Series-A

ELECTRICAL ENGINEERING
PAPER – II

1. A single-phase half-controlled bridge converter feeds a resistive load. The supply voltage is $V_m \sin \omega t$. The average output voltage for firing angle α is

(a) $(V_m/\pi)(1 + \cos \alpha)$
(b) $(2V_m/\pi) \cos \alpha$
(c) $(V_m/2\pi)(1 + \cos \alpha)$
(d) $(V_m/\pi) \cos \alpha$

2. In a single-phase bridge rectifier using PN diodes, the peak inverse voltage (PIV) across each diode when input voltage is $V \sin \omega t$ is

(a) V
(b) 2V
(c) V/2
(d) $V/\sqrt{2}$

3. In a three-phase controlled bridge rectifier, as the firing angle α increases, the output DC voltage

(a) increases
(b) decreases
(c) remains unchanged
(d) first increases then decreases

4. A single-phase full-wave AC voltage controller feeds a 20 Ω resistive load from a 230 V (rms), 50 Hz supply. For a firing angle of 60°, the power delivered to the load is

(a) 1.32 kW
(b) 1.98 kW
(c) 2.64 kW
(d) 0.66 kW

5. A single-phase full-bridge VSI has a capacitor C as the load. For a constant DC input voltage, the current through the capacitor is

(a) Triangular wave
(b) Square wave
(c) Sine wave
(d) Sawtooth wave

6. Which of the following pairs related to DC motor drives is INCORRECTLY matched?

(a) Fully controlled bridge converter – two-quadrant operation
(b) Half-controlled bridge converter – one-quadrant operation
(c) Dual converter – four-quadrant operation
(d) Step-down chopper – four-quadrant operation

7. For speed control of a high-speed, low-capacity synchronous motor, the preferred power electronic circuit is

(a) Cycloconverter
(b) Voltage-fed inverter
(c) Current-fed inverter
(d) AC voltage controller

8. Assertion: Static Kramer drive is used for speed control of slip-ring induction motors.
Reason: It allows recovery of slip power back to the supply.

(a) Assertion and Reason are correct. Reason explains Assertion.
(b) Assertion and Reason are correct. Reason does not explain Assertion.
(c) Assertion is true. Reason is false.
(d) Assertion is false. Reason is true.

9. The output of an arc welding transformer is characterized by

(a) High voltage and low current
(b) Low voltage and high current
(c) High voltage and high current
(d) Low voltage and low current

10. In a McMurray inverter (auxiliary-commutated inverter),

(a) Commutation energy is stored in the LC circuit
(b) Natural commutation is employed
(c) No commutation circuit is needed
(d) A transformer is used for commutation

11. A three-phase bridge inverter operating in 120° conduction mode supplies a balanced resistive Y-connected load. The rms value of the fundamental phase voltage across the load is (V_s = DC supply voltage)

(a) $0.3928\ V_s$
(b) $0.4502\ V_s$
(c) $0.6366\ V_s$
(d) $0.7071\ V_s$

12. In a three-phase to three-phase cycloconverter, the number of thyristors required is

(a) 18
(b) 36
(c) 6
(d) 12

13. For two-quadrant operation of a separately excited DC motor (motoring in both directions), the converter used is

(a) Dual converter
(b) Half-controlled bridge converter
(c) Fully controlled bridge converter with field reversal
(d) Step-down chopper

14. Consider the following power electronic circuits for speed control of DC drives:
1. Fully controlled bridge converter 2. Half-controlled bridge converter
3. Dual converter 4. DC chopper
Which of the above can provide two-quadrant operation?

(a) 1 and 3 only
(b) 1, 2 and 4
(c) 1 and 4 only
(d) 2 and 3 only

15. Consider the following statements about a voltage-fed inverter (VSI):
1. DC link has a large capacitor
2. Source appears as a constant current source
3. Can handle regenerative loads
4. Requires feedback diodes
Which are correct?

(a) 1, 3 and 4
(b) 2 and 3
(c) 1 and 4
(d) 1, 2 and 3

16. The PWM technique that offers better harmonic elimination and higher DC bus utilization in a three-phase VSI is

(a) Sinusoidal PWM
(b) Space vector PWM
(c) Hysteresis current control PWM
(d) Selected harmonic elimination PWM

17. A phase-controlled converter with ideal thyristors has an overlap angle of 20° at α = 0°. At the inverter limit (α = 150°), the overlap angle will be

(a) 20°
(b) less than 20°
(c) greater than 20°
(d) 30°

18. In a three-phase full-wave (six-pulse) AC-to-DC converter, the ratio of ripple frequency to supply frequency is

(a) 3
(b) 6
(c) 12
(d) 2

19. In a single-phase fully controlled bridge converter with ripple-free load current I_L, the average current through each thyristor is

