122

QUESTION PAPER
SERIES CODE

B

ENTRANCE EXAMINATION, 2017

M.Tech. NANO SCIENCE

[Field of Study Code : NNSP (182)/NNEP (190)]

Time Allowed : 3 hours   *Maximum Marks* : 100

INSTRUCTIONS FOR CANDIDATES

Candidates must read carefully the following instructions before attempting the Question Paper :

(i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.

(ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

(iii) The Question Paper is divided into two Parts : Part—A and Part—B. Both Parts have multiple-choice questions. All answers are to be entered in separate Answer Sheet (for Part—A and Part—B) provided with the Question Paper for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BALLPOINT PEN only against each question in the corresponding Circle.

(iv) Part—A consists of 50 questions and all are compulsory.

(v) Part—B consists of 50 questions and all are compulsory.

(vi) Each correct answer carries *1* mark. **There will be negative marking and ½ mark will be deducted for each wrong answer.**

(vii) Answer written by the candidates inside the Question Paper will not be evaluated.

(viii) Calculators and log tables are allowed.

(ix) Pages at the end have been provided for Rough Work.

(x) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

INSTRUCTIONS FOR MARKING ANSWERS

1. Use only Blue/Black Ballpoint Pen (do not use pencil) to darken the appropriate Circle.

2. Please darken the whole Circle.

3. Darken ONLY ONE CIRCLE for each question as shown in example below :

Wrong	Wrong	Wrong	Wrong	Correct
○ ⓑ ⓒ ○	ⓐ̸ ⓑ ⓒ ⓓ	ⓐ̸ ⓑ ⓒ ⓓ̸	● ⓑ ⓒ ○	ⓐ ⓑ ⓒ ○

4. Once marked, no change in the answer is allowed.

5. Please do not make any stray marks on the Answer Sheet.

6. Please do not do any rough work on the Answer Sheet.

7. Mark your answer only in the appropriate space against the number corresponding to the question.

8. **Ensure that you have darkened the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

/122-**B**

PART—A

(Research Methodology)

1. A hypothesis is a

   (a) tentative statement whose validity is still to be tested

   (b) statement of fact

   (c) supposition which is based on the past experiences

   (d) All of the above

2. Tippit table is

   (a) a table of random digits

   (b) used in statistical investigation

   (c) used in sampling method

   (d) All of the above

3. What should come in place of the question mark (?) in the following letter-number series?

   M3V O5U R7T T9S W11R ?

   (a) Y13Q   (b) Z13Q

   (c) Y15Q   (d) Y13P

4. X-ray diffractogram of a bcc lattice shows

   (a) only even integer reflection indices

   (b) only odd integer reflection indices

   (c) only those reflection indices whose sum is an even integer

   (d) only those reflection indices whose sum is an odd integer

5. If a system absorbs 100 J of heat and does a work of 25 J, what is the increase in its internal energy in joules?

   (a) 75   (b) 125

   (c) 100   (d) None of these

6. Calculate the work done in joules by a gas in expanding from a volume of 1 m^3 to 2 m^3 at a pressure of 1 Pa.

(a) 1

(b) 0·5

(c) 2

(d) None of these

7. Which method would you use to determine that a membrane fraction you have isolated contains actin?

(a) Thin-layer chromatography

(b) Column chromatography

(c) Immunoblotting

(d) Ultracentrifugation

8. NMR signal mainly depends on

(a) electronegativity of nearby atoms

(b) hydrogen bonds of the molecules

(c) charge of the atoms

(d) mass of the molecules

9. Cluster analysis in DNA microarray experiments refers to

(a) genes that are clustered together in the genome

(b) cluster of probes that are used to monitor gene expression

(c) genes which are likely to work in concert in the cell

(d) cluster of cDNAs printed on microarray chip

10. In a mass spectrometry experiment for determining molecular mass of a protein, the property that is used for the determination of the molecular mass is

(a) mass/charge ratio

(b) charge/mass ratio

(c) total charge on the protein

(d) net charge on the protein

11. Which one of the following wavelengths is most suitable for determining the concentration of polyalanine (a synthetic polypeptide composed solely of alanine residues) directly in aqueous solution without using any reagents in a UV-visible spectrometer?

