

MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE UNDER POWER & ELECTRICITY DEPARTMENT, NOVEMBER, 2015

ELECTRONICS & COMMUNICATION ENGINEERING PAPER - II

Time Allowed : 3 hours

Full Marks : 200

Attempt all questions.

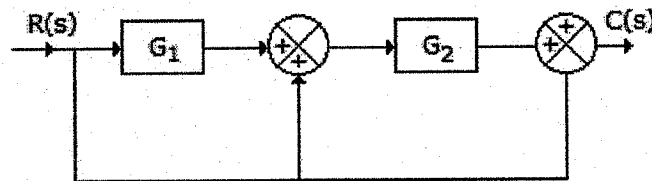
Part A - Objective Type Questions (100 Marks)

All questions carry equal marks of 2 each.

This Part should be answered only on the OMR Response Sheet provided.

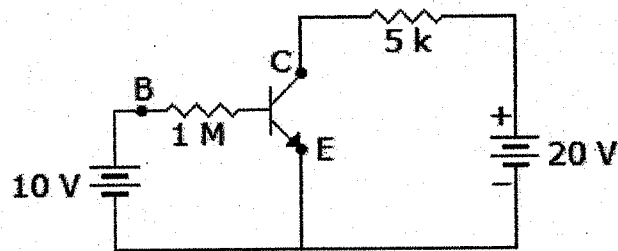
- Which of the following relations is correct?
(a) $\nabla \cdot B = \rho$
(b) $\nabla \cdot D = \rho$
(c) $\nabla \cdot D = -\rho$
(d) $\nabla \cdot B = J$
- For a reflection coefficient of 0.5, the value of SWR is
(a) -1
(b) 1
(c) 2
(d) 3
- For a distortionless line, the parameters are related as
(a) $R/G=L/C$
(b) $R/L=1$
(c) $R/G=C/L$
(d) $RG=LC$
- Q factor of a transmission line at resonance is
(a) $\omega L/R$
(b) L/R
(c) $R/\omega L$
(d) L/CR
- Polarisation of a wave is
(a) Direction of electric field
(b) Direction of magnetic field at some point in space
(c) Either (a) or (b)
(d) None of these
- The maximum theoretical efficiency of a class A amplifier is
(a) 12.5%
(b) 25%
(c) 50%
(d) 75%
- A Hartley oscillator uses
(a) A tapped inductor
(b) A tapped capacitor
(c) Both (a) and (b)
(d) Neither (a) nor (b)
- In a bridge rectifier circuit the rms value of input ac voltage is 10V. The PIV across each diode is
(a) 7.07V
(b) 14.14V
(c) 10V
(d) 28.28V

9. The coupling capacitor in amplifier circuits
- (a) Affects dc biasing
 - (b) Does not affect dc biasing
 - (c) Affects dc biasing to some extent
 - (d) Both (a) and (c)
10. A 10 bit D/A converter gives a maximum output of 10.23V. The resolution is
- (a) 10 mV
 - (b) 20 mV
 - (c) 15 mV
 - (d) 25 mV
11. A basic S-R flip-flop can be constructed by cross-coupling which basic logic gates?
- (a) AND or OR gates
 - (b) XOR or XNOR gates
 - (c) NOR or NAND gates
 - (d) AND or NOR gates
12. The 2's complement of the number 1101101 is
- (a) 0101110
 - (b) 0111110
 - (c) 0110010
 - (d) 0010011
13. Which device changes serial data to parallel data?
- (a) Counter
 - (b) Multiplexer
 - (c) Demultiplexer
 - (d) Flip flop
14. Which memory requires periodic recharging?
- (a) All ROMs
 - (b) All RAMs
 - (c) Static RAM
 - (d) Dynamic RAM
15. For the system in the given figure. The transfer function $C(s)/R(s)$ is

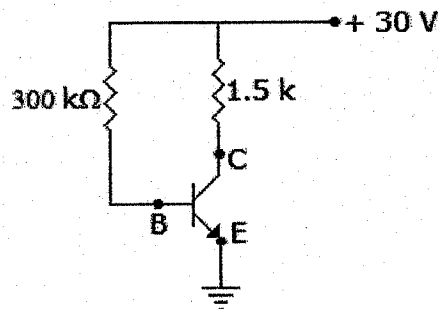


- (a) $G_1 + G_2 + 1$
 - (b) $G_1 G_2 + 1$
 - (c) $G_1 G_2 + G_2 + 1$
 - (d) $G_1 G_2 + G_1 + 1$
16. A system has its two poles on the negative real axis and one pair of poles lies on $j\omega$ axis. The system is
- (a) stable
 - (b) unstable
 - (c) marginally stable
 - (d) either (a) or (c)
17. Nichols chart consists of
- (a) Constant magnitude loci
 - (b) Constant phase angle loci
 - (c) Magnitude and phase angle loci in log magnitude versus phase diagram
 - (d) None of these
18. If the transfer function of a first-order system is $G(s) = 10/(1+2s)$, then the time constant of the system is
- (a) 10 seconds.
 - (b) 1/10 second.
 - (c) 2 seconds.
 - (d) 1/2 second.