(a) $I_L/2$
(b) $I_L/4$
(c) I_L
(d) $I_L/3$

20. An SMPS operating at 200 kHz to 500 kHz typically uses which device as the main switching element?

(a) GTO
(b) IGBT
(c) SCR
(d) Power MOSFET

21. A step-down (buck) chopper has input voltage V_s, duty cycle D, and resistive load R. The average output voltage is

(a) DV_s
(b) $\sqrt{D} \cdot V_s$
(c) D^2V_s
(d) $V_s/(1-D)$

22. A step-up (boost) chopper fed from 120 V DC with duty ratio 0.4 provides an output voltage of

(a) 200 V
(b) 150 V
(c) 300 V
(d) 240 V

23. A step-down chopper feeds a separately excited DC motor at duty ratio D. Assuming continuous current, the ripple factor of the armature voltage is

(a) $\sqrt{[(1-D)/D]}$
(b) $(1-D)/D$
(c) $\sqrt{[D/(1-D)]}$
(d) $D/(1-D)$

24. A step-up chopper must deliver 500 V from a 200 V DC source. The thyristor ON time (T_{ON}) for a total period T = 500 µs is

(a) 200 µs
(b) 300 µs
(c) 400 µs
(d) 100 µs

25. A single-phase fully controlled bridge rectifier has supply voltage 300 sin 314t and feeds a resistive load. The average output voltage at firing angle $\alpha = 30°$ is

(a) 165.4 V
(b) 190.9 V
(c) 270.1 V
(d) 147.0 V

26. The minimum number of 2-input NOR gates required to implement a 2-input XNOR gate is

(a) 3
(b) 4
(c) 5
(d) 6

27. The logic family best suited for high-speed ECL applications requiring low propagation delay is

(a) TTL
(b) CMOS
(c) ECL
(d) I^2L

28. A half adder circuit has

(a) two inputs and one output
(b) three inputs and two outputs
(c) two inputs and two outputs
(d) three inputs and one output

29. A full subtractor can be realized using two half subtractors and one

(a) AND gate
(b) NAND gate
(c) OR gate
(d) NOR gate

30. A lamp is controlled by two switches P and Q such that it glows only when both switches are simultaneously ON or simultaneously OFF. The Boolean expression is

(a) PQ + P'Q'
(b) PQ' + P'Q
(c) P + Q
(d) $P \oplus Q$

31. A demultiplexer has 1 data input, m selection inputs and n data outputs. The relationship is

(a) $n = 2^m$
(b) $m = 2^n$
(c) $n = m^2$
(d) $m = n^2$

32. A sequential circuit element whose output changes on the active clock edge and remembers its state is

(a) SR latch
(b) D latch
(c) D flip-flop
(d) T latch

33. How many flip-flops are needed to build a decade (mod-10) counter?

(a) 3
(b) 4
(c) 5
(d) 10

34. The Boolean expression (A + B')(A' + C)(B + C) simplifies to

(a) AC + A'B
(b) AB' + A'C
(c) AC + B'C
(d) AB + BC

35. For a monostable multivibrator, an external trigger is employed

(a) always
(b) never
(c) only once at startup
(d) to initiate each output pulse

36. Which of the following is used as a frequency divider?

(a) Astable multivibrator
(b) Monostable multivibrator
(c) Bistable multivibrator
(d) Schmitt trigger

37. The propagation delay of a digital IC refers to

(a) time for output to change after input changes
(b) time for a flip-flop to change state
(c) rise time of the output
(d) fall time of the output

38. A 4-bit ripple carry adder requires

(a) 4 full adders
(b) 3 full adders and 1 half adder
(c) 4 half adders
(d) 2 full adders and 2 half adders

39. Which of the following is NOT a characteristic of an astable multivibrator?

(a) It has no stable state
(b) It requires an external trigger
(c) It generates a continuous square wave
(d) It uses positive feedback

40. A common-emitter BJT amplifier has $h_{fe} = 150$, $h_{ie} = 3\ k\Omega$, $r_{bb'} = 0$. At room temperature $V_T = 26$ mV. The quiescent collector current I_{CQ} is

(a) 5 mA
(b) 1.3 mA
(c) 13 mA
(d) 0.5 mA

41. Thin-film ICs are fabricated on

(a) a silicon wafer
(b) a glass or ceramic substrate
(c) a single crystal chip
(d) a PCB

42. A 7-segment display shows the digit '3'. The active segments are

(a) a, b, c, d, g
(b) a, b, c, d, e, g
(c) a, b, g, f, e
(d) b, c, d, f, g

43. The circuit consisting of three pnp transistors with collectors tied together and emitters connected to individual inputs, all feeding a common resistor to $-V_{CC}$, is a

(a) 3-input OR gate
(b) 3-input AND gate
(c) 3-input NOR gate
(d) 3-input NAND gate

44. The circuit with a diode and capacitor in series with the AC source, followed by a resistive load, acts as a

(a) negative clamper
(b) positive clipper
(c) positive clamper
(d) half-wave rectifier

45. Which one of the following is a combinational (non-sequential) circuit?

(a) JK flip-flop
(b) Ring counter
(c) Priority encoder
(d) Shift register

46. Output of a logic gate is '0' when all inputs are at '1'. The gate is

(a) AND or XNOR
(b) NAND or NOR
(c) NAND or XOR
(d) NOR or XNOR

47. In Boolean algebra, if F = (A' + B)(A + C'), then

(a) F = A'C' + AB
(b) F = A'B + AC'
(c) F = A'B + A'C'
(d) F = AB' + A'C

48. In the Indian television (PAL) system, the frame rate is

(a) 25 frames/sec
(b) 30 frames/sec
(c) 50 frames/sec
(d) 60 frames/sec

49. The magnetic field in a cavity magnetron serves to

(a) ensure the electrons travel in curved paths around the cathode
(b) increase the oscillation frequency
(c) focus the output microwave beam
(d) modulate the output power