(a) 220 nm

(b) 260 nm

(c) 280 nm

(d) 595 nm

12. $_{92}U^{238}$ after the emission of an alpha particle is converted to

(a) $_{92}U^{238}$

(b) $_{92}U^{235}$

(c) $_{92}U^{234}$

(d) $_{90}Th^{234}$

13. Which one of the following is nonradiative transition?

(a) Internal Conversion

(b) Phosphorescence

(c) Intersystem crossing

(d) All of the above

14. You are given two tubes (A and B) containing actively growing cell cultures. The cell culture in tube A is treated with a drug that inhibits cell division, while the culture in tube B remains untreated. Which one of the following techniques you would use to analyze the inhibition of cell cycle?

(a) Fluorescence spectroscopy

(b) Fluorescence-activated cell sorting

(c) UV-Vis spectroscopy

(d) NMR spectroscopy

15. Efficiency of a thermal engine working between upper temperature of 500 K and a lower temperature of 400 K is

(a) 20%

(b) 25%

(c) 80%

(d) None of these

16. As you increase the n (number of measurements) in an experiment, which quantity do you expect, to decrease?

(a) Mean

(b) Correlation

(c) Standard error of the mean

(d) Both (b) and (c)

17. Which blood cells are called 'soldiers' of the body?

(a) WBCs

(b) Platelets

(c) RBCs

(d) All of the above

18. The SI unit of refractive index is

(a) meter

(b) cm

(c) watt

(d) No unit

19. Acid present in gastric juice is

(a) hydrochloric acid

(b) citric acid

(c) sulphuric acid

(d) acetic acid

20. The liquid metal is

(a) bismuth

(b) magnesium

(c) mercury

(d) sodium

21. Electric bulb filament is made of

(a) copper

(b) aluminium

(c) lead

(d) tungsten

22. Which of the following is a nonmetal that remains liquid at room temperature?

(a) Phosphorus

(b) Bromine

(c) Chlorine

(d) Helium

23. Main memory in computer is

    (a) random access memory

    (b) read only memory

    (c) serial access memory

    (d) None of the above

24. The brain of a computer is

    (a) CPU   (b) CD

    (c) floppy disc   (d) mouse

25. A compact disc is a data storage of which of the following types?

    (a) Magnetic

    (b) Optical

    (c) Electrical

    (d) Electromechanical

26. An atmospheric pollutant is

    (a) CO_2 (b) CO

    (c) O_2 (d) N_2

27. An object is placed to the left of thin convex lens, at a distance greater than twice the focal length of the lens. Which of the following is *true?*

    (a) A real inverted image is formed on the right side of lens between the focal length and twice the focal length.

    (b) A real inverted image is formed on the right side of lens at a distance larger than twice the focal length.

    (c) A virtual erect image is formed on the right side of lens at a distance larger than twice the focal length.

    (d) A virtual erect image is formed on the left side of lens at a distance larger than twice the focal length.

28. *Ozone hole is maximum over*

   (a)   Europe

   (b)   Antarctica

   (c)   India

   (d)   Africa

29. Spraying of DDT produces pollution of

   (a)   air

   (b)   air and water

   (c)   air and soil

   (d)   air, water and soil

30. The first atomic bomb was thrown over

   (a)   Nagasaki

   (b)   Hiroshima

   (c)   Tokyo

   (d)   Hong Kong

31. The methane gas producing field is

   (a)   wheat field

   (b)   paddy field

   (c)   cotton field

   (d)   groundnut field

32. Find the odd one out.

   (a)   Ellipsoid   (b)   Cone

   (c)   Torus   (d)   Sphere

33. Number of the nearest neighbours for a face-centered-cubic lattice is

(a) 6

(b) 8

(c) 12

(d) 10

34. Find the odd one out.

(a) 32:15

(b) 86:42

(c) 56:26

(d) 74:36

35. Which of the following pollutants can cause cancer in humans?

(a) Ozone

(b) Pesticides

(c) Mercury

(d) Lead

36. Which of the following phenomena is *not* a natural hazard?

(a) Chemical contamination

(b) Wildfire

(c) Lightning

(d) Landslide

37. India's contribution to total global carbon dioxide emissions is about

(a) ~ 3%

(b) ~ 6%

(c) ~ 10%

(d) ~ 15%

38. In the recently launched Air Quality Index in India, which of the following pollutants is *not* included?

(a) Carbon monoxide

(b) Fine particulate matter

(c) Ozone

(d) Chlorofluorocarbon

39. Dyslexia is associated with

(a) mental disorder

(b) behaviour disorder

(c) reading disorder

(d) writing disorder

40. Internal communication within institutions is done through

(a) LAN

(b) WAN

(c) EBB

(d) MMS

41. In a fuel cell-driven vehicle, the energy is obtained from the combustion of

(a) methane

(b) hydrogen

(c) LPG

(d) CNG

42. Which one of the following is an indication of the quality of a research journal?

(a) Impact factor

(b) h-index

(c) g-index

(d) 10-index

43. The advantage of sampling is

    (a)   time-saving

    (b)   capital-saving

    (c)   increased accuracy

    (d)   Both (a) and (b)