19. $Z_L = 200 \Omega$ and it is desired that $Z_i = 50 \Omega$ The quarter wave transformer should have a characteristic impedance of
- (a) 100Ω (b) 40Ω
(c) 10000Ω (d) 4Ω
20. For an ideal antenna, numerical value of directivity must be
- (a) 0 (b) 1
(c) $5 \sigma^2 \beta$ (d) Any value
21. According to maximum power transfer theorem, if the load is inductive, the source should be
- (a) Inductive (b) Capacitive
(c) Resistive (d) All of the above
22. In figure what is the base current if $V_{BE} = 0.7 \text{ V}$?



- (a) $10 \mu\text{A}$ (b) 10 mA
(c) 4 mA (d) $9.3 \mu\text{A}$
23. The self bias provides
- (a) stable Q point (b) large voltage gain
(c) high input impedance (d) high base current
24. In figure what is value of I_C if $\beta_{dc} = 100$? Neglect V_{BE}



- (a) 5 mA (b) $5 \mu\text{A}$
(c) 10 mA (d) $10 \mu\text{A}$

25. Consider the following statements : A clamper circuit

1. adds or subtracts a dc voltage to a waveform
2. does not change the waveform
3. amplifies the waveform

Which are correct?

- | | |
|-----------|---------|
| (a) 1,2 | (b) 1,3 |
| (c) 1,2,3 | (d) 2,3 |

26. Which power amplifier can deliver maximum load power?

- | | |
|-------------|--------------|
| (a) Class A | (b) Class AB |
| (c) Class B | (d) Class C |

27. In a push pull circuit

- (a) each transistor conducts for 180°
- (b) each transistor conducts for more than 180° but less than 360°
- (c) each transistor conducts for less than 180°
- (d) the period of conduction of each transistor depends on circuit configuration

28. An oscillator requires an amplifier

- | | |
|---|----------------------------|
| (a) with negative feedback | (b) with positive feedback |
| (c) with either positive or negative feedback | (d) none of these |

29. A differential amplifier has a differential gain of 20,000. CMRR=80 dB. The common mode gain is given by

- | | |
|---------|-------|
| (a) 2 | (b) 1 |
| (c) 1/2 | (d) 0 |

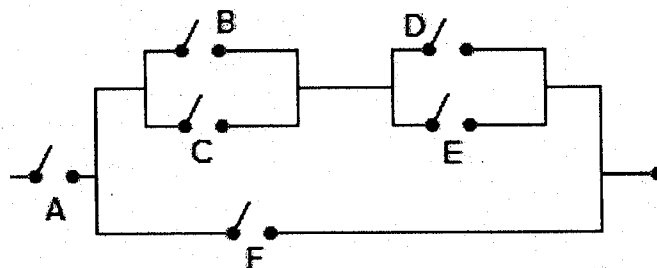
30. An OPAMP has a slew rate of $5 \text{ V}/\mu\text{S}$. The largest sine wave O/P voltage possible at a frequency of 1MHz is

- | | |
|--------------|---------------|
| (a) 10 volts | (b) 5 volts |
| (c) 15volts | (d) 5/2 volts |

31. The race around condition exists in J-K FF if

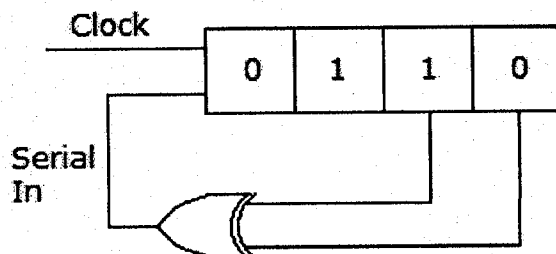
- | | |
|----------------|----------------|
| (a) $J=0, K=0$ | (b) $J=1, K=0$ |
| (c) $J=0, K=1$ | (d) $J=1, K=1$ |