50. When the modulation index of an AM wave is changed from 0 to 0.5, the total transmitted power increases by

(a) 12.5%
(b) 25%
(c) 50%
(d) 100%

51. Which antenna is most suitable for wideband HF transmission?

(a) Yagi-Uda
(b) Rhombic
(c) Log-periodic dipole array
(d) Folded dipole

52. A rectangular air-filled waveguide has dimensions 7 cm × 3.5 cm. The cutoff frequency of the dominant TE_{10} mode is

(a) 2.14 GHz
(b) 4.28 GHz
(c) 1.07 GHz
(d) 3.0 GHz

53. For a transmission line terminated in its characteristic impedance Z_0, the VSWR is

(a) 0
(b) 1
(c) infinity
(d) 0.5

54. If the total radiated power of an AM transmitter is 15 kW at a modulation index of 0.8, the carrier power is approximately

(a) 11.36 kW
(b) 12.5 kW
(c) 10.0 kW
(d) 13.89 kW

55. The noise figure of an amplifier is 6 dB. Its equivalent noise temperature above 290 K is

(a) 580 K
(b) 870 K
(c) 1160 K
(d) 290 K

56. Strapping in a cavity magnetron is used to

(a) prevent mode jumping
(b) increase the anode current
(c) cool the cathode
(d) improve electron emission

57. In microwave line-of-sight links, repeater stations are typically spaced at intervals of

(a) 5 km
(b) 15 km
(c) 50 km
(d) 200 km

58. The major disadvantage of a single-hole directional coupler is

(a) high insertion loss
(b) poor directivity
(c) narrow bandwidth
(d) high VSWR

59. Which mode cannot propagate in a hollow rectangular metallic waveguide?

(a) TE_{10}
(b) TE_{20}
(c) TEM
(d) TM_{11}

60. Which waveguide tuning element provides a purely reactive (imaginary) impedance change and is continuously variable?

(a) Iris
(b) Post
(c) Sliding short (plunger)
(d) Screw

61. Domestic satellites used for TV broadcasting within a country are called

(a) INTELSAT
(b) DOMSAT
(c) MARISAT
(d) COMSAT

62. At microwave frequencies, vacuum tubes fail mainly because their

(a) shunt capacitive reactances become negligibly small
(b) transit time becomes comparable to the signal period
(c) filament current is too high
(d) plate dissipation increases

63. A Cassegrain antenna uses a secondary subreflector to

(a) place the feed at a convenient rear location
(b) increase the side-lobe level
(c) widen the beamwidth
(d) reduce the gain

64. In a modulation system where doubling the modulating frequency halves the modulation index while keeping the modulating voltage constant, the system is

(a) AM
(b) FM
(c) PM
(d) SSB

65. In a PCM system with 8 quantization bits per sample and a maximum signal frequency of 4 kHz, the bit transmission rate (by Nyquist) is

(a) 32 kbps
(b) 64 kbps
(c) 128 kbps
(d) 16 kbps

66. A low-pass signal bandlimited to 3 kHz is sampled. The minimum (Nyquist) sampling frequency is

(a) 3 kHz
(b) 6 kHz
(c) 1.5 kHz
(d) 12 kHz

67. For minimum attenuation over long distances, the preferred transmission medium is

(a) Coaxial cable
(b) Optical fibre
(c) Rectangular waveguide
(d) Twisted pair

68. A backward wave oscillator (BWO) is a

(a) Microwave amplifier using forward wave interaction
(b) Voltage-tunable microwave oscillator
(c) High-power pulsed transmitter
(d) Low-noise microwave preamplifier

69. Which of the following is NOT a slow-wave structure used in a TWT?

(a) Helix
(b) Coupled cavities
(c) Ring-and-bar
(d) Circular resonant cavity

70. In frequency-division multiplexing (FDM),

(a) each channel occupies a separate frequency band
(b) channels share the medium by taking turns in time slots
(c) data is transmitted in digital pulses only
(d) all channels use the same carrier frequency

71. In a radar system, if the antenna diameter is doubled, the maximum range increases by a factor of

(a) 2
(b) $\sqrt{2}$
(c) 4
(d) 8

72. Sound information in an analogue TV broadcast signal is transmitted using

(a) AM
(b) FM
(c) PM
(d) SSB

73. The reflex klystron is primarily used as

(a) a high-power microwave amplifier
(b) a low-power microwave oscillator
(c) a microwave mixer
(d) a microwave switch

74. A resonant antenna is

(a) Rhombic
(b) Beverage (wave) antenna
(c) Half-wave dipole
(d) Log-periodic

75. A short vertical grounded monopole antenna of effective height h_{eff} = 15 m radiates at 1 MHz. Its radiation resistance is approximately

