SEAL

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Invigilator's signature

Question Booklet No. 500070

J/EE/R EXAM

2020

ELECTRONICS & TELECOMMUNICATION ENGINEERING

Time : 2 Hours **Maximum Marks : 200**

ROLL NO. | | | | | | |

INSTRUCTIONS FOR CANDIDATES

1. This Test Booklet consists of two parts—PART–I (Objective) contains 50 multiple choice questions carrying *2* marks each and PART–II (Subjective) is of 100 marks.
2. In PART–I (Objective), each question contains four responses. Choose only one correct answer for each question and darken the bubble on the OMR RESPONSE SHEET. In PART–II (Subjective), answer all questions as directed. The marks in the right-hand margin indicate full marks for the questions.
3. DO NOT write your Name or anything else except Roll No. and the actual answer to the question, anywhere on the OMR RESPONSE SHEET.
4. DO NOT handle your OMR RESPONSE SHEET in such a manner as to mutilate, fold, etc.
5. Entry into the examination venue shall be closed **10 minutes** before the scheduled commencement of the Examination, i.e. 8:50 AM for Forenoon session and 12:50 PM for the Afternoon session.
6. No candidate shall have in his/her possession, inside the Examination Hall, any book, notebook or loose paper, calculator, mobile phone etc., except his/her Admit Card and other things permitted by the Commission.
7. Immediately after the final bell indicating the closure of the Examination, stop bubbling. Be seated till the OMR RESPONSE SHEET is collected by the Invigilator. Thereafter you may leave the Examination Hall.
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NB : CANDIDATES ARE ALLOWED TO TAKE THIS QUESTION BOOKLET ONLY AFTER COMPLETION OF 2 (TWO) HOURS EXAMINATION TIME

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PART—I

(Objective)

1. A voltage $v = 10 \sin \omega t + 10 \sin 5\omega t$ is applied to a pure capacitor having capacitance of $1\,\mu F$. If $\omega = 314$ rad/sec, the current through the capacitor is

[A] $0{\cdot}0314 \cos 314t + 0{\cdot}0157 \cos 1570t$

[B] $0{\cdot}0314 \sin 314t + 0{\cdot}0157 \sin 1570t$

[C] $0{\cdot}0314 \cos 314t + 0{\cdot}0314 \cos 1570t$

[D] $0{\cdot}0157 \cos 314t + 0{\cdot}0157 \cos 1570t$

2. If $H(z) = \dfrac{1 + z^{-1}}{1 - \frac{5}{6}z^{-1} + \frac{1}{6}z^{-2}}$, then the poles of $H(z)$ are at

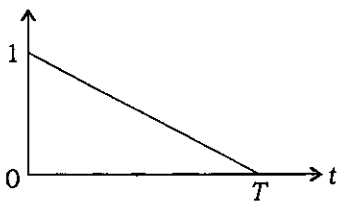
[A] $z = 1/2$ and $z = 1/3$

[B] $z = 1$ and $z = 1$

[C] $z = (-1/2)$ and $z = (-1/3)$

[D] $z = (-1)$ and $z = (-3)$

3. Which of the following is the correct Laplace transform of the signal shown in the figure below?



[A] $\dfrac{1}{Ts^2}[1 - e^{-Ts}(1 + Ts)]$

[B] $\dfrac{1}{Ts^2}[e^{-Ts} - 1 + Ts]$

[C] $\dfrac{1}{Ts^2}[e^{-Ts} + 1 + Ts]$

[D] $\dfrac{1}{Ts^2}[1 - e^{-Ts} + Ts]$

4. The eigenvalues of matrix $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ are

[A] 1, 1

[B] $-1, -1$

[C] $j, -j$

[D] 1, -1

5. The joint probability function of two discrete random variables X and Y is given by

$$f(x, y) = \begin{cases} \dfrac{x + 2y}{14}, & x = 0, 2;\ y = 2, 3 \\ 0, & \text{otherwise} \end{cases}$$

Then $E(X)$ will be equal to

[A] 8/14

[B] 40/14

[C] 16/14

[D] 12/14

6. If $f(x) = \begin{cases} \dfrac{x}{2}, & 0 < x < 3 \\ 0, & \text{otherwise} \end{cases}$

Find $E(X)$.