32. The Boolean expression for the circuit of the given figure



- | | |
|---------------------------------|----------------------------|
| (a) $A \{F + (B + C) (D + E)\}$ | (b) $A [F + (B + C) (DE)]$ |
| (c) $A + F + (B + C) (D + E)$ | (d) $A [F + (BC) (DE)]$ |

33. In the given figure shows a 4 bit serial in parallel out right shift register. The initial contents as shown are 0110. After 3 clock pulses the contents will be

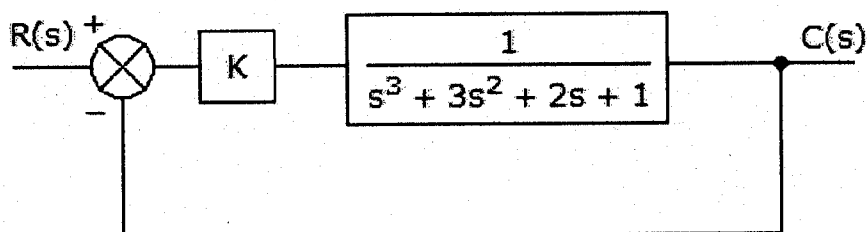


- (a) 0000 (b) 0101
(c) 1010 (d) 1111

34. Propagation delay should be

- (a) Equal to the clock pulse (b) Greater than the clock pulse.
(c) Smaller than the clock pulse (d) All of the above

35. A control system is as shown in given figure The maximum value of gain K for which the system is stable is



- (a) more than 5 (b) equal to 5
(c) less than 5 (d) less than 1

36. Indicate which of the following transfer function represents phase lead compensator?

- (a) $\frac{S+1}{S+2}$ (b) $\frac{6S+3}{6S+2}$
(c) $\frac{S+5}{3S+2}$ (d) $\frac{S+8}{S^2+5S+6}$

37. The steady state error due to a ramp input for a type two system is equal to

- (a) Zero (b) Infinite
(c) Constant (d) Data is insufficient

38. Coulomb's Law is a

- (a) vector equation (b) scalar equation
(c) may be (a) or (b) (d) phasor equation

39. The direction of induced emf is given by

- (a) Fleming's right hand rule (b) clock screw rule
(c) Fleming's left hand rule (d) KVL

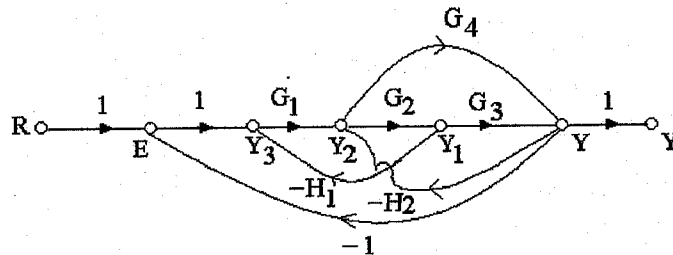
40. The dominant mode in a waveguide is characterized by
(a) longest cutoff λ (b) shortest cutoff λ
(c) infinite attenuation (d) zero attenuation
41. A biasing circuit has a stability factor of 40. If due to temperature change, I_{CO} changes by $1 \mu A$. Then the change in I_C will be
(a) $20 \mu A$ (b) $40 \mu A$
(c) $80 \mu A$ (d) none of these
42. A voltage divider biased amplifier has its Q point at the middle of the DC load line. What is the maximum unclipped peak to peak output voltage?
(a) V_{CEQ} (b) $I_{CQ}R_C$
(c) $2 I_{CQ}R_C$ (d) $2 V_{CEQ}$
43. A buffer amplifier has a gain of
(a) zero (b) unity
(c) very large (d) infinity
44. Ripple factor of an ideal rectifier is
(a) zero (b) unity
(c) infinity (d) none of these
45. An op-amp has a common mode gain of 0.01 and differential mode gain of 10^5 . Its CMRR will be
(a) 10^{-7} (b) 10^{-3}
(c) 10^3 (d) 10^7
46. In op-amp IC741, output is taken from the pin number
(a) 3 (b) 6
(c) 7 (d) 8
47. To form a half adder, which two gate combinations are essential?
(a) AND, OR (b) AND, NOR
(c) AND, EX-OR (d) AND, NOT
48. Which of the following is not a sequential circuit?
(a) flip-flop (b) counter
(c) register (d) decoder
49. In the Bode plot of a unity feedback control system, the value of phase of $G(j\omega)$ at the gain crossover frequency is -125° . The phase margin is
(a) -125° (b) -55°
(c) 55° (d) 125°
50. If the poles of a system lie on the imaginary axis, the system will be
(a) stable (b) conditionally stable
(c) marginally stable (d) unstable

Part B - Short Answer Questions (100 Marks)

All questions carry equal marks of 5 each.