(a) 1.48 Ω
(b) 4.62 Ω
(c) 7.4 Ω
(d) 14.8 Ω

76. A three-phase induction motor has a starting current equal to six times full-load current, and full-load slip of 5%. The ratio of starting torque to full-load torque (neglecting stator resistance) is

(a) 0.18
(b) 1.8
(c) 0.36
(d) 3.6

77. A three-phase induction generator operating above synchronous speed for self-excitation

(a) draws reactive power from the supply grid
(b) feeds real power to the supply grid
(c) supplies both real and reactive power to the grid
(d) draws both real and reactive power from the grid

78. For obtaining very high starting torque in a three-phase induction motor, the most suitable rotor is

(a) Squirrel cage
(b) Double squirrel cage
(c) Wound rotor (slip ring)
(d) Deep bar squirrel cage

79. The speed-torque characteristic of a series DC motor resembles that of a

(a) repulsion motor
(b) synchronous motor
(c) shunt DC motor
(d) universal motor

80. The drag-cup rotor used in a two-phase AC servo motor is designed to

(a) increase rotor inertia for smooth operation
(b) reduce rotor inertia for fast dynamic response
(c) improve power factor
(d) increase starting torque

81. Regarding a universal motor, which of the following statements are TRUE?
1. Speed–torque characteristic is similar to DC series motor
2. It can operate on both AC and DC supply
3. Power factor is unity at all loads
4. Commutation is excellent at high speeds
Select the correct combination:

(a) 1 and 2 only
(b) 1, 2 and 3
(c) 2 and 4 only
(d) 3 and 4 only

82. A six-pole, 50 Hz, three-phase induction motor runs at 940 rpm at full load. The percent slip is

(a) 3%
(b) 5%
(c) 6%
(d) 4%

83. If an alternator connected to an infinite bus loses its prime mover input suddenly, it will

(a) come to a standstill immediately
(b) continue as a synchronous motor in the same direction
(c) run as an induction generator
(d) reverse direction of rotation

84. Which voltage regulation method for a three-phase alternator gives results that are too optimistic (lower than actual regulation)?

(a) Synchronous impedance (EMF) method
(b) MMF (ampere-turn) method
(c) Zero power factor (Potier) method
(d) ASA method

85. Which pair is NOT correctly matched for an induction generator?
List – I → List – II

(a) Capacitive load → negative voltage regulation
(b) Distributed winding → reduction in harmonics
(c) Salient pole rotor → reluctance power present
(d) Over-excitation → leading power factor at terminals

86. Which pair is CORRECTLY matched for an electric motor?
List – I → List – II

(a) Shaded-pole motor → high efficiency
(b) Over-excited synchronous motor → lagging power factor
(c) Hysteresis motor → constant speed from sub- to synchronous speed
(d) Linear induction motor → rotary motion output

87. The Potier (zero power factor) method for an alternator is used to determine

(a) short-circuit ratio
(b) Potier reactance and voltage regulation
(c) synchronous impedance
(d) efficiency

88. A 4-pole, 50 Hz, three-phase induction motor has full-load speed 1440 rpm. At half load, the speed will be approximately

(a) 1440 rpm
(b) 1470 rpm
(c) 720 rpm
(d) 1380 rpm

89. A fundamental requirement of a DC servo motor is that it must produce high torque at

(a) all speeds
(b) low speeds only
(c) high speeds only
(d) synchronous speed

90. A two-phase AC servo motor differs from a standard single-phase induction motor mainly because it has

(a) a low rotor resistance
(b) a high rotor resistance
(c) a salient pole stator
(d) a squirrel cage rotor only

91. For a three-phase induction motor at low slip s, the torque is proportional to (V_1 = stator voltage, R_2' = rotor resistance referred to stator)

(a) $V_1^2 \cdot s / R_2'$
(b) $V_1^2 \cdot R_2' / s$
(c) $V_1 \cdot s / R_2'$
(d) $V_1^2 \cdot (1-s) / R_2'$

92. In a synchronous machine, when a three-phase short circuit occurs at the terminals while on no load, the DC offset component in the fault current decays with which time constant?

(a) Subtransient time constant T_d''
(b) Transient time constant T_d'
(c) Armature (DC) time constant T_a
(d) Open-circuit time constant T_{d0}'

93. In a synchronous generator, the pitch factor for a coil pitched 5/6 of full pitch is

(a) 0.866
(b) 0.966
(c) 0.707
(d) 1.0

94. Damper windings in a synchronous machine are used to

(a) damp out hunting oscillations
(b) improve power factor
(c) reduce armature reaction
(d) increase synchronizing power

95. When the field current of an over-excited synchronous motor is reduced to make it normally excited (unity power factor), the armature current

(a) increases
(b) decreases to a minimum
(c) remains the same
(d) decreases then increases

96. A salient-pole synchronous motor develops reluctance torque maximum at a load angle of

(a) 90°
(b) 45°
(c) 30°
(d) 60°

97. Torque developed in a three-phase induction motor is maximum when the rotor circuit power factor is

(a) 0.707 lagging
(b) 0.866 lagging
(c) unity
(d) $1/\sqrt{2}$ leading

98. An Amplidyne is essentially a

(a) high-gain, fast-response DC amplifier/generator
(b) single-phase AC induction generator
(c) type of stepper motor
(d) power MOSFET driver circuit