44. Which of the following is a step of research design?

    (a)   Defining the problem and formulating a hypothesis

    (b)   Collecting data

    (c)   Drawing inferences from the data

    (d)   All of the above

45. Which of the following is a nonprobability sampling method?

    (a)   Simple random sampling

    (b)   Systematic sampling

    (c)   Cluster sampling

    (d)   Quota sampling

46. Reliability of a research result implies its

    (a)   verifiability

    (b)   validity

    (c)   uniqueness

    (d)   usefulness

47. Evaluation research is concerned with

   (a) what are we doing?

   (b) why are we doing?

   (c) how well are we doing?

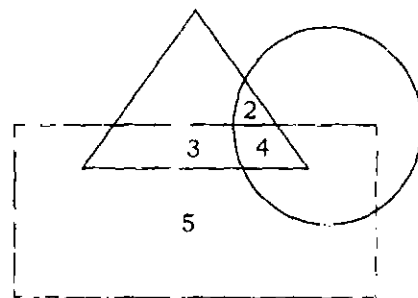   (d) None of the above

48. Communication is the transmission of

   (a) information

   (b) meaning

   (c) Both (a) and (b)

   (d) None of the above

49. 'Metal' is related to 'Sculptor' in the same way as 'Canvas' is related to

   (a) Painter

   (b) Cloth

   (c) Colours

   (d) Painting

50. In the given figure if triangle represents healthy people, square represents old persons and circle represents men, then what is the number of those men who are healthy but not old?

   (a) 3   (b) 5

   (c) 4   (d) 2

PART—B

(Subject Specific)

1. In the given figure, a silicon is carrying a constant current of 1 mA. When the temperature of the diode is 20 °C, V_D is found to be 700 mV. If the temperature rises to 40 °C, V_D becomes approximately equal to

(a) 740 mV

(b) 660 mV

(c) 680 mV

(d) 700 mV

2. Assume that the β of the transistor is extremely large and $V_{BE} = 0 \cdot 7$ V, I_c and V_{CE} in the circuit shown in the figure below are

(a) $I_c = 1$ mA, $V_{CE} = 4 \cdot 7$ V

(b) $I_c = 0 \cdot 5$ mA, $V_{CE} = 3 \cdot 75$ V

(c) $I_c = 1$ mA, $V_{CE} = 2 \cdot 5$ V

(d) $I_c = 0 \cdot 5$ mA, $V_{CE} = 3 \cdot 9$ V

3. Expression A+A′B+A′B′C+A′B′C′D+A′B′C′D′E would be simplified to

(a) A+A′B+CD+E

(b) A+B+CDE

(c) A+BC+CD+DE

(d) A+B+C+D+E

4. The magnitude frequency response of a control system is shown in figure below. The values of ω_1 and ω_2 are respectively
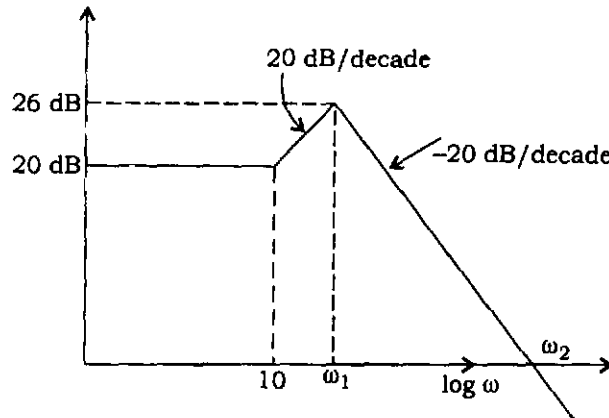

(a)   10 and 200

(b)   20 and 200

(c)   20 and 400

(d)   100 and 400

5. A GaAs device is doped with a donor concentration of 3×10^{15} cm^{-3}. For the device to operate properly, the intrinsic carrier concentration must remain less than 5% of the total concentration. The maximum temperature on which the device may operate is

