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1. Which of the following terms accurately describes a synchro?
A. Electromechanical
B. Position-sensing
C. Rotary
D. All of the above *

2. What are the two general classifications of synchro systems?
A. Torque and control *
B. Load and control
C. Load and lock
D. Torque and load

3. What is the difference in application between the two classifications of synchros?
A. Circular versus straight-line motion
B. Mechanical versus electrical Output
C. High-frequency versus low-frequency operation
D. Light versus heavy load *

4. Which of the following types of synchro devices provides a mechanical output?
A. A torque transmitter
B. A control transformer
C. A torque receiver *
D. A control transmitter

5. A 115-volt, 400-Hz torque transmitter with a diameter of 2.36 inches will have what military standard designation code?
A. 115 V-24TT4
B. 23TD4
C. 24TX4 *
D. 115 V-23CT6

6. A 3.5-inch diameter differential receiver will have what Navy prestandard designation code?
A. 5DG
B. 35TDR
C. 5D *
D. 35CR

7. What does the arrow on a synchro schematic symbol indicate?
A. The angular position of the rotor *
B. The direction of current flow
C. The direction of rotor movement
D. The angular position of the stator

8. What are the two major components of a synchro?
A. The rotor and the shaft
B. The housing and the shaft
C. The housing and the stator
D. The rotor and the stator *

9. What type of rotor can be composed of a single winding or three Y-connected windings?
A. Fixed
B. Salient-pole
C. Drum or wound *
D. "H"

10. How does the stator of a TX receive voltage?
A. By a magnetic coupling with the rotor *
B. By a physical connection with the rotor
C. By a physical connection with a source
D. By a magnetic coupling with another stator

11. What part of a synchro provides a point for external connections?
A. The slip ring
B. The terminal board *
C. The brush
D. The stator

12. Which of the following terms is defined as the amount of load a machine can turn?
A. Tension
B. Torque *
C. Load factor
D. Radian force

13. Which of the following units should be used in measuring the amount of turning force of a synchro?
A. Pounds
B. Ounces
C. Ounce-inches *
D. Foot-pounds

14. An overloaded synchro will probably exhibit which of the following conditions?
A. Excessive temperature *
B. Noisy operation
C. Oscillation
D. Overspeed

15. A synchro receiver has which of the following characteristics that is NOT found in an ordinary transformer?
A. A step-up turns ratio
B. An air core
C. A primary magnetically coupled to the second
D. A primary that can rotate in relation to the secondary *

16. Maximum voltage is induced in a stator winding of a synchro transmitter when the rotor and the stator winding have what angle between them?
A. 0 degrees *
B. 30 degrees
C. 60 degrees
D. 90 degrees

17. Which of the following factors does NOT affect the amplitude of the voltage induced in a stator winding of a synchro transmitter?
A. The speed of data transmission *
B. The amplitude of the primary voltage
C. The turns ratio of the synchro
D. The angular displacement between the rotor and stator

18. Damping is necessary for which of the following synchro devices?
A. Differential transmitter
B. Transmitter
C. Control transformer
D. Receiver *

19. The primary purpose of damping is to reduce which of the following conditions in a synchro device?
A. Overheating
B. Readings 180° out of phase
C. Oscillating *
D. All of the above

20. What is the minimum number of synchro devices needed for a simple synchro transmission system?
A. 1
B. 2 *
C. 3
D. 4

21. When a s ynchro transmitter, and receiver are in correspondence, what is the relative value of the (a) current through the stators and (b) receiver torque?
A. (a) Minimum (b) maximum
B. (a) Minimum (b) minimum *
C. (a) Maximum (b) minimum
D. (a) Maximum (b) maximum

22. What term applies to the angle through which a synchro transmitter rotor is rotated mechanically?
A. Lag
B. Gain
C. Signal *
D. Lead

23. What type of synchro can accept two signals simultaneously and add or subtract?
A. Differential *
B. Automatic
C. Shiftless
D. Transmission

24. What are the two types of synchro devices that will accept two inputs?
A. TDR and TDX *
B. TDR and TX
C. TR and TDX
D. TR and TX

25. What types of synchro devices have (a) one electrical and one mechanical input and an electrical output; and (b) two electrical inputs and a mechanical outputs
A. (a) TDX (b) TDR *
B. (a) TX (b) TR
C. (a) TDR (b) TDX
D. (a) TR (b) TX