99. In stepper motors,

(a) speed is proportional to the applied voltage
(b) position is controlled open-loop by pulse counting
(c) starting current is very high
(d) they cannot operate in reverse

100. A 6-pole synchronous motor has a torque angle of 12° mechanical. The torque angle in electrical degrees is

(a) 12°
(b) 36°
(c) 72°
(d) 24°

101. To eliminate the 7th harmonic from the induced EMF of a three-phase alternator, the winding pitch should be

(a) 5/6
(b) 6/7
(c) 4/5
(d) 7/8

102. A three-phase induction motor always operates at

(a) lagging power factor
(b) leading power factor
(c) unity power factor
(d) either lagging or leading depending on load

103. A reluctance motor can run at

(a) synchronous speed only
(b) below synchronous speed only
(c) synchronous and sub-synchronous speeds
(d) any speed depending on load

104. The two stator windings of a two-phase AC servo motor must be supplied with voltages having a phase difference of

(a) 0°
(b) 90°
(c) 45°
(d) 180°

105. In a synchronous machine, armature flux aids the main field flux when the load power factor is

(a) zero leading
(b) unity
(c) zero lagging
(d) 0.8 leading

106. Two mechanically coupled alternators deliver power at 50 Hz and 60 Hz respectively. The lowest possible synchronous speed of the set is

(a) 250 rpm
(b) 300 rpm
(c) 500 rpm
(d) 600 rpm

107. A 4-pole, 50 Hz three-phase induction motor runs at 1440 rpm at full load. The frequency of the rotor-induced current is

(a) 50 Hz
(b) 2 Hz
(c) 4 Hz
(d) 10 Hz

108. A rotor resistance starter (external resistance in rotor circuit) is used with

(a) Squirrel-cage induction motor
(b) Slip-ring (wound rotor) induction motor
(c) Single-phase capacitor-start motor
(d) Synchronous motor

109. Shaded-pole starting is used in

(a) Three-phase squirrel-cage motors
(b) Single-phase fractional-horsepower induction motors
(c) DC shunt motors
(d) Universal motors

110. For a three-phase induction motor at slip s, the ratio of mechanical power developed to the air-gap power is

(a) s
(b) 1-s
(c) s(1-s)
(d) $1-s^2$

111. The reactive power capability of a synchronous generator at lagging power factor is limited mainly by

(a) armature current
(b) field current heating
(c) stability limit (load angle)
(d) prime mover rating

112. SF_6 gas is preferred in circuit breakers because

(a) it is non-toxic and environmentally friendly
(b) its dielectric strength is much higher than air and it has excellent arc-quenching properties
(c) it is cheap and widely available
(d) it liquifies at room temperature aiding cooling

113. The circuit breaker best suited for interrupting DC arc faults in HVDC systems is

(a) Vacuum circuit breaker
(b) SF_6 circuit breaker
(c) Air-blast circuit breaker
(d) Solid-state (power-electronic) circuit breaker

114. For protection of EHV (400 kV and above) AC transmission lines, the preferred circuit breaker type is

(a) Bulk oil circuit breaker
(b) Minimum oil circuit breaker
(c) SF_6 circuit breaker
(d) Air circuit breaker (ACB)

115. The relay used for protection of HV transmission lines against ground (earth) faults is

(a) Directional overcurrent relay
(b) MHO relay
(c) Thermal relay
(d) Differential relay

116. For protection of distribution feeders (11 kV and below), the following circuit breakers are commonly used:
1. Vacuum circuit breaker 2. Air circuit breaker
3. SF_6 circuit breaker 4. Bulk oil circuit breaker
Which combination is correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 4 only
(d) 3 and 4 only

117. The relay recommended for protection of long HV AC transmission lines against power swing is

(a) Instantaneous overcurrent relay
(b) MHO (admittance) relay
(c) Reactance relay
(d) Negative sequence relay

118. A fault is most severe from the perspective of RRRV (rate of rise of recovery voltage) when it is a

(a) three-phase fault
(b) short-line fault
(c) long-line fault
(d) generator terminal fault

119. Simultaneous tripping of circuit breakers at both ends of a transmission line without communication is provided by

(a) Distance protection (zone 1)
(b) Pilot protection using carrier current
(c) Overcurrent protection
(d) Differential protection

120. Which protection scheme is NOT normally applied to a large power transformer?

(a) Differential protection
(b) Buchholz relay
(c) Negative sequence overcurrent relay
(d) Distance protection

121. When a bus-bar fault occurs, the buszone protection relay should

(a) trip only the faulted feeder breaker
(b) trip all circuit breakers connected to the faulty bus section
(c) issue an alarm and wait for manual intervention
(d) trip only the incoming source breaker

122. In an AC circuit breaker during arc extinction, the arc voltage is

(a) in phase with the arc current
(b) leading the arc current by 90°
(c) lagging the arc current by 90°
(d) in phase opposition to the arc current

123. Match the type of fault in a generator (List I) with the appropriate protection (List II):
A. Inter-turn winding fault 1. Distance relay
B. Over-speed 2. Differential protection
C. Unbalanced loading 3. Negative sequence relay
D. Loss of field 4. Under-frequency relay

