MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR
JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE, P&E CADRE (ELECTRICAL WING)
UNDER POWER & ELECTRICITY DEPARTMENT,
GOVERNMENT OF MIZORAM, JUNE-2022

ELECTRICAL ENGINEERING PAPER-III

Time Allowed : 3 hours   FM : 200

SECTION - A *(Multiple Choice questions)*
(100 Marks)
All questions carry equal mark of 2 each. Attempt all questions.
*This Section should be answered only on the **OMR Response Sheet** provided.*

1. When a bipolar junction transistor is operating in the saturation mode, which one of the following statements is true about the state of its collector-base (CB) and the base-emitter (BE) junctions?
   (a) The CB junctions is forward biased and the BE junction is reverse biased
   (b) The CB junctions is reverse biased and the BE junction is forward biased
   (c) Both the CB and BE junctions are forward biased
   (d) Both the CB and BE junctions are reverse biased

2. An op-amp has an open-loop gain of 105 and an open loop upper cut-off frequency of 10 Hz. If this op-amp is connected as an amplifier with a closed loop gain of 100, then the new upper cut-off frequency is :
   (a) 10 Hz   (b) 10 kHz
   (c) 100 Hz   (d) 100 kHz

3. In a RC coupled amplifier, the gain decreases in the frequency response due to the :
   (a) coupling capacitor at low frequency and bypass capacitor at high frequency
   (b) coupling capacitor at high frequency and bypass capacitor at low frequency
   (c) coupling junction capacitance at low frequency and coupling capacitor at high frequency
   (d) device junction capacitor at high frequency and coupling capacitor at low frequency

4. The digital circuit shown in the figure works as :
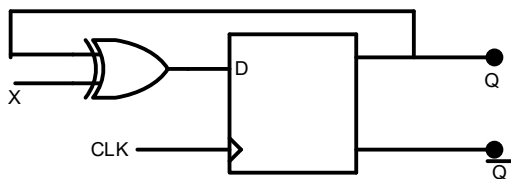
   (a) JK flip-flop   (b) Clocked RS flip-flop
   (c) T flip-flop   (d) Ring counter

5. Schottky clamping is resorted to in TTL gates :
   (a) to reduce propagation delay   (b) to increase noise margins
   (c) to increase packing density   (d) to increase fan-out

6. The Boolean expression:

$$\overline{(a+\bar{b}+c+\bar{d})+(b+\bar{c})}$$

Simplifies is :

(a) 1

(b) $\overline{a.b}$

(c) a.b

(d) 0

7. A handshake signal in a data transfer is transmitted :
    (a) along with the data bits
    (b) before the data transfer
    (c) after the data transfer
    (d) either along with the bits or after the data transfer

8. Which one of the following instructions is a 3-byte instruction?
    (a) MVI A
    (b) LDAX B
    (c) JMP 2050
    (d) MOV A, M

9. To address the memory 14 bits are used. Then what is the address of the last memory location?
   (a) 16382
    (b) 16383
    (c) 16384
    (d) 16385

10. Turn-on and turn-off times of transistor depend on :
    (a) static characteristic
    (b) junction capacitances
    (c) current gain
    (d) voltage injection

11. For the same voltage output, which one of the following has larger peak inverse voltage of the thyristor?
    (a) single phase full wave centre tapped circuit
    (b) single phase full wave bridge circuit
    (c) three phase full wave bridge circuit
    (d) three phase full wave centre tapped circuit

12. The circuit shown in the below figure will work as which one of the following?
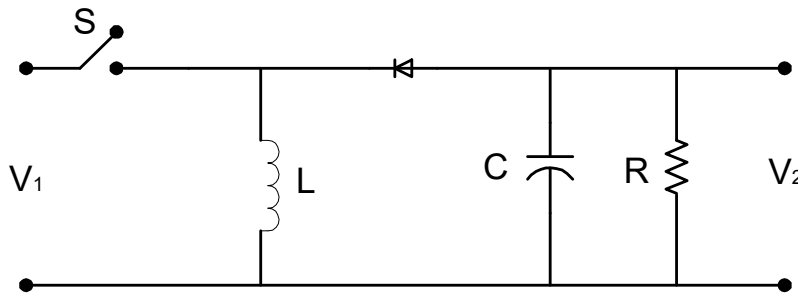
    (a) Buck-boost converter
    (b) Buck converter
    (c) Boost converter
    (d) Dual converter

13. Which one of the following is the main advantage of SMPS over linear power supply?
    (a) No transformer is required
    (b) Only one stage of conversion
    (c) No filter is required
    (d) Low power dissipation

14. In a commutation circuit employed to turn-off an SCR, satisfactory turn-off is obtained when :
    (a) Circuit turn-off time < device turn-off time
    (b) Circuit turn-off time > device turn-off time
    (c) Circuit time constant > device turn-off time
    (d) Circuit time constant < device turn-off time

15. In a 3-phase controlled bridge rectifier, with an increase of overlap angle the output DC voltage :
    (a) decreases
    (b) increases
    (c) does not change
    (d) depends upon load inductance