26. What determines whether a differential synchro device adds or subtracts its inputs?
A. The number of stator windings
B. The way it is connected in the system *
C. The supply voltage polarity
D. The direction of rotor movement

27. In a TDX system, for the TR rotor to follow the TX rotor exactly, in what position must the TDX rotor be kept?
A. 0 degree position *
B. 60 degree position
C. 120 degree position

D. 240 degree position

28. If a TDX system with standard synchro connections has the TX rotor at the 60- degree position and the TDX rotor at the 270-degree position, what is the position of the TR rotor?
A. 210 degrees
B. 110 degrees
C. 250 degrees
D. 150 degrees *

29. If a TDR system is connected for addition and the TX rotor connected to the TDR rotor turns counterclockwise, in what direction will the TDR rotor field rotate?
A. Clockwise *
B. Counterclockwise
C. In a direction determined by the other TX stator
D. In a direction determined by the other TX rotor

30. Which of the following types of synchros is used in a system requiring large amounts of power and high accuracy?
A. Differential
B. Control *
C. Torque
D. All of the above

31. What are the three types of control synchros?
A. CX, CT, CDX *
B. CX, CT, CR
C. TX, CDX, CR
D. TX, TR, CT

32. The CX and CDX differ from the TX and TDX because the CX and CDX have which of the following characteristics?
A. Lower impedance windings
B. Larger physical size
C. Higher impedance windings *
D. Smaller physical size

33. Which of the following is not a characteristic of the rotor of a control transformer (CT) rotor?
A. It has a drum- or wound-type rotor
B. It must be turned by an external force
C. It is connected to an ac source *
D. It is connected to a high-impedance load

34. If a control transformer is held at electrical zero and the control transmitter is turned 90 degrees counterclockwise, what is (a) the amplitude of the induced voltage in the rotor of the control transformer, and (b) the phase relationship of this voltage and the excitation voltage to the control transmitter?
A. (a) Minimum (b) in phase
B. (a) Minimum (b) out-of-phase
C. (a) Maximum (b) in phase *
D. (a) Maximum (b) out-of-phase

35. Which of the following terms applies to the output of a control transformer?
A. Deflection angle
B. Mechanical movement
C. Error signal *
D. Output voltage

36. If the output of a control transformer is zero, what is the relationship of the rotors of the control transformer and the control transmitters?
A. Out of correspondence
B. In correlation
C. Out of correlation
D. In correspondence *

37. Synchro capacitors are used to provide which of the following characteristics in a synchro system?
A. Higher load-carrying capacity
B. Wider frequency response
C. Improved accuracy *
D. Reduced oscillations

38. Which of the following synchro devices uses a synchro capacitor?
A. CDX *
B. RX
C. TDR
D. TX

39. What type of current is eliminated by synchro capacitors?
A. Magnetizing Stator *
B. Loss
C. Rotor
D. Stator

40. In what configuration are synchro capacitors connected in a synchro circuit?
A. Delta, across the stator windings *
B. Wye, across the rotor windings
C. Delta, across the rotor windings
D. Wye, across the stator windings

41. To maintain system accuracy, where are synchro capacitors physically placed in a synchro circuit?
A. Far away from the TDR, CDX, or CT
B. Close to the TDX, CDX, or CT *
C. Midway between the TX and CT
D. Close to the TX or RX

42. Synchro systems that transmit data at two different speeds are referred to by which of the following terms?
A. Twin-speed
B. Dual-speed *
C. Two-speed
D. Each of the above

43. Multispeed synchro systems have which of the following advantages over single- speed synchro systems?
A. Greater accuracy *
B. Fewer moving parts
C. Easier to troubleshoot and align
D. All of the above

44. What does the gear ratio between the two transmitters in a dual-speed synchro system determine?
A. The relative direction of rotation
B. The direction of receiver rotation
C. The speeds of transmission *
D. The direction of transmitter-rotation

45. Which of the following synchro systems, if any, should be used to transmit very large quantities?
A. Two-speed
B. Single-speed
C. Tri-speed *
D. None of the above

46. Which of the following is a disadvantage of a double receiver as compared to two single receivers?
A. It is much more costly
B. The entire unit must be replaced if one portion fails *
C. It takes up much more space
D. It is much heavier