(a) A-2, B-4, C-3, D-1
(b) A-1, B-2, C-3, D-4
(c) A-2, B-1, C-4, D-3
(d) A-3, B-4, C-1, D-2

124. An MHO relay is best described as a

(a) voltage-restrained directional impedance relay
(b) current-restraint overcurrent relay
(c) directional overcurrent relay
(d) thermal overcurrent relay

125. Directional overcurrent relays are typically used to protect

(a) Ring-main (loop) distribution systems
(b) Radial feeders
(c) Large power transformers
(d) High-voltage bus bars

126. In an AC circuit breaker, the arc is interrupted at

(a) the instant of peak arc current
(b) a natural current zero
(c) the peak of the recovery voltage
(d) any random instant after contact separation

127. Which relay can detect incipient (developing) faults inside an oil-filled transformer before they become serious?

(a) Overcurrent relay
(b) Differential relay
(c) Buchholz relay
(d) Distance relay

128. How many overcurrent relays are required to detect all inter-phase faults in a three-phase system?

(a) 1
(b) 2
(c) 3
(d) 6

129. The relay that provides primary protection to about 80–90% of a transmission line in the forward direction is

(a) Directional overcurrent relay
(b) MHO relay (zone 1)
(c) Carrier-aided distance relay
(d) Differential relay

130. For HV and EHV substations, the preferred circuit breaker type is

(a) SF_6 circuit breaker
(b) Vacuum circuit breaker
(c) Bulk oil circuit breaker
(d) Air circuit breaker

131. The characteristic impedance (surge impedance) of a transmission line is independent of

(a) line inductance L
(b) line capacitance C
(c) line length
(d) conductor material

132. A relay has CT ratio 200/5, relay current setting 100%, and fault current 4000 A. The plug-setting multiplier (PSM) is

(a) 10
(b) 20
(c) 5
(d) 40

133. Negative sequence protective relays are typically applied to protect

(a) Transformers
(b) Generators and motors
(c) Transmission lines
(d) Bus bars

134. Protection against direct lightning strokes on a transmission line is most effectively provided by

(a) Surge arresters (lightning arresters) at tower bases only
(b) Ground (earth) wires strung above the phase conductors
(c) Arcing horns on insulators
(d) Grounding the neutral

135. A minimum oil circuit breaker uses less oil than a bulk oil circuit breaker because

(a) solid insulation isolates the interrupting chamber from earth
(b) its voltage rating is lower
(c) it operates at lower current
(d) the contacts are smaller

136. A relay has CT ratio = 500/5, fault current = 5000 A, and percentage relay current setting = 125%. The PSM is

(a) 5
(b) 8
(c) 10
(d) 4

137. In a short-circuit test on a circuit breaker, the time to peak of the restriking voltage is 60 μs. The natural frequency of oscillation is approximately

(a) 4.17 kHz
(b) 8.33 kHz
(c) 16.7 kHz
(d) 2.08 kHz

138. For a Buchholz relay, which statement is INCORRECT?

(a) It is actuated by gas evolved from oil decomposition
(b) It can be used with conservator-type transformers
(c) It can also protect the HV cable connected to the transformer
(d) It gives a warning alarm for slow faults and trips for sudden faults

139. The distance relay with the characteristic that is a circle passing through the origin of the R-X diagram is the

(a) Impedance relay
(b) Reactance relay
(c) MHO relay
(d) Offset MHO relay

140. Which of the following is NOT a routine type test for circuit breakers?

(a) Dielectric withstand test
(b) Breaking capacity test
(c) Making capacity test
(d) Impulse current test

141. Unit (differential) protection provides

(a) primary protection for the equipment within its zone
(b) backup protection for adjacent zones
(c) remote backup to breaker failure
(d) protection for the whole system

142. For overload protection of AC motors, the relay normally used is

(a) MHO relay
(b) Differential relay
(c) Thermal (bimetallic) relay
(d) Distance relay

143. A reactance relay is preferred for the protection of

(a) Short transmission lines
(b) Long transmission lines
(c) Medium transmission lines
(d) Bus bars

144. The time taken for a travelling wave to traverse a 300 km overhead transmission line is approximately

(a) 1 ms
(b) 0.1 ms
(c) 100 μs
(d) 10 μs

145. The earth wire (ground wire) on an EHV transmission line is installed to

(a) reduce the capacitance of the line
(b) provide a low-resistance return path for load current
(c) shield the phase conductors from direct lightning strikes
(d) reduce corona loss

146. RRRV is normally expressed in units of

(a) V/μs
(b) kV/μs
(c) kV/ms
(d) MV/s

147. The primary reason for using higher and higher transmission voltages is to

(a) increase the power transfer capability and reduce losses
(b) reduce the number of transmission towers
(c) lower the cost of insulators
(d) eliminate the need for reactive compensation

148. A lossless transmission line (Z_0 = 400 Ω) is terminated in an open circuit. The reflection coefficient at the open end is

