RADIO NAVIGATION SYSTEMS

- LORAN C - positional accuracy of around 150 m
- 8 LORAN C chains comprising 34 ground station transmitters
- OMEGA - accuracy around 2 NM -VLF at 10 khz using 8 ground stations.

68. Explain the various communication systems used in aircraft.

Ans:-

- High-frequency (HF) communications;
- Very high-frequency (VHF) communications;
- Ultrahigh-frequency (UHF) communications;
- Satellite communications (SATCOM);
- Data links.

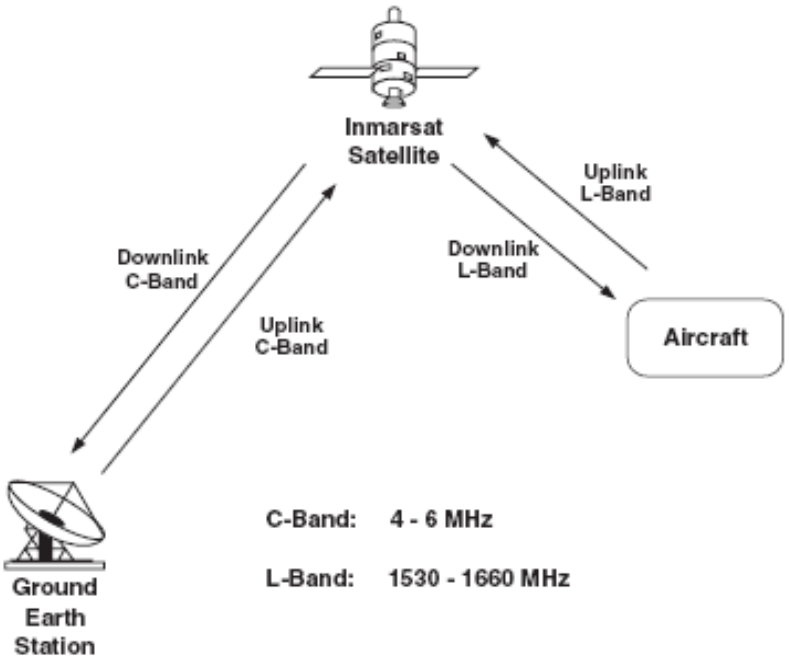
69. Differentiate between HF and VHF communication systems.

Ans:- High frequency (HF) covers the communications band between 3 and 30 MHz and is a very common communications means for land, sea and air. The utilized band is HF SSB/AM over the frequency range 2.000–29.999 MHz using a 1 kHz (0.001 MHz) channel spacing. The primary advantage of HF communications is that this system offers communication beyond the line of sight.

The VHF band for aeronautical applications operates in the frequency range 118.000–135.975 MHz with channel spacing in past decades of 25 kHz (0.025 MHz). In recent years, to overcome frequency congestion and taking advantage of digital radio technology, channel spacing has been reduced to 8.33 kHz (0.00833 MHz) which permits 3 times more radio channels in the available spectrum. VHF signals will only propagate over line of sight. That is, the signal will only be detected by the receiver when it has line of sight or can 'see' the transmitter. This line-of-sight property is affected by the relative heights of the radio tower and aircraft.

70. Explain satellite communication systems.

Ans:- Satellite communications provide a more reliable method of communications using the International Maritime Satellite Organization (INMARSAT) satellite constellation. The aircraft communicates via the INMARSAT constellation and remote ground earth station by means of C-band uplinks and downlinks to/from the ground stations and L-band links to/from the aircraft. In this way, communications are routed from the aircraft via the satellite to the ground station and on to the destination. Conversely, communications to the aircraft are routed in the reverse fashion. The airborne SATCOM terminal transmits on frequencies in the range 1626.5– 1660.5 MHz and receives messages on frequencies in the range 1530.0–1559.0 MHz. The coverage offered by the INMARSAT constellation was a total of four satellites in 2001. Further satellites are planned to be launched in the near future. The INMARSAT satellites are placed in earth geostationary orbit above the equator.



71. Describe data links.

Ans:- Many of the data links are limited to line-of-sight operation owing to the transmission characteristics of the RF frequencies being employed. However, the use of communications satellites to perform a relay function permits transmission of data over the horizon (OTH), thereby enabling intra- and inter-theatre communications.

Typical data packages that may be delivered by data links include:

- Present position reporting;
- Surveillance;
- Aircraft survival, EW and intelligence information;
- Information management;
- Mission management;
- Status.

The primary data links used for communications between airborne platforms and space and surface platforms are-

Link-16 - This is the most commonly used avionics data link and is usually manifested in avionics systems as the joint tactical information distribution system (JTIDS).

Link-11 - a data link commonly used by naval forces.

PART-B

Descriptive Questions and Hints

(Module-I)

1. Explain the salient features that enhances the need for avionics in civil and military aircrafts and also in space systems. (16)

Hint: - Refer the note-Avionics-Module-I

2. With a neat block diagram explain typical avionics systems. (16)
Hint: - Refer the note-Avionics systems.

(Module-II)

3. Explain with a neat diagram, 8085 microprocessor architecture and describe the function of its various parts. (16)
Hint:- Draw the architecture of 8085 μP and explain the function of its parts.
Refer the note(Module-II)-Digital computers and microprocessors

4. Draw the pin configuration of 8085 microprocessor chip and describe the functions of individual pins. (16)
Hint:- Draw the pin layout of 8085 μP and explain the function of its pins.
Refer the note(Module-II)-Digital computers and microprocessors.

5. (i) What operations can be performed with the following 8085 instructions,
(1) ADD B (2) RAR (3) ORA M (4) INX B (5) ANA M (6) DAD B (7) XRI 05
(8) STAX D (9) XCHG (10) DAA (10)
Hint:- Refer the note(Module-II)-Digital computers and microprocessors-8085 Instruction set.