47. The voltage used to prevent false synchronizations is known by what term?
A. Signal voltage
B. Source voltage
C. Stickoff voltage *
D. Error voltage

48. What is the reference point for the alignment of all synchro units?
A. Mechanical null
B. Electrical zero *
C. Electrical null
D. Mechanical zero

49. What is the most accurate method of aligning a synchro?
A. The synchro-tester method
B. The ac voltmeter method *
C. The electric-lock method
D. The dc voltmeter method

50. During synchro alignment, what is the purpose of the coarse setting?
A. To correct the fine setting
B. To keep the synchro device from overheating
C. To ensure a setting of zero degrees rather than 180 degrees *
D. To prevent the voltmeter from being overloaded

51. If a synchro receiver is properly zeroed, when do the stator windings have electrical zero voltages?
A. When the rotor is stopped
B. When the rotor is at 270 degrees
C. When the rotor is at its reference position *
D. When the rotor is moving

52. When a 115-volt synchro transmitter is set on its coarse-zero position, approximately what voltage should be read on a voltmeter?
A. 15 volts
B. 26 volts
C. 37 volts *
D. 193 volts

53. When a 115-volt source is used during the alignment of a differential synchro, what is the maximum time the circuit can be energized without causing damage to the synchro?
A. 1 minute
B. 2 minutes *
C. 15 minutes
D. 30 minutes

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54. After a control transformer has been zeroed and clamped down, what is the final step in the zeroing procedure?
A. Recheck the zero voltage reading *
B. Turn it to 270 degrees
C. Disconnect all wires to the control transformer
D. Replace the fuses

55. The output voltage of a control transformer on electrical zero is which of the following relative values?
A. Minimum *
B. Maximum
C. Half the supply voltage
D. Equal to the supply voltage

56. When a tri-speed synchro system is being zeroed, which synchro should be zeroed first?
A. Fine
B. Medium
C. Largest
D. Coarse *

57. What method of zeroing a synchro is the fastest but NOT the most accurate?
A. The electrical-lock method *
B. The dc voltmeter method
C. The ac voltmeter method
D. The synchro-tester method

58. The electrical-lock method of zeroing a synchro requires accessible leads and which of the following conditions?
A. A zero-volt potential between S1 and S2
B. A supply voltage to the stators
C. A rotor free to turn *
D. A stator free to turn

59. A synchro is zeroed by the use of a synchro tester. After it is zeroed, the S1 and S3 leads are shorted together, and the synchro tester dial moves. What does this indicate?
A. The supply voltage is too high
B. The synchro is not zeroed correctly *
C. The supply voltage is too low
D. The synchro is zeroed correctly

60. If you find that a synchro has bad bearings, which of the following actions should you take?
A. Lubricate the synchro
B. Replace the bearing
C. Continue to use it
D. Replace the synchro *

61. Which of the following troubles is common in newly installed synchro systems?
A. Shorted synchro windings
B. Worn slip rings
C. Improper wiring *
D. Dirty brushes

62. What type of indicating device is usually installed in the stator circuit of a torque synchro system?
A. An overload indicator *
B. An ohmmeter indicator
C. A voltmeter indicator
D. A blown-fuse indicator

63. A synchro system with four receivers is malfunctioning. All of the receivers have incorrect readings. Which of the following is/are the most likely cause(s) of the trouble?
A. The transmitter *
B. All of the receivers
C. One of the receivers
D. Damper failure

64. An ac voltmeter is connected between windings S1 and S3 of a synchro transmitter. Which of the following rotor positions should give a zero voltage reading?
A. 300°
B. 240°
C. 330°
D. 180° *

65. When a synchro tester is used in place of a synchro transmitter, which of the following precautions will help to keep the tester from being overloaded?
A. Use a 115-volt supply only
B. Use a 26-volt supply only
C. Use at least three synchro receivers
D. Use only one syncho receiver *

66. A servo is normally designed to move (a) what type of load to (b) what type of positions?
A. (a) Small (b) Exact
B. (a) Large (b) Approximate
C. (a) Small (b) Approximate
D. (a) Large (b) Exact *

67. Servo systems can be found in which of the following forms?
A. Electromechanical
B. Hydraulic
C. Pneumatic
D. All of the above *

