

122

QUESTION PAPER
SERIES CODE
A

Registration No. :

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Centre of Exam. :

Name of Candidate :

Signature of Invigilator

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 $\frac{1}{2}$ 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 <input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/>	Wrong <input checked="" type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/> (d)	Wrong <input checked="" type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input checked="" type="radio"/> (d)	Wrong <input checked="" type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/>	Correct <input type="radio"/> (a) <input checked="" type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/>
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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.**

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PART—A

(Research Methodology)

1. Main memory in computer is
 - (a) random access memory
 - (b) read only memory
 - (c) serial access memory
 - (d) None of the above

2. The brain of a computer is
 - (a) CPU
 - (b) CD
 - (c) floppy disc
 - (d) mouse

3. A compact disc is a data storage of which of the following types?
 - (a) Magnetic
 - (b) Optical
 - (c) Electrical
 - (d) Electromechanical

4. An atmospheric pollutant is
 - (a) CO₂
 - (b) CO
 - (c) O₂
 - (d) N₂

5. 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.

- 6. Ozone hole is maximum over**
- (a) Europe
 - (b) Antarctica
 - (c) India
 - (d) Africa
- 7. Spraying of DDT produces pollution of**
- (a) air
 - (b) air and water
 - (c) air and soil
 - (d) air, water and soil
- 8. The first atomic bomb was thrown over**
- (a) Nagasaki
 - (b) Hiroshima
 - (c) Tokyo
 - (d) Hong Kong
- 9. The methane gas producing field is**
- (a) wheat field
 - (b) paddy field
 - (c) cotton field
 - (d) groundnut field
- 10. Find the odd one out.**
- (a) Ellipsoid
 - (b) Cone
 - (c) Torus
 - (d) Sphere

11. Number of the nearest neighbours for a face-centered-cubic lattice is
- (a) 6 (b) 8
- (c) 12 (d) 10
12. Find the odd one out.
- (a) 32:15 (b) 86:42
- (c) 56:26 (d) 74:36
13. Which of the following pollutants can cause cancer in humans?
- (a) Ozone
- (b) Pesticides
- (c) Mercury
- (d) Lead
14. Which of the following phenomena is *not* a natural hazard?
- (a) Chemical contamination
- (b) Wildfire
- (c) Lightning
- (d) Landslide
15. India's contribution to total global carbon dioxide emissions is about
- (a) ~ 3% (b) ~ 6%
- (c) ~ 10% (d) ~ 15%

16. 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
17. Dyslexia is associated with
- (a) mental disorder
 - (b) behaviour disorder
 - (c) reading disorder
 - (d) writing disorder
18. Internal communication within institutions is done through
- (a) LAN
 - (b) WAN
 - (c) EBB
 - (d) MMS
19. In a fuel cell-driven vehicle, the energy is obtained from the combustion of
- (a) methane
 - (b) hydrogen
 - (c) LPG
 - (d) CNG
20. 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

- 21.** The advantage of sampling is
- (a) time-saving
 - (b) capital-saving
 - (c) increased accuracy
 - (d) Both (a) and (b)
- 22.** 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
- 23.** Which of the following is a nonprobability sampling method?
- (a) Simple random sampling
 - (b) Systematic sampling
 - (c) Cluster sampling
 - (d) Quota sampling
- 24.** Reliability of a research result implies its
- (a) verifiability
 - (b) validity
 - (c) uniqueness
 - (d) usefulness

25. 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

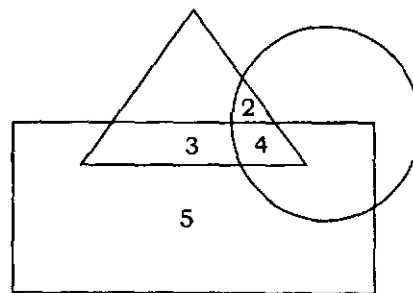
26. Communication is the transmission of

- (a) information
- (b) meaning
- (c) Both (a) and (b)
- (d) None of the above

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

- (a) Painter
- (b) Cloth
- (c) Colours
- (d) Painting

28. 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

29. 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
30. Tippit table is
- (a) a table of random digits
 - (b) used in statistical investigation
 - (c) used in sampling method
 - (d) All of the above
31. 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
32. 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
33. 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

34. 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
35. 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
36. 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
37. 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

38. 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
39. 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
40. ${}_{92}\text{U}^{238}$ after the emission of an alpha particle is converted to
- (a) ${}_{92}\text{U}^{238}$
 - (b) ${}_{92}\text{U}^{235}$
 - (c) ${}_{92}\text{U}^{234}$
 - (d) ${}_{90}\text{Th}^{234}$
41. Which one of the following is nonradiative transition?
- (a) Internal Conversion
 - (b) Phosphorescence
 - (c) Intersystem crossing
 - (d) All of the above