16. When the firing angle á of a single phase, fully controlled rectifier feeding a constant DC current into a load is 30^0, the displacement power factor of the rectifier is :

(a) 1

(b) 0.5

(c) $\dfrac{1}{\sqrt{3}}$

(d) $\dfrac{2}{\sqrt{3}}$

17. A gate turn off (GTO) thyristor has capacity to :

(a) amplify the gate-current

(b) turn-off when positive current pulse is given at the gate

(c) turn-off when a gate-pulse is given at the gate even though it is reverse biased

(d) turn-off when a negative current pulse is given at the gate

18. If a diode is connected in anti-parallel with a thyristor, then :

(a) both turn-off power loss and turn-off time decreases

(b) turn-off power loss and turn-off time increase

(c) turn-off power loss increase, but turn-off time decreases

(d) none of the above

19. The drawback of FM relative to AM is that :

(a) noise is very high for high modulation frequencies

(b) larger bandwidth is required

(c) higher modulating power is required

(d) higher output power is required

20. The channel capacity of a noiseless channel is equal to :

(a) rate at which information is transmitted

(b) signaling speed

(c) bandwidth

(d) bandwidth-SNR product

21. Bandwidth occupied by 10 MHz carrier, AM modulated by signal frequency of 10 kHz is :

(a) 100 MHz

(b) 20 kHz

(c) 10 kHz

(d) 10 MHz

22. In differential PCM, Each word indicates :

(a) difference between a sample amplitude and a reference signal

(b) difference in amplitude between a sample and the previous sample

(c) addition of a sample amplitude and a reference signal

(d) addition of amplitude of a sample and the previous sample

23. Which one of the following statements is correct?

In TDM, non-essential frequency components of the modeling signal are removed by :

(a) Sampler

(b) Attenuator

(c) Modulator

(d) Pre-alias filter

24. In double sideband suppressed carrier modulation, the modulated wave undergoes phase reversal, whenever :

(a) modulating signal's amplitude decreases

(b) modulating signal's amplitude increases

(c) modulating signal crosses zero

(d) carrier signal crosses zero

25. The common emitter transistor circuit has :

(a) high gain

(b) low gain

(c) negligible gain

(d) zero gain

26. As the reverse bias in a P-N junction is increased the reverse saturation current :

    (a) increase
    (b) remains constant
    (c) decrease
    (d) none of these

27. A circuit in which the output voltage remains constant irrespective of the value of load resistance, uses :

    (a) Silicon diode
    (b) Zener diode
    (c) SCR
    (d) None of these

28. Push-pull amplifier circuit is used as :

    (a) power amplifier
    (b) audio amplifier
    (c) RF amplifier
    (d) none of these

29. Which of the following amplifier operations has the highest efficiency?

    (a) Class A amplifier
    (b) Class B amplifier
    (c) Class C amplifier
    (d) None of these

30. Low frequency response of an RC coupled amplifier can be improved by :

    (a) increasing the coupling capacitors only
    (b) increasing the by-pass capacitors only
    (c) increasing the by-pass capacitor as well as coupling capacitor
    (d) decreasing the by-pass capacitor

31. The output of a JK flip-flop toggles when :

    (a) J=1 and K=0
    (b) J=0 and K=1
    (c) J=1 and K=1
    (d) J=0 and K=0

32. A lamp is controlled from two positions A and B (e.g. staircase circuit). The Boolean expression for the above circuit is :

    (a) $A\overline{B}+\overline{A}B$
    (b) $AB + A\overline{B}$
    (c) $AB + \overline{A}\overline{B}$
    (d) $A\overline{B} + \overline{A}\overline{B}$

33. Which of the following is a non vectored hardware interrupt of 8085?

    (a) TRAP
    (b) RST 7.5
    (c) INTR
    (d) All of these

34. How many flags do 8085 microprocessor has?

    (a) 5
    (b) 9
    (c) 11
    (d) None of these

35. How many machine cycle does 8085 microprocessor has?

    (a) 11
    (b) 7
    (c) 5
    (d) 16

36. A microprocessor with a 12-bit address bus will be able to access :

    (a) 16 kilobytes of memory
    (b) 4 kilobytes of memory
    (c) 8 kilobytes of memory
    (d) none of these

37. Which of the following statements is not true for modulation?

    (a) It allows the use of practicable antennas
    (b) It ensures transmission over long distances
    (c) It reduces the bandwidth
   (d) It separates different transmissions

38. In AM, if modulation index is more than 100% then :
    (a) power of the wave increases
    (b) efficiency of transmission increases
    (c) the wave gets distorted
    (d) bandwidth increases

39. The disadvantage of FM over AM is that
    (a) noise is very high for high frequency signals
    (b) larger bandwidth is required
    (c) high modulating power is required
    (d) high output power is required

40. In high speed TDM, the channels are separated in the receiver employing :
    (a) OR gate
    (b) AND gate
    (c) NAND gate
    (d) NOR gate

41. The thermal noise is due to random :
    (a) motion of atoms and molecules
    (b) motion of free electrons
    (c) vibration of atoms about their mean position, inside the conducting medium
    (d) none of these