[A] 27/6

[B] 40/14

[C] 28/6

[D] 0

7. A full wave bridge diode rectifier uses diodes having forward resistance of $50\,\Omega$ each. The load resistance is also $50\,\Omega$. The voltage regulations is

[A] 20%

[B] 50%

[C] 100%

[D] 200%

8. In an amplifier with a gain of -1000 and feedback factor $\beta = -0.1$, the change in gain is 20% due to temperature. The change in gain for feedback amplifier will be

[A] 10%

[B] 5%

[C] 0·2%

[D] 0.01%

9. A 12 kHz pulse waveform is amplified by a circuit having an upper cut-off frequency 1 MHz. The minimum input pulse width that can be accurately reproduced is

[A] 83·33 μs

[B] 1 μs

[C] 0·1 ms

[D] 3·5 ms

10. For a system to work as oscillator the total phase shift of the loop gain must be equal to

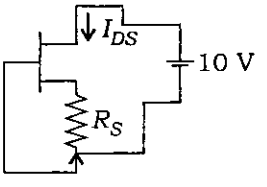
[A] 90°

[B] 45°

[C] 0°

[D] 360°

11. The JFET in the circuit below has an $I_{DSS} = 10$ mA and $V_P = -5$ V. The value of resistance R_S for a drain current $I_{DS} = 6 \cdot 4$ mA is



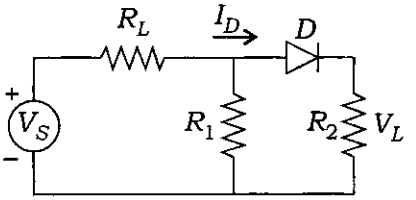
[A] 156 Ω

[B] 470 Ω

[C] 560 Ω

[D] 1 kΩ

12. The voltage V_L in the circuit when $V_S < 0$, where D is an ideal diode and $R_1 = R_2 = R_L = 1\,\Omega$ is



[A] 0

[B] 1

[C] 1·5

[D] Cannot find

13. The mobility of electron for Ge and Si respectively are

[A] 1·66, 2·5

[B] 2·5, 1·66

[C] 2·7, 2·33

[D] 2·33, 2·7

14. In an unloaded transformer, the fluxes limiting the primary and secondary are 30 mWb and 20 mWb. The coefficient of coupling is

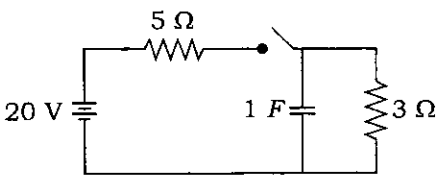
[A] 1

[B] 0·1

[C] 0.·33

[D] 0·67

15. In the given circuit the current through capacitor at $t = \infty$ is



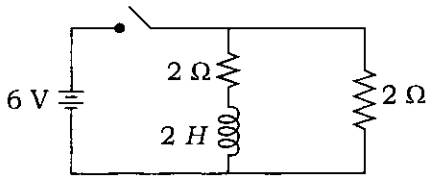
[A] 4 A

[B] 2·5 A

[C] 3·1 A

[D] 0

16. The given circuit is switched on at $t = 0$. At any time t, $i(t)$ is



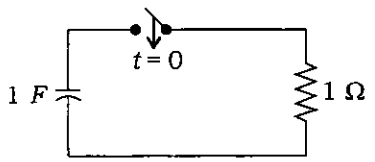
[A] $3 + 3e^{-1}$ A

[B] $6 - 3e^{-1}$ A

[C] $3 - 3e^{-1}$ A

[D] $6 - 6e^{-1}$ A

17. In the given circuit, the capacitor is charged to 1 V. At $t = 0$, the switch is closed so that $i = e^{-t}$. When $i = 0 \cdot 37$ A, the voltage across capacitor is