(a) 0
(b) -1
(c) +1
(d) +0.5

149. After final current interruption in a circuit breaker, the voltage that appears across the open contacts is the

(a) Restriking voltage
(b) Recovery voltage
(c) Supply voltage
(d) Arc voltage

150. The contact resistance of a well-maintained circuit breaker is of the order of

(a) 20 mΩ
(b) 20 μΩ
(c) 20 Ω
(d) 200 mΩ

151. Which numerical method is used to solve ordinary differential equations step by step?

(a) Gauss–Seidel method
(b) Runge–Kutta method
(c) Newton–Raphson method
(d) Bisection method

152. For an ideal op-amp inverting amplifier with R_f = 100 kΩ and R_{in} = 10 kΩ, the input impedance seen by the source is

(a) 110 kΩ
(b) 10 kΩ
(c) infinity
(d) 100 kΩ

153. In a non-inverting amplifier using an ideal op-amp, the two inputs are at the same potential because

(a) the input terminals are internally shorted
(b) the open-loop gain is infinite (virtual short)
(c) CMRR is zero
(d) the output impedance is zero

154. When $R_f >> R_1$ in a non-inverting op-amp circuit with R_1 in feedback and R_f to ground, the circuit behaves as

(a) a voltage follower (unity gain)
(b) a high-gain inverting amplifier
(c) an integrator
(d) a Schmitt trigger

155. If the input V_i to an op-amp differentiator circuit is a ramp (linearly increasing), the output V_0 will be

(a) a parabola
(b) a constant (DC) voltage
(c) a triangular wave
(d) a sinusoid

156. A 2 MHz carrier is frequency modulated by a 10 kHz audio signal. The lower sideband frequency of the first FM sideband is

(a) 1990 kHz
(b) 2010 kHz
(c) 1999 kHz
(d) 2001 kHz

157. In the op-amp summing amplifier shown, with $R_f = 12\ k\Omega$, $R_1 = 4\ k\Omega$ ($V_1 = +1$ V), $R_2 = 6\ k\Omega$ ($V_2 = +2$ V), the output V_0 is

(a) –7 V
(b) +7 V
(c) –3 V
(d) +3 V

158. Using Newton–Raphson method to solve $x^2 – 5 = 0$ with $x_0 = 2$, the first iterate x_1 is

(a) 2.25
(b) 2.5
(c) 2.236
(d) 2.333

159. In which iterative numerical method does the convergence rate depend most critically on the choice of initial guess?

(a) Bisection method
(b) False position (Regula Falsi) method
(c) Newton–Raphson method
(d) Fixed-point iteration

160. Differentiators are rarely used in analog computers because

(a) their gain increases with frequency, amplifying high-frequency noise
(b) they are harder to build than integrators
(c) they cannot process DC signals
(d) they require a larger op-amp

161. An op-amp oscillator (Wien bridge) will sustain oscillations when the loop gain is

(a) exactly $1\angle 0°$
(b) greater than $1\angle 0°$
(c) less than $1\angle 0°$
(d) $1\angle 180°$

162. In the shown op-amp non-inverting amplifier, if the feedback resistor is doubled, the closed-loop gain

(a) approximately doubles
(b) exactly halves
(c) remains the same
(d) becomes unity

163. A differential amplifier has two modes: differential mode and common mode. The key figure of merit is

(a) CMRR (Common Mode Rejection Ratio)
(b) Slew rate
(c) Gain-bandwidth product
(d) Input offset voltage

164. The –3 dB bandwidth of a single-tuned (LC) amplifier is equal to

(a) f_r/Q
(b) $f_r \times Q$
(c) Q/f_r
(d) $1/(f_r \times Q)$

165. A shunt capacitor filter works satisfactorily (with low ripple) only when the load

(a) current is low (high impedance load)
(b) current is high
(c) voltage is very high
(d) is purely inductive

166. An RLC parallel resonant circuit has resonant frequency $f_r = 500$ kHz and $Q = 80$. Its –3 dB bandwidth is

(a) 6.25 kHz
(b) 5 kHz
(c) 12.5 kHz
(d) 2.5 kHz

167. Which amplifier configuration provides the highest gain–bandwidth product?

(a) Common emitter
(b) Common base
(c) Common collector
(d) Cascode (CE-CB)

168. An op-amp has a slew rate of 2 V/μs. The full-power bandwidth for a peak output of 8 V is approximately

(a) 39.8 kHz
(b) 79.6 kHz
(c) 19.9 kHz
(d) 159.2 kHz

169. In a digital computer, floating-point arithmetic compared to fixed-point (integer) arithmetic requires

(a) less time and less memory
(b) more time and more memory
(c) more time and less memory
(d) less time and more memory

170. A negative feedback amplifier has open-loop gain A = 1000 and feedback factor β = 0.02. The lower cutoff frequency without feedback is 50 Hz. With feedback, the lower cutoff frequency becomes

(a) 50 Hz
(b) 2.38 Hz
(c) 1050 Hz
(d) 25 Hz

171. In serial communication, the start bit is used to

(a) indicate the end of a data frame
(b) synchronize the receiver clock to the incoming data
(c) indicate parity
(d) signal a data error