(a)   763 K

(b)   769 K

(c)   486 K

(d)   243 K

6. A 10 V carrier is amplitude modulated by three different frequencies with amplitude of 1 V, 2 V and 3 V respectively. The modulation index is

(a)   0·374

(b)   0·89

(c)   0·576

(d)   0·239

7. The drift velocity of the electron is dependent upon the

(a)   electron mobility

(b)   electron field

(c)   Both (a) and (b)

(d)   None of the above

8. An FM signal has a carrier swing of 100 kHz when the modulating signal has a frequency of 8 kHz. The modulation index is
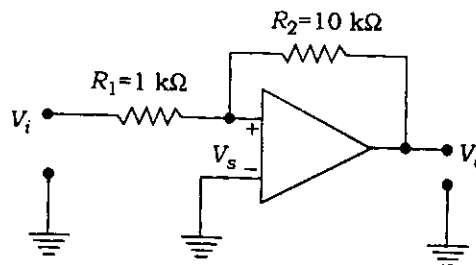
(a) 6·25

(b) 12·5

(c) 7·5

(d) 15

9. In the circuit shown below, voltage $V_E = 4$ V. The values of α and β are respectively
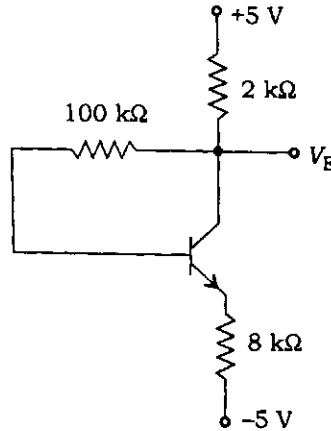
(a) 0·943, 17·54

(b) 0·914, 17·54

(c) 0·914, 11·63

(d) 0·914, 10·54

10. The inverting op-amp shown in figure below has an open-loop gain of 100. The closed-loop gain V_o / V_s is


(a) −8

(b) −9

(c) −10

(d) −11

11. The Boolean expression $AB + BC'$ is equivalent to

(a) $A'C + BC' + AC$

(b) $B'C + AC + BC' + A'CB$

(c) $AC + BC' + B'C + ABC$

(d) $ABC + A'BC' + ABC' + AB'C$

12. A *p-n* junction in series with a 100 Ω resistor is forward biased so that a current of 100 mA flows. If voltage across this combination is instantaneously reversed to 10 V at $t = 0$, then reverse current that flows through the diode at $t = 0$ is approximately given by

(a) zero

(b) 100 mA

(c) 200 mA

(d) 50 mA

13. An audio amplifier is designed to have a small-signal bandwidth of 20 kHz. The open-loop low-frequency voltage gain of the op-amp is 10^5 and unity gain bandwidth is 1 MHz. What is the maximum closed-loop voltage gain for this amplifier?

(a) 500

(b) 5×10^6

(c) 2×10^6

(d) 50

14. Power content of each of the sidebands for 90% modulation of an AM wave having carrier power as 800 W is

(a) 152 W

(b) 132 W

(c) 142 W

(d) 162 W

15. A signal $m(t) = 5\cos 2\pi 100t$ undergoes frequency modulates a carrier. The resulting FM signal is $10 \cos(2\pi 10^5 t) + 15 \sin(2\pi 100 t)$. The approximate bandwidth of the FM signal would be

(a) 0·1 kHz

(b) 1 kHz

(c) 3·2 kHz

(d) 100 kHz

16. In the transistor amplifier circuit shown in the figure below, the transistor has the following parameters $\beta_{DC} = 60$, $V_{BE} = 0·7$ V, $h_w \to \infty$. The capacitance C_c can be assumed to be infinite
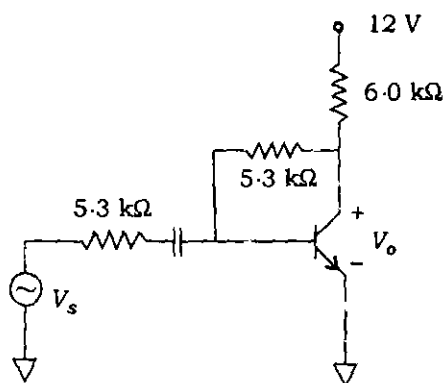

Find V_{CE} under DC condition.

(a) 4·8 V

(b) 5·3 V

(c) 6·0 V

(d) 6·6 V

17. The diode in the circuit has the nonlinear terminal characteristics as shown in figure below. Let the voltage be $V_S = \cos\omega t$ V.