42. 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
43. 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
44. 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)
45. Which blood cells are called 'soldiers' of the body?
- (a) WBCs
 - (b) Platelets
 - (c) RBCs
 - (d) All of the above
46. The SI unit of refractive index is
- (a) meter
 - (b) cm
 - (c) watt
 - (d) No unit

- 47. Acid present in gastric juice is**
- (a) hydrochloric acid
 - (b) citric acid
 - (c) sulphuric acid
 - (d) acetic acid
- 48. The liquid metal is**
- (a) bismuth
 - (b) magnesium
 - (c) mercury
 - (d) sodium
- 49. Electric bulb filament is made of**
- (a) copper
 - (b) aluminium
 - (c) lead
 - (d) tungsten
- 50. Which of the following is a nonmetal that remains liquid at room temperature?**
- (a) Phosphorus
 - (b) Bromine
 - (c) Chlorine
 - (d) Helium

PART—B

(Subject Specific)

1. $[\text{CoCl}_4]^{2-}$ 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
2. 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
3. The absorbance of solution having 20% transmittance is
 - (a) 1.301
 - (b) 0.301
 - (c) 0.699
 - (d) 1.699
4. Which of the following is a free radical?
 - (a) CO
 - (b) CN^-
 - (c) NO
 - (d) CS
5. Phosphorus is mainly extracted from
 - (a) sand
 - (b) ash
 - (c) bone ash
 - (d) fertilizer

6. Identify the molecule whose rotational constant cannot be determined by spectroscopic methods.
- (a) CH_4
 - (b) H_2
 - (c) CO_2
 - (d) HCl
7. Atmosphere contains dust particles, salt grains, pollen grains, smoke, etc., which are collectively known as
- (a) water vapour
 - (b) ozone
 - (c) aerosol
 - (d) CFC
8. Heavy metal pollution of water is caused by
- (a) acid plants
 - (b) paints
 - (c) wood burning
 - (d) domestic sewage
9. What is the name of the iron containing protein that gives red blood vessels their colour?
- (a) Hemocyanin
 - (b) Pyrite
 - (c) Hemoglobin
 - (d) Myoglobin
10. During photosynthesis, the source of oxygen is
- (a) water
 - (b) CO_2
 - (c) glucose
 - (d) chlorophyll

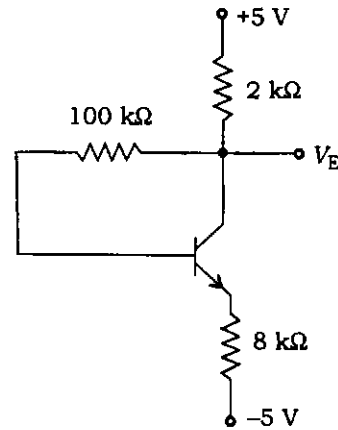
11. Greenhouse gases in the atmosphere absorb
- (a) more visible radiation than infrared
 - (b) visible and infrared equally
 - (c) more infrared radiation than visible
 - (d) neither visible nor infrared radiation
12. Normal blood pressure of a healthy person is
- (a) 120/100
 - (b) 110/90
 - (c) 120/80
 - (d) 120/90
13. 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
14. The simplest hydrophilic moiety present in the membrane lipid is
- (a) phosphate group
 - (b) hydroxyl group
 - (c) amino group
 - (d) glucose

15. The medulla oblongata is a part of human
- (a) heart
 - (b) brain
 - (c) liver
 - (d) sex organ
16. 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
17. At what speed should a clock be moved so that it may appear to lose 1 minute in each hour?
- (a) 2.2×10^7 m/sec
 - (b) 8.71×10^6 m/sec
 - (c) 5.45×10^7 m/sec
 - (d) 7.72×10^7 m/sec
18. Displacement current appears because of
- (a) time-varying electric field
 - (b) time-varying magnetic field
 - (c) negative charge only
 - (d) positive charge only
19. 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
20. 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)

21. 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
22. 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
23. 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
24. The resistivity of the uniformly doped *n*-type silicon sample is 0.5 Ω-cm. If the electron mobility (μ_n) is 1250 cm²/V-s and the charge of an electron is 1.6×10^{-19} , the donor impurity concentration (N_D) in the sample is
- (a) 2×10^{16} cm⁻³
(b) 1×10^{16} cm⁻³
(c) 2.5×10^{15} cm⁻³
(d) 2×10^{15} cm⁻³
25. 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

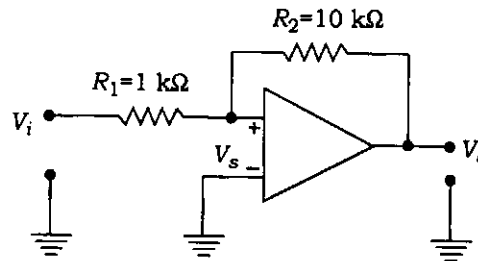
37. An FM signal has a carrier swing of 100 kHz when the modulating signal has a frequency of 8 kHz. The modulation index is
- (a) 6.25 (b) 12.5
(c) 7.5 (d) 15