This Part should be answered only on the Answer Booklet provided.

- A half-wave rectifier has a load resistance of $2.5 \text{ K}\Omega$. If the diode and secondary of the transformer have a total resistance of $800\text{K}\Omega$ and the ac input voltage has 240 V (peak value), determine:
 - peak, rms and average values of current through load
 - DC power output
 - AC power input
 - rectification efficiency
- Briefly explain how a transistor can be used as a switch.
- What is standing wave ratio? What is its significance?
- Two small identical conducting spheres have charges of 2 nC and -1 nC respectively. When they are separated by 4 cm apart, find the magnitude of force between them. If they are brought into contact and then again separated by 4 cm , find the force between them.
- What are NMOS and PMOS logic circuits? Draw the circuit of an NMOS nor-gate and briefly explain.
- For the system whose signal flow graph is shown by Fig. below, find $Y(s)/R(s)$

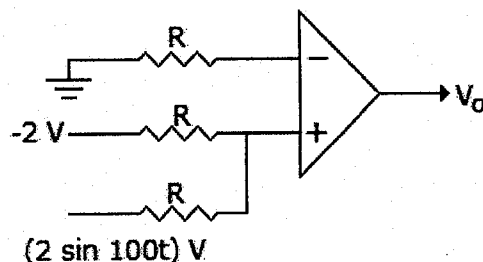


- The open-loop transfer function of a control system is

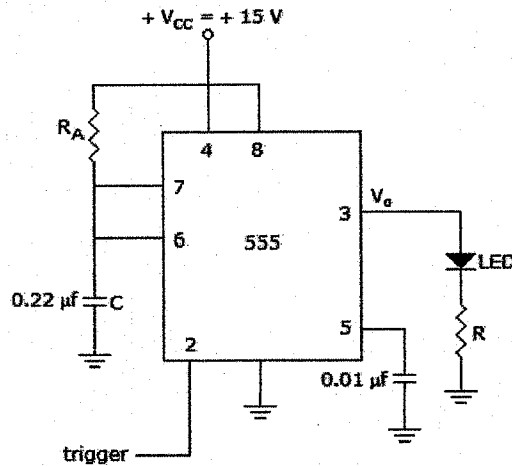
$$G(s)H(s) = \frac{10}{s(1+0.5s)(1+0.1s)}$$

Draw the Bode plot and determine the gain crossover frequency, and phase and gain margins.

- If the electric field intensity associated with a uniform plane electromagnetic wave travelling in a perfect dielectric medium is given by $E(z, t) = 10 \cos(2\pi \times 10^7 t - 0.1 z)$ volt/metre, what will be the velocity of the travelling wave?
- What are the four possible topologies of a feedback amplifier? Draw the block diagram for each one of them.
- In a non-inverting op-amp summer is shown in figure, the output voltage V_o is



11. Design a 1-bit full adder using a decoder and 2 “or” gates?
12. What is the basic difference between Latches and Flip flops? How can you convert an SR Flip-flop to a JK Flip-flop?
13. With respect to the following 555 timer circuit what will be the value of R_A and R such that the LED turns on for duration of 10 ms every time it receives negative trigger pulse. LED operating current = 20 mA, $V_f = 1.4$ V, $V_{o_{on}} = 13.4$ V and $C = 0.22$ nF



14. What is the significance of the Maxwell’s equations? Mention them in their various forms.
15. Consider a rectangular waveguide with $a/b = 2$, $a = 5.817$ cm, $\mu_r = 1$ and $\epsilon_r = 2.5$. Assuming dominant mode propagation, calculate the guide wavelength and characteristic impedance at 3.0 GHz.
16. Draw the circuit diagram of an op-amp Wein-bridge oscillator. Sketch the oscillator waveform and explain the circuit operation.
17. Design a 3-Bit binary UP/DOWN counter. Draw its state table, timing diagram and explain the working of the circuit.
18. Draw and explain the circuit (any one)
 - (a) Weighted resistor DAC
 - (b) Successive approximation ADC
19. Define the following terms
 - (a) Transient response
 - (b) Steady state response
 - (c) Delay time
 - (d) Settling time
 - (e) Overshoot
20. (a) What do you mean by Root Locus plot? State the angle and magnitude conditions of root locus. (3)
(b) State the effects of addition of poles briefly. (2)

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