100 Ω

V_i

100 Ω

2 V

a

I_D

V_D

b

I_D(mA)

4

0.5 0.7 $\rightarrow V_D$(V)
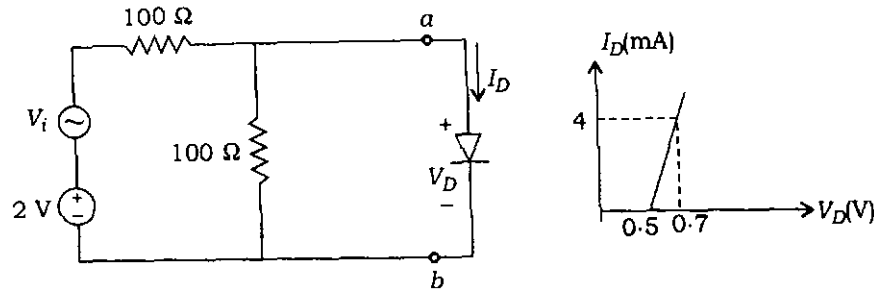
The current I_D is

(a) $2 \cdot 5(1 + \cos\omega t)$ mA

(b) $5(0 \cdot 5 + \cos\omega t)$ mA

(c) $5(1 + \cos\omega t)$ mA

(d) $5(1 + 0 \cdot 5\cos\omega t)$ mA

18. BCD coded number is expressed in digit such as

(a) 1 bit

(b) nibble

(c) 1 byte

(d) None of these

19. Determine the values of the binary numbers in 2's complement number is 10101010.

(a) −86

(b) +86

(c) −98

(d) +98

20. Octal number equivalent to decimal number 324·987 is

(a) 640·781

(b) 815·234

(c) 70·771

(d) 504·771

21. The logic circuit given below converts a binary code y_1, y_2, y_3, y_4 into

y_1 y_2 y_3 y_4

x_1 x_2 x_3 x_4
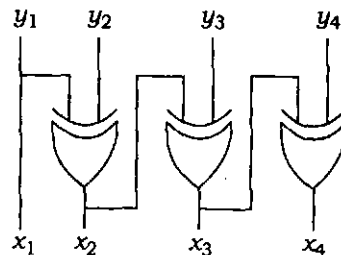
(a) Gray code

(b) Excess-3 code

(c) BCD code

(d) Hamming code

22. $[CoCl_4]^{2-}$ shows a deep blue colour because

    (a) metal to ligand charge transfer transition

    (b) ligand to metal charge transfer transition

    (c) spin allowed and Laporte forbidden d-d transition

    (d) spin allowed and Laporte allowed d-d transition

23. Among the three types of orbitals p, d and f

    (a) both p and f orbitals have centre of symmetry

    (b) both p and d orbitals have centre of symmetry

    (c) only d orbitals have centre of symmetry

    (d) f orbitals alone have centre of symmetry

24. The absorbance of solution having 20% transmittance is

    (a) 1·301   (b) 0·301

    (c) 0·699   (d) 1·699

25. Which of the following is a free radical?

    (a) CO

    (b) CN^-

    (c) NO

    (d) CS

26. Phosphorus is mainly extracted from

    (a) sand

    (b) ash

    (c) bone ash

    (d) fertilizer

27. Identify the molecule whose rotational constant cannot be determined by spectroscopic methods.

    (a) CH_4

    (b) H_2

    (c) CO_2

    (d) HCl

28. Atmosphere contains dust particles, salt grains, pollen grains, smoke, etc., which are collectively known as

    (a) water vapour

    (b) ozone

    (c) aerosol

    (d) CFC

29. Heavy metal pollution of water is caused by

    (a) acid plants

    (b) paints

    (c) wood burning

    (d) domestic sewage

30. What is the name of the iron containing protein that gives red blood vessels their colour?

    (a) Hemocyanin

    (b) Pyrite

    (c) Hemoglobin

    (d) Myoglobin

31. During photosynthesis, the source of oxygen is

    (a) water

    (b) CO_2

    (c) glucose

    (d) chlorophyll

32. Greenhouse gases in the atmosphere absorb

   (a) more visible radiation than infrared

   (b) visible and infrared equally

   (c) more infrared radiation than visible

   (d) neither visible nor infrared radiation

33. Normal blood pressure of a healthy person is

   (a) 120/100

   (b) 110/90

   (c) 120/80

   (d) 120/90

34. A rise in blood cholesterol may lead to a deposition of cholesterol on the walls of blood vessels. This causes the arteries to lose their elasticity and get stiffened. This is called