42. Power MOSFET can operate at high frequency than BJT as :
    (a) It is a majority carrier device
    (b) It is a minority carrier device
    (c) It does not have the drift layer
    (d) None of the above

43. In a three phase half-wave rectifier, each diode conducts for a duration of
    (a) 180°
    (b) 30°
    (c) 60°
    (d) 45°

44. Thyristers are basically :
    (a) SCRs
    (b) Triacs
    (c) both SCRs and Triacs
    (d) all PNPN devices

45. In a thyristor, holding current is :
    (a) more than latching current
    (b) less than latching current
    (c) equal to latching current
    (d) none of these

46. Each diode of a 3-phase half-wave diode rectifier conducts for :
    (a) 60°
    (b) 120°
    (c) 180°
    (d) 90°

47. In a 3-phase full converter, the output voltage pulsates at a frequency equal to :
    (a) supply frequency, f
    (b) 2f
    (c) 3f
    (d) 6f

48. In single-pulse modulation of PWM inverter, third harmonic can be eliminated if pulse width is equal to:
    (a) 30°
    (b) 60°
    (c) 120°
    (d) none of these

49. In a single-phase full converter, the output voltage during overlap is equal to :
    (a) zero
    (b) source voltage
    (c) source voltage minus the inductance drop
    (d) none of these

50. In d.c choppers, per unit ripple is maximum when duty cycle a is :
    (a) 0.2
    (b) 0.5
    (c) 0.7
    (d) 0

SECTION - B *(Short answer type question)*
(100 Marks)

All questions carry equal marks of 5 each.
*This Section should be answered only on the **Answer Sheet** provided.*

1. Explain the operation of an Op-amp comparator with circuit diagram and waveforms.

2. Derive the expression for output power and conversion efficiency of class-B push pull power amplifier.

3. Specify different schemes of coupling in multistage amplifiers. Compare their merits and demerits.

4. Explain the interrupts in 8085 Microprocessor.

5. Why modulation used in analog communication? What are the sources of noise that affect the communication quality?

6. Draw the block diagram of AM transmitter and explain it.

7. Draw the V-I characteristics of SCR and explain it briefly?

8. Explain the different control strategies in DC-DC circuits?

9. Explain R firing circuit of SCR with circuit diagram and waveforms.

10. What is meant by Pulse Width Modulation? List the various PWM techniques. How do these differ from each other?

11. With the help of waveform explain sinusoidal pulse width modulation used in single phase inverter.

12. With the help of circuit diagram explain the working of single phase dual converter with circulating current mode.

13. In an N-type semiconductor, the Fermi level is 0.3eV below the conduction level at a room temperature of $300°K$. If the temperature is increased to $360°K$, determine the new position of the Fermi level.

14. Draw the circuit diagram of a push-pull amplifier and explain its working.

15. Find the Boolean expression of F1 and F2 for the given multiplexers circuit.
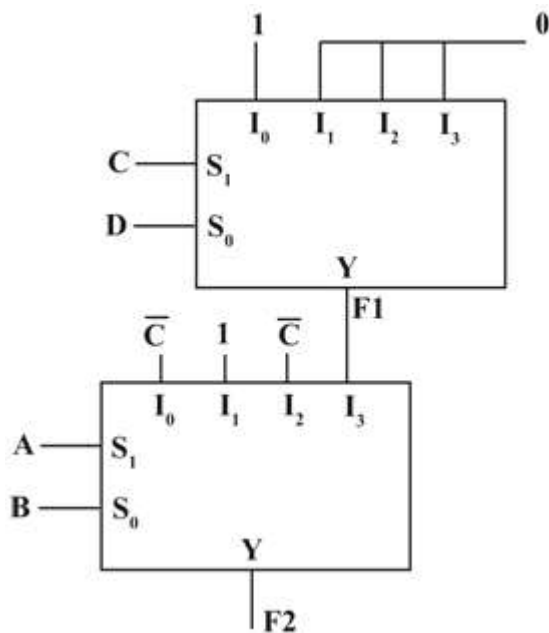
16. Design a JK flip flop using a D flip flop along with suitable logic gates.

17. An amplitude modulated wave is modulated to 50%. What is the saving in power if carrier as well as one of the sidebands is suppressed?

18. A single-phase fully controlled bridge converter supplies an inductive load. Assuming that the output current is virtually constant, and is equal to I_d, determine the following performance measures, if the supply voltage is 230V and if the firing angle is maintained at $p/6$ radians.

   (a) Average output voltage   (b) Fundamental power factor

   (c) Supply power factor   (d) Supply harmonic factor

   (e) Voltage ripple factor

19. A single-phase half bridge inverter has a resistive load of $R=3W$ and the d.c input voltage $V=24$volt. Determine: **(2+2+1=5)**

   (a) The RMS output voltage at the fundamental frequency

   (b) The output power

   (c) The peak reverse blocking voltage for each transistor

20. An on-off type a.c regulator is operating with a resistive load of $R=10W$, and the RMS supply voltage is 230V. The controller remains on for 40 cycles and is off for 60 cycles. Determine:

   (a) RMS load voltage

   (b) Input power factor

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