68. Which of the following systems are control systems?
A. Inductive-loop
B. Open-loop
C. Closed-loop
D. Both B and C *

69. A servo system is defined as which of the following types of control systems?
A. Inductive-loop
B. Open-loop
C. Closed-loop *
D. Both B and C

70. Which of the following is a basic difference between an open-loop control system and a closed-loop control system?
A. System of feedback *
B. Speed of movement
C. Size of the load
D. Number of loops

71. In a dc position servo system, what characteristic of the error signal determines the direction in which the load is driven?
A. Phase
B. Amplitude
C. Frequency
D. Polarity *

72. The sum point in a position servo system combines what two signals to produce an error signal?
A. Feedback and input *
B. Feedback and Output
C. Output and input
D. Response and output

73. A position servo system exhibits a series of overtravels. This condition is known by which of the following terms?
A. Undershooting
B. Overdamping
C. Hunting *
D. All of the above

74. A velocity servo has which of the following characteristics?
A. Senses speed of the load; error signal present at correspondence *
B. Senses speed of the load; no error signal at correspondence
C. Senses position of the load; error signal present at correspondence
D. Senses position of the load; no error signal at correspondence

75. What device is usually used to provide feedback in a velocity servo loop?
A. CX
B. CT
C. Tachometer *
D. Potentiometer

76. For a servo system to operate smoothly and efficiently, it must have balance between which of the following factors?
A. Amplification and damping *
B. Inertia and oscillation
C. Overshooting and feedback signal
D. Acceleration and speed

77. When friction-clutch damping is used in a servo system, the first overshoot of the load may be characterized as
A. eliminated
B. small
C. reversed
D. large *

78. Error-rate damping is considered to be better than friction or friction-clutch damping because of which of the following characteristics of the error-rate damping system?
A. A small change in the error signal causes maximum damping
B. A large change in the error signal causes maximum damping *
C. A small error signal of short duration will not be damped
D. A large error signal of short duration will not be damped

79. Under what condition would a servo system that is properly designed and operating correctly have an oscillating load?
A. Error-rate damping is used
B. Friction damping is used
C. The input signal oscillates *

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D. The input signal is large in amplitude

80. A servo system is found to be "noisy." If the bandwidth of the servo amplifier were adjusted to reject the unwanted noise signals, which of the following characteristics of the servo system would be affected?
A. Error-detection capability
B. Amplifier gain *
C. Correspondence position
D. Power requirements

81. Which of the following devices can be used as a position sensor in a servo system?
A. A CT
B. A potentiometer *
C. A summing network
D. An E-transformer

82. Which of the following devices are magnetic error detectors?
A. Summing networks
B. E-transformers *
C. CXs
D. All of the above

83. A dc rate generator is used in which of the following loops of a velocity servo system?
A. Prime mover
B. Error
C. Feedback *
D. Control

84. What is the function of a modulator in a servo system?
A. To convert an ac error signal to a dc error signal
B. To convert a dc error signal to an ac error signal *
C. To change the frequency of an ac error signal
D. To impress an ac error signal on an ac carrier

85. In a servo system that uses a modulator, what characteristic of the modulator output determines the direction of load movement?
A. Phase *
B. Amplitude
C. Polarity
D. Frequency

86. Which of the following objects has gyroscopic properties?
A. The moving blade assembly of an electric fan
B. A wheel on a moving bicycle
C. A spinning top
D. All of the above *

87. The ability of a gyro to maintain a fixed position in space is referred to by what term?
A. Gimbal-stability
B. Apparent rotation
C. Rigidity *
D. Precession

88. A gyro will resist all forces that attempt to change its
A. center of gravity
B. spin axis direction *
C. location
D. speed of rotation

89. What action takes place when an outside force attempts to tilt the spin axis of a gyro?
A. The gyro remains fixed in its original position
B. The gyro precesses in a direction at a right angle to the applied force *
C. The gyro precesses in a direction opposite to the applied force
D. The gyro precesses in the direction of the applied force

90. For a gyro to be universally mounted, it MUST have a total of how many gimbals, if any?
A. 1
B. 2 *
C. 3
D. 4

91. Of the following factors, which one does NOT affect rigidity?
A. Rotor position *
B. Rotor weight
C. Rotor shape
D. Rotor speed

92. The forces that act through the center of gravity of a gyro and do NOT cause precession are referred to by what term?
A. Forces of erection
B. Forces of isolation
C. Forces of induction
D. Forces of translation *