   (a) hypertension

   (b) hypotension

   (c) arteriosclerosis

   (d) systolic pressure

35. The simplest hydrophilic moiety present in the membrane lipid is

   (a) phosphate group

   (b) hydroxyl group

   (c) amino group

   (d) glucose

36. The medulla oblongata is a part of human

    (a) heart

    (b) brain

    (c) liver

    (d) sex organ

37. An electron is in a box 0·10 nm across, which is the order of magnitude of atomic dimensions. The minimum energy the electron can have is

    (a) 38 eV

    (b) 152 eV

    (c) 25 eV

    (d) 48·5 eV

38. At what speed should a clock be moved so that it may appear to lose 1 minute in each hour?

    (a) $2 \cdot 2 \times 10^7$ m/sec

    (b) $8 \cdot 71 \times 10^6$ m/sec

    (c) $5 \cdot 45 \times 10^7$ m/sec

    (d) $7 \cdot 72 \times 10^7$ m/sec

39. Displacement current appears because of

    (a) time-varying electric field

    (b) time-varying magnetic field

    (c) negative charge only

    (d) positive charge only

40. How long does it take for 60·0 percent of a sample of radon (half-life : 3·8 d) to decay?

    (a) 6 d

    (b) 8·12 d

    (c) 1·52 d

    (d) 5·05 d

41. The Miller indices of a set of parallel planes which make equal intercepts on the three axes are

    (a) (1 0 0)

    (b) (1 2 1)

    (c) (1 1 1)

    (d) (1 0 1)

42. If the penetration depth for aluminium is 16 nm and 96 nm at 2·18 K and 8·1 K, respectively, the critical temperature of aluminium will be

(a)   6·11 K

(b)   8·16 K

(c)   2·18 K

(d)   5·15 K

43. What is the highest order spectrum which may be seen with monochromatic light of wavelength 5000 Å by means of diffraction grating with 5000 lines/cm?

(a)   2

(b)   8

(c)   4

(d)   6

44. Upon decreasing the dimension of a nanoparticle what kind of a shift is observed in the absorption spectra of a semiconducting particle?

(a)   Red shift

(b)   Blue shift

(c)   Green shift

(d)   Violet shift

45. The resistivity of the uniformly doped n-type silicon sample is 0·5 Ω-cm. If the electron mobility (μ_n) is 1250 cm^2/V-s and the charge of an electron is $1·6 \times 10^{-19}$, the donor impurity concentration (N_D) in the sample is

(a) 2×10^{16} cm^{-2}

(b) 1×10^{16} cm^{3}

(c) $2·5 \times 10^{15}$ cm^{-3}

(d) 2×10^{15} cm^{3}

46. In UJT relaxation oscillator, if supply voltage is doubled, then the amplitude of the voltage waveform across capacitor will

(a)   get doubled

(b)   reduce to half

(c)   not change at all

(d)   None of the above

47. For an AM signal, the bandwidth is 10 kHz and the highest frequency component present is 705 kHz. The carrier frequency used for this AM signal is

(a) 695 kHz

(b) 700 kHz

(c) 705 kHz

(d) 710 kHz

48. An angle modulated signal is given as $x(t) = 100\cos[2\pi f_c t + 2\sin 100\pi t]$, where $f_c = 10$ MHz. The peak frequency deviation is

(a) $4000\,\pi$

(b) $8000\,\pi$

(c) 1000

(d) 8000

49. A signal is sampled at 8 kHz and is quantized using 8-bit uniform quantizer. Assuming SNR_q for a sinusoidal signal, the correct statement for PCM signal with a bit rate of R is

(a) $R = 32$ kbits/s, $SNR_q = 25 \cdot 8$ dB

(b) $R = 64$ kbits/s, $SNR_q = 49 \cdot 8$ dB

(c) $R = 64$ kbits/s, $SNR_q = 55 \cdot 8$ dB

(d) $R = 32$ kbits/s, $SNR_q = 49 \cdot 8$ dB

50. An analog signal is quantized and transmitted using a PCM system. The tolerable error in sample amplitude is 0·5% of the peak-to-peak full-scale value. The minimum binary digits required to encode a sample is

(a) 5

(b) 6

(c) 7

(d) 8

SPACE FOR ROUGH WORK

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