38. 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

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

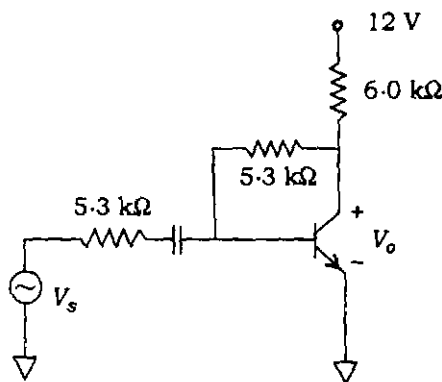


- (a) -8 (b) -9
(c) -10 (d) -11

40. 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) $ABC + A'BC' + ABC' + AB'C$

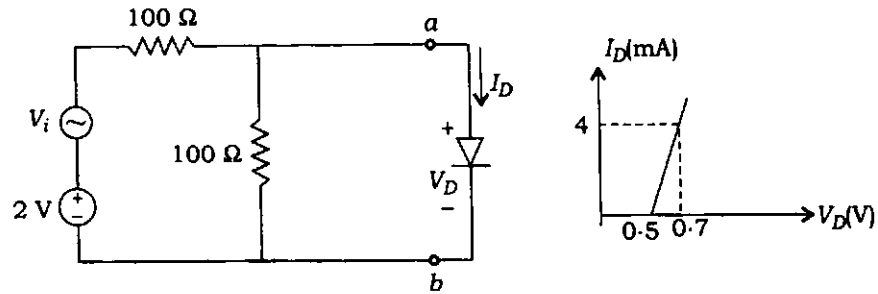
41. A $p-n$ junction in series with a $100\ \Omega$ resistor is forward biased so that a current of $100\ \text{mA}$ flows. If voltage across this combination is instantaneously reversed to $10\ \text{V}$ at $t = 0$, then reverse current that flows through the diode at $t = 0$ is approximately given by
- (a) zero (b) $100\ \text{mA}$
(c) $200\ \text{mA}$ (d) $50\ \text{mA}$
42. An audio amplifier is designed to have a small-signal bandwidth of $20\ \text{kHz}$. The open-loop low-frequency voltage gain of the op-amp is 10^5 and unity gain bandwidth is $1\ \text{MHz}$. What is the maximum closed-loop voltage gain for this amplifier?
- (a) 500 (b) 5×10^6
(c) 2×10^6 (d) 50
43. Power content of each of the sidebands for 90% modulation of an AM wave having carrier power as $800\ \text{W}$ is
- (a) $152\ \text{W}$ (b) $132\ \text{W}$
(c) $142\ \text{W}$ (d) $162\ \text{W}$
44. A signal $m(t) = 5\cos 2\pi 100t$ undergoes frequency modulates a carrier. The resulting FM signal is $10\cos(2\pi 10^5 t) + 15\sin(2\pi 100t)$. The approximate bandwidth of the FM signal would be
- (a) $0.1\ \text{kHz}$ (b) $1\ \text{kHz}$
(c) $3.2\ \text{kHz}$ (d) $100\ \text{kHz}$
45. In the transistor amplifier circuit shown in the figure below, the transistor has the following parameters $\beta_{DC} = 60$, $V_{BE} = 0.7\ \text{V}$, $h_{w} \rightarrow \infty$. The capacitance C_c can be assumed to be infinite



Find V_{CE} under DC condition.

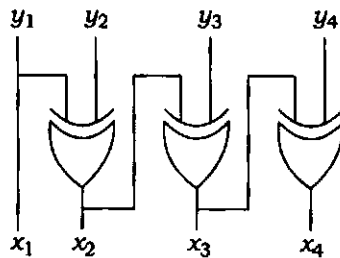
- (a) $4.8\ \text{V}$ (b) $5.3\ \text{V}$
(c) $6.0\ \text{V}$ (d) $6.6\ \text{V}$

46. 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.



The current I_D is

- (a) $2.5(1 + \cos \omega t)$ mA
 (b) $5(0.5 + \cos \omega t)$ mA
 (c) $5(1 + \cos \omega t)$ mA
 (d) $5(1 + 0.5 \cos \omega t)$ mA
47. BCD coded number is expressed in digit such as
 (a) 1 bit (b) nibble
 (c) 1 byte (d) None of these
48. Determine the values of the binary numbers in 2's complement number is 10101010.
 (a) -86 (b) +86
 (c) -98 (d) +98
49. Octal number equivalent to decimal number 324.987 is
 (a) 640.781 (b) 815.234
 (c) 70.771 (d) 504.771
50. The logic circuit given below converts a binary code y_1, y_2, y_3, y_4 into



- (a) Gray code (b) Excess-3 code
 (c) BCD code (d) Hamming code

SPACE FOR ROUGH WORK

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