93. Which of the following factors determine(s) the amount of precession that will result from a given applied force?
A. Rotor shape
B. Rotor weight
C. Rotor speed
D. All of the above *

94. Which of the following factors determine(s) the direction a gyro will precess in response to a particular force?
A. Direction of the rotor's spin *
B. Shape of the rotor
C. Speed of the rotor's spin
D. All of the above

95. According to the right-hand rule for gyro precession, what does the thumb indicate?
A. Axis of rotor rotation only
B. Precession vector and axis *
C. Torque vector and axis
D. Spin vector and axis

96. Which of the following is a universally mounted gyro?
A. A rate gyro
B. A restrained gyro
C. A two-degrees-of-freedom gyro *
D. A one-degree-of-freedom gyro

Wireless LAN/ Wireless PAN Standards

Technology	Bluetooth™*	IEEE 802.11b	IEEE 802.11g	IEEE 802.15.3a (UWB)	IEEE 802.16a/e
Description	Wireless Personal Area Network (PAN)	Wireless Local Area Network (LAN)	Wireless Local Area Network (LAN)	Ultra Wideband Personal Area Network (PAN)	Wireless Metropolitan Area Network (MAN)
Introduction	2000	1999	2002-2003	2004-2005	a: 2005 e: 2006
Frequency range	ISM band: 2.400-2.4835 GHz	ISM band: 2.400 – 2.4835 GHz	2.4-2.4835 GHz	500 MHz Bands in the range 3.1-10.6 GHz	a: 2-11 GHz e: up to 5GHz
Multiple access technology	TDMA	CSMA-CA	CSMA-CA	CSMA-CA	TDMA
Symbol rate/chip rate	1 Msps	11Mchips/sec	--	Depends on format	--
Modulation	GFSK	CCK with DQPSK modulation for 5.5 and 11 Mbps data rates	52 sub-carrier OFDM	Shaped Pulse or Frequency switched OFDM	OFDM with QPSK, 16QAM, 64QAM
Maximum data rate	1 Mbps raw	11 Mbps raw	54 Mbps	480 Mbps	a: 75 Mbps e: 30 Mbps
Switching	Packet switched or synchronous	Packet switched	Packet	Packet	Packet

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Comparison between different WLAN/WPAN Standards

Standard	Bluetooth	Wireless Fidelity (WiFi) or IEEE 802.11b	Wireless ATM or IEEE 802.11a	ZigBee or IEEE 802.15.4	CDPD (Cellular Digital Packet Data)	HomeRF
Mobile Frequency Range	2.4-2.48 GHz	2.4-2.484 GHz	5.725-5.825 GHz	2.4-2.48 GHz	824-849 MHz 869-894 MHz	2.4-2.48 GHz
Multiple Access Method	Frequency Hopping	CSMA/CA	CSMA/CA	TDMA	FDMA	Frequency Hopping
Duplex Method	TDD	TDD	TDD	FDD	FDD	TDD
Number of Channels	79	FHSS: 79 DSSS: 11	--	--	832	--
Users per Channel	7 active, 200 inactive	127	127	255	1	8 active
Modulation	Shaped Binary FM	FHSS: GFSK DSSS: DQPSK CCK: QPSK	BPSK, 16-QAM, 64-QAM	GFSK	GMSK	FHSS
Channel Bit Rate	1 Mbps (symbol rate) 721 kbps raw date rate 56 kbps (return)	DSSS: 2 Mbps CCK: 11 Mbps	12 Mbps (symbol rate) 5.5-54 Mbps	28-250 kbps	19.2 kbps	1 Mbps (symbol rate) 1.6 to 10 Mbps

Wireless LAN/ Wireless PAN/ Wireless MAN

Technology	Technology Application	Date Rates	Typical Range
Bluetooth	Wireless Personal Area Network (WPAN)	0.723 Mbps	10 m
802.15.4 Zigbee	Wireless Personal Area Network (PAN)	0.250 Mbps	10 m to 100 m
802.11a (Wireless ATM)	Wireless Local Area Network (WLAN)	54 Mbps	300 m
802.11b (WiFi)	Wireless Local Area Network (WLAN)	11 Mbps	100 m
802.16a (WiMax)	Broadband Wireless Metropolitan Area Network (WMAN)	70 Mbps	Less than 3 km range