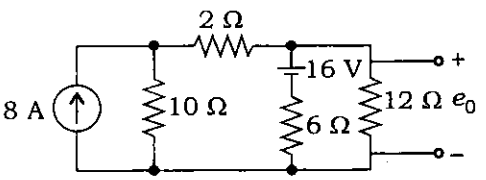
[A] 1 V

[B] 0·63 V

[C] 0·37 V

[D] 0·185 V

18. The voltage e_0 in the given circuit is



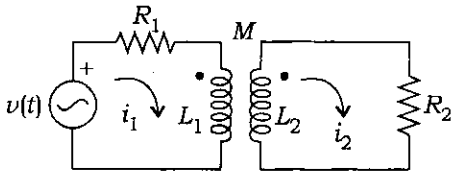
[A] 48 V

[B] 24 V

[C] 36 V

[D] 28 V

19. For the network of figure, KVL for first loop is



[A] $v(t) = R_1 i_1 + L_1 \frac{di_1}{dt} + M \frac{di_2}{dt}$

[B] $v(t) = R_1 i_1 - L_1 \frac{di_1}{dt} - M \frac{di_2}{dt}$

[C] $v(t) = R_1 i_1 + L_1 \frac{di_1}{dt} - M \frac{di_2}{dt}$

[D] $v(t) = R_1 i_1 - L_1 \frac{di_1}{dt} + M \frac{di_2}{dt}$

20. Two coils having self-inductances of 10 mH and 40 mH are mutually coupled. The maximum possible mutual inductance is

[A] 40 mH

[B] 20 mH

[C] 10 mH

[D] 5 mH

21. A wire 1 m long carries a current of 5 A and is at angle of 30° with $B = 1 \cdot 5$ Wb/m. Magnitude of force is

[A] 2 N

[B] 2·5 N

[C] 3·75 N

[D] 5 N

22. A negative point charge $q = -40$ nC is moving with velocity of 6×10^6 m/s on a direction specified by unit vector $u_v + 0 \cdot 6\, u_z$. Find the magnitude of vector forced on the moving particle by the field $B = 2u_n 3u_y + 5u_z$ mT and $E = 2u_x - 3u_y + 5u_z$ kV/m.

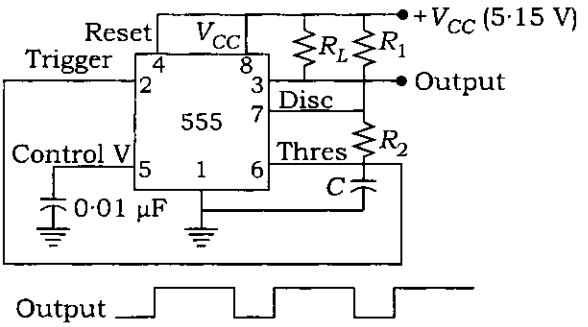
[A] 144 μN

[B] 244 μN

[C] 1440 μN

[D] 1144 μN

23. A 555 timer is connected for astable operation as shown below along with the output waveform. It is determined that the duty cycle should be 0·5. What steps need to be taken to correct the duty cycle, while maintaining the same output frequency?



$t_L = 0 \cdot 693RC$

$t_H = 0 \cdot 693(R_1 + R_2)C$

Duty cycle $= \frac{R_1 + R_2}{R_1 + 2R_2} = \frac{t_H}{T}$

$T = t_L + t_H$

[A] Increase the value of C

[B] Increase V_{cc} and decrease R_L

[C] Decrease R_1 and R_2

[D] Decrease R_1 and increase R_2

24. The output pulse width of a 555 monostable circuit with $R_1 = 4 \cdot 7$ k and $C_1 = 47$ F is

[A] 24 s

[B] 24 ms

[C] 243 ms

[D] 243 s

25. Two *J-K* flip-flops with their *J-K* inputs tied HIGH are cascaded to use as counters. After four input clock pulses, the binary count is

[A] 00

[B] 11

[C] 01

[D] 10

26. A *D* flip-flop utilizing a PGT clock is in the CLEAR state. Which of the following input actions will cause it to change states?