(ii) The numbers 12H and 45H are stored in memory locations 3001H and 3002H respectively. Write an assembly language program to add these two numbers, convert the result to decimal system and store the result in location 3003H and 3004H respectively. (6)

Hint:-
```
        LXI H, 3001
        MVI C, 00
        MOV A, M
        INX H
        ADD M
        DAA
        JNC   AHEAD
        INR C
AHEAD   STA 3003
        MOV A, C
        STA 3004
        HLT
```

6. 8- bit decimal subtraction (8)
Hint:- DAA instruction cannot be used after SUB or SBB instruction for decimal subtraction. It is used only after ADD, ADC. Therefore, for decimal subtraction, the number which is to be subtracted is converted into 10's complement.
Eg: 96 - 96 – 38 = 96+(-38) = 96 + 10's complement of 38.

38

58(decimal)

```
LXI H, 2502
MVI A, 99
SUB M
INR A
DCX H
ADD M
DAA
STA 2503
HLT
```

7. (i) Write short notes on subroutines. (8)
Hint:- Refer the note(Module-II)-Digital computers and microprocessors-8085.
(ii) Describe the various types of memories used in digital computers. (8)
Hint:- Refer the note(Module-II)-Digital computers and microprocessors-8085.

8. (i) Explain briefly the interrupts in Intel 8085. (8)
Hint:- Refer the note(Module-II)-Digital computers and microprocessors-8085.
(ii) Differentiate between memory mapped I/O and I/O mapped I/O (8)
Hint:- Refer the note (Module-II)-Digital computers and microprocessors-8085.

(Module-III)

9. Discuss the bus protocol in MIL-STD 1553B and the word formats. (16)
Hint:- Bus protocol in MIL-STD-1553 includes message formats and word structure. Important message formats include BC-RT transfer, RT-BC transfer and RT-RT transfer. Three word formats include command word, status word and data word. Explain each of them as given in note(Module-III)-Avionics data buses.

10. (i) Explain ARINC-629 protocols (8)
Hint:- There are two ARINC-629 protocols. They are basic and combined. Explain each briefly as given in note (Module-III)-Avionics data buses.

(ii)Explain ARINC-429 word format (8)
Hint:- ARINC-429 word format includes five primary fields, namely Parity, SSM, Data, SDI, and Label.
Refer the note(Module-III)- Avionics data buses.

11. (i)What is Sign/Status Matrix? (8)
Hint:- ARINC-429 word format includes five primary fields, namely Parity, SSM, Data, SDI, and Label. Bits 31 and 30 contain the Sign/Status Matrix or SSM. This field contains hardware equipment condition, operational mode, or validity of data content.
Refer the note(Module-III)-Avionics data buses.

(ii) Explain ARINC-629 Communication system. (8)
Hint:- Refer the note(Module-III)-Avionics data buses-ARINC-629.

12. (i) Discuss ARINC-629 Word formats (8)
Hint:- Refer the note(Module-III)-Avionics data buses-ARINC-629.

(ii) The unique feature of ARINC 629 is that access to the bus to transmit by a given terminal is based on meeting three timing conditions. What are they? Explain with neat timing diagram. (8)
Hint:- Three timing conditions are:- Transmit Interval, Terminal gap and Synchronization gap. Refer the note(Module-III)-Avionics data buses-ARINC-629.

13. Explain Pave pillar architecture (16)
Hint:- Refer the note(Module-III)- Avionics architectures-Pave Pillar.

14. Write short notes on
(i) Federated architecture
(ii) Hierarchical architecture
(iii) Distributed architecture
(iv) Pave Pace (16)
Hint:- Refer the note(Module-III)- Avionics architectures-Pave Pillar.

(Module-IV)

15. With a neat block diagram explain Head up Display, multifunction displays and Multifunction keys in a civil and military aircraft. (16)
Hint:- Refer note-Module-IV-Cockpit displays.

16. (i) Compare the following display technologies: CRT, LCD, LED and EL. (8)
Hint:- Refer note-Module-IV-Cockpit displays.

(ii) Explain DVI concept in a cockpit. (8)
Hint:- Refer note-Module-IV-Voice Recognition Systems

17. Write short notes on
(i) Helmet mounted display (8)
Hint:- Refer note-Module-IV-Cockpit displays.

(ii) Voice synthesis systems (8)
Hint:- Refer note-Module-IV-Voice Recognition Systems

18. (i) Explain Touch screens with a neat diagram (8)
Hint:- Refer note-Module-IV-Data entry and Control

(ii) Explain HOTAS (8)
Hint:- Refer note-Module-IV-Cockpit displays.

(Module-V)

19. (i) Explain the relation between reliability and maintainability. (6)
Hint:- Refer note-Module-V- Chapter-6
(ii)Discuss Radar Electronic Warfare (10)
Hint:- Refer note-Module-V-Weather radar, Electronic warfare.

20. (i) Explain inertial sensors and how are they used in inertial navigation systems. (8)
Hint:- Refer note-Module-V-Inertial Navigation Systems

(ii) Describe fly-by-wire flight control systems. (8)
Hint:- Refer note-Module-V-FBW control systems

21. (i) Describe the various navigation systems. (8)
Hint:- Various navigation systems are:- Radio navigation, Dead reckoning systems etc. Refer note-Module-V- Navigation

(ii) Discuss the communication systems used in aircrafts. (8)
Hint:- Various communication systems used in aircrafts include HF, VHF, UHF, SATCOM, Data links etc. Refer note-Module-V-Communication systems

22. Describe the methods involved in Certification (16)
Hint:- Refer note-Module-V- Certification