172. In an 8085 microprocessor, the accumulator contents are NOT altered by

(a) ADI 05H
(b) CMP B
(c) ANA C
(d) ORI 0FH

173. In the 8085 microprocessor, the memory address register (MAR) is loaded from

(a) the instruction register
(b) the program counter or a register pair
(c) the accumulator
(d) the stack pointer only

174. The 8085 instruction that exchanges the contents of the HL register pair with the top two bytes of the stack is

(a) XTHL
(b) PCHL
(c) XCHG
(d) SPHL

175. Access in a magnetic disk (hard disk) memory is

(a) truly random (any byte immediately)
(b) sequential only
(c) semi-random (random track, sequential within track)
(d) cyclic sequential only

176. The flag register of the 8085 microprocessor has five flags. The flag that is set when the result of an arithmetic operation is zero is

(a) Sign flag (S)
(b) Zero flag (Z)
(c) Carry flag (CY)
(d) Parity flag (P)

177. The DC characteristics of a memory chip include

(a) access time
(b) cycle time
(c) power supply current and voltage levels
(d) propagation delay

178. At the output port interface of an 8085 system, the device commonly used to latch the data is

(a) Tristate buffer
(b) D-type latch or latch IC
(c) Decoder
(d) Priority encoder

179. A program stored in ROM that controls the basic hardware functions of a computer system is called

(a) Operating system
(b) Firmware
(c) Application software
(d) Compiler

180. A ROM is needed to store a table of sine values for 0–360° in steps of 1° using 12-bit output words. The ROM size is

(a) 256 × 8
(b) 360 × 12
(c) 512 × 12
(d) 1024 × 8

181. The 8085 microprocessor has how many vectored interrupts (excluding INTR)?

(a) 4
(b) 5
(c) 3
(d) 2

182. A 8086 microprocessor has how many general-purpose 16-bit data registers?

(a) 4
(b) 6
(c) 8
(d) 16

183. The maximum memory that can be directly addressed by the 8085 microprocessor is

(a) 32 kB
(b) 64 kB
(c) 128 kB
(d) 256 kB

184. Which of the following 8085 interrupts has the highest priority?

(a) INTR
(b) RST 5.5
(c) TRAP
(d) RST 7.5

185. The first commercially successful microprocessor introduced by Intel was

(a) 8008
(b) 8080
(c) 4004
(d) 8085

186. An 8085 microprocessor with a 4 MHz clock executes an instruction requiring 12 T-states. The execution time is

(a) 3 µs
(b) 4 µs
(c) 1.5 µs
(d) 6 µs

187. Which storage technology made online (real-time) transaction processing practical?

(a) Punch cards
(b) Magnetic tape
(c) Random-access disk storage
(d) Optical discs

188. Non-volatile memory retains its data

(a) only at room temperature
(b) only when powered
(c) even after power is removed
(d) only in sealed enclosures

189. The main disadvantage of SRAM compared to DRAM is

(a) it requires periodic refresh cycles
(b) it is slower
(c) it consumes more power and occupies more chip area
(d) it cannot be used in cache memory

190. An assembler converts

(a) machine code to assembly language
(b) high-level language to machine code
(c) assembly language mnemonics to machine code
(d) machine code to high-level language

191. A PROM (Programmable ROM) differs from a mask ROM in that

(a) PROM can be erased and reprogrammed
(b) PROM is programmed by the user after manufacture using a programmer
(c) PROM is faster than mask ROM
(d) PROM consumes less power

192. Which device is used for parallel-to-serial conversion in 8085 microprocessor systems?

(a) 8255 PPI
(b) 8251 USART
(c) 8253 Timer
(d) 8259 PIC

193. DMA (Direct Memory Access) is used to

(a) allow the CPU to directly access I/O devices without interrupts
(b) transfer data between memory and I/O devices at high speed without continuous CPU involvement
(c) increase CPU clock speed
(d) replace the need for cache memory

194. Microprogramming is a technique where each machine instruction is

(a) written in a high-level language
(b) implemented as a sequence of simpler microoperations stored in control memory
(c) executed directly by hardware logic
(d) stored in the instruction cache

195. In an 8085 system, the stack grows

(a) towards higher memory addresses
(b) towards lower memory addresses
(c) randomly
(d) at a fixed location

196. Which of the following is NOT a standard transmission voltage used in India?

(a) 33 kV
(b) 765 kV
(c) 528 kV
(d) 220 kV

197. The 8085 instruction XRI data performs

(a) logical AND of accumulator with data
(b) logical OR of accumulator with data
(c) exclusive-OR of accumulator with immediate data
(d) rotate accumulator right through carry

198. Registers and counters differ mainly in that counters

(a) store binary data
(b) have a regulated counting sequence (up or down)
(c) are made from flip-flops
(d) can only count up

199. A subroutine call instruction in the 8085 that saves the return address on the stack and jumps to the subroutine is

(a) JMP addr
(b) CALL addr
(c) RST n
(d) PCHL

200. In an 8085 microprocessor system with isolated (port-mapped) I/O, input/output addresses are

(a) part of the 64 kB memory map
(b) 8-bit addresses (256 input + 256 output ports), accessed using IN/OUT instructions
(c) 16-bit addresses
(d) accessed using memory read/write signals

Space for Rough Work