[A] CLK = NGT, $D = 0$

[B] CLK = PGT, $D = 0$

[C] CLOCK NGT, $D = 1$

[D] CLOCK PGT, $D = 1$

27. When the channel is noisy, producing a conditional probability of error $p = 0 \cdot 5$; the channel capacity and entropy function would be, respectively

[A] 1 and 1

[B] 1 and 0·5

[C] 0·5 and 1

[D] 0 and 1

28. In a facsimile reproduction time to scan one line is 2 ms. If it has 4% blanking, the visible trace time is

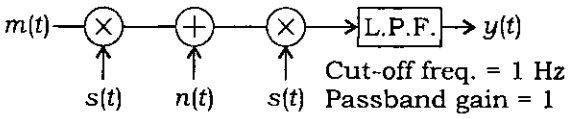
[A] 1·92 ms

[B] 2·08 ms

[C] 50 ms

[D] 0·08 ms

29. In the figure



$$m(t) = \frac{2 \sin 2\pi t}{t}, s(t) = \cos 200\pi t$$

$$\text{and } n(t) = \frac{\sin 199\pi t}{t}$$

The output $y(t)$ will be

[A] $\frac{a \sin 2\pi t}{t}$

[B] $\frac{\sin 2\pi t}{t} + \frac{\sin \pi t}{t} \cos 3\pi t$

[C] $\frac{\sin 2\pi t}{t} + \frac{\sin 0 \cdot 5\pi t}{t} \cos 1 \cdot 5\pi t$

[D] $\frac{\sin 2\pi t}{t} + \frac{\sin \pi t}{t} \cos 0 \cdot 75\pi t$

30. A 1000 kHz carrier is simultaneously modulated with 300 Hz, 800 Hz and 2 kHz audio sine waves. Which of the following frequencies is least likely to be present in the output?

[A] 1002 kHz

[B] 1000 kHz

[C] 999·2 kHz

[D] 998·0 kHz

31. The ratio of impurity atoms to intrinsic semiconductor is about

[A] 1 : 10

[B] 1 : 1000

[C] 1 : 10000

[D] 1 : 10^8

32. In a p type material, the Fermi level is 0·3 eV above valance band. If the concentration of acceptor atoms is increased, the new position of Fermi level is likely to be

[A] 0·5 eV above valance band

[B] 0·28 eV above valance band

[C] 0·1 eV above valance band

[D] below the valance band

33. For most metals, Fermi level E_F is less than

[A] 0·1 eV

[B] 2 eV

[C] 5 eV

[D] 10 eV

34. The intrinsic resistivity of silicon at 300 K is about

[A] 1 Ω – cm

[B] 400 Ω – cm

[C] 10000 Ω – cm

[D] 230000 Ω – cm

35. Hall coefficient K_H and charge density ρ are related as

[A] $K_H = \frac{1}{\rho}$

[B] $K_H = \rho$

[C] $K_H = \left(\frac{1}{\rho}\right)^{1.2}$

[D] $K_H = (\rho)^{1.2}$

36. An electron rises through a voltage of 100 V. The energy acquired by it will be

[A] 100 eV

[B] 100 J

[C] $(100)^{1.2}$ eV

[D] $(100)^{1.2}$ J

37. Which of the following has the highest conductivity?

[A] Silver

[B] Aluminium

[C] Tungsten

[D] Platinum

38. In photoelectric emission, the maximum kinetic energy of emitted electron is proportional to

[A] $\sqrt{f}$

[B] f

[C] f^2

[D] f^3

39. The temperature of cathode is increased from 2500 K to 2600 K. The increase in thermo-ionic emission current is about

[A] 0·1%

[B] 4%

[C] 50%

[D] 150%

40. A reverse voltage of 18 V is applied to a semiconductor diode. The voltage across the depletion layer is

[A] 0

[B] 0·7 V

[C] about 10 V

[D] 18 V

41. The derating factor for a BJT transistor is about

[A] 0·5 mW/°C

[B] 2·5 mW/°C

[C] 10 mW/°C

[D] 25 mW/°C

42. It is required to trace the output characteristics of CE bipolar transistor on a CRO screen. The proper method is

[A] to apply the voltage drop across the collector resistance to Y input, disconnect sweep generator and apply V_{CE} to X input

[B] to apply voltage drop across the collector resistance to Y input

[C] to apply V_{CE} to X input

[D] to apply V_{CE} to Y input, disconnect sweep generator and apply voltage drop across collector resistance to X input

43. Which is the correct expression for vacuum triode?

[A] $\mu = r_p g_m$

[B] $r_p = \mu g_m$

[C] $\mu r_p = g_m$

[D] $\mu = \sqrt{r_p g_m}$

44. Which of the following is used for generating time varying wave form?

[A] MOSFET

[B] PIN diode

[C] Tunnel diode

[D] UJT

45. In a solar cell, the photovoltaic voltage is the voltage at which the resultant current is

[A] positive

[B] zero

[C] negative

[D] rated current

46. The small signal input impedance of a transistor whose output is shorted for measuring a signal is

[A] $h_{11} = \frac{v_1}{i_1} / v_2 = 0$

[B] $h_{12} = \frac{v_1}{i_2} / i_1 = 0$

[C] $h_{21} = \frac{i_2}{i_1} / v_2 = 0$

[D] $h_{22} = \frac{i_2}{v_2} / i_1 = 0$

47. In a 741 OP-AMP, there is 20 dB/decade fall-off starting at a relatively low frequency. This is due to

[A] the applied load

[B] the internal compensation

[C] the impedance of the source

[D] the power dissipation in the chip

48. In standard TTL, the 'totem pole' stage refers to

[A] the multi-emitter I/P stage

[B] the phase splitter

[C] the O/P buffer

[D] the open collector O/P stage

49. If 100 V is the peak voltage across the secondary of the transformer in a half-wave rectifier (without any filter circuit), then the maximum voltage on the reverse-biased diode is

[A] 200 V

[B] 141·4 V

[C] 100 V

[D] 86 V

50. Hall's effect can be used to measure

[A] magnetic field intensity

[B] average number of holes

[C] carriers concentration

[D] electrostatic field intensity

PART—II

(Subjective)

1. Draw and explain different parts of composite signal of black-and-white television. Describe different parts of PAL television using block diagram. 6+4

2. Draw the circuit of Class-AB amplifier using BJT. How can you fix operating points of output characteristics and load line to obtain class-AB and Class-A amplification? 4+6

3. With a block diagram, explain the construction and working of DIAC. 10

4. With logic gate, draw logic circuits of three 4-bit digital word multiplexer. Explain its operation with truth table. 5+5

5. Draw the circuit diagram of Wien bridge oscillator using operational amplifier and derive the oscillating frequency. 4+6

6. Draw the block diagram of frequency-shift keying (FSK) modulation. How can you get FSK signal considering the digital signal : 101000100101? 5+5

7. What is loading effect in an instrument? How can an ammeter having the range of (0–5) be used to measure a current of range (0–50) A? Assume internal resistance of 100 k-ohm. 4+6

8. Draw and explain the energy band diagram of conductor, semiconductor and insulator. 10

9. Using R-2R ladder, design 3-bit digital to analog (DAC) converter. 10

10. Draw two port transmission line model having load circuit and generating circuit. Discuss the effect of short and long dispersion on digital signal transmitted through transmission line model. 4+6