Admission Test – M.Tech. (Optoelectronics and Communications)

Model Question Paper

Test-I (Common for all): 50 Objective type items
Max. Marks: 50 Duration: 90 minutes

Test-II (For Engineering candidates): 50 Objective type Questions
Max. Marks: 50 marks Duration: 90 minutes

Test-II (For Physics candidates): 50 Objective type Questions
Max. Marks: 50 Duration: 90 minutes

Test-I: COMMON FOR ALL

Choose the correct answer and WRITE IN CAPITAL LETTER viz., A, B, C, or D in the RESPONSE SHEET given separately.

SAMPLE QUESTIONS

1. The equation $x^2 + 3xy + 2y^2 + 2x + 3y + 1 = 0$ represents

(A) An ellipse (B) A parabola
(C) A hyperbola (D) A pair of straight lines

2. Let *V* be a vector space, and let *W* be a subset of *V*. What does it mean when we say that *W* is closed under addition?

(A) If *x*+*y* is in *W*, then *x* and *y* are in *W*
(B) Whenever *x* and *y* are in *W*, then *x* + *y* is in *W*
(C) *W(x* + *y)* = *Wx* + *Wy* for every two vectors *x* and *y*
(D) None of the above

3. The function f(z) = Sec(z) is
(A) analytic for all z (B) not analytic at z = π
(C) not analytic at z = π/2 (D) not analytic for any z

4. The value of $\int_{-a}^{a} \sqrt{1 - \frac{x^2}{a^2}}\, dx$
(A) aπ/2 (B) πa (C) 2πa (D) πa^2

5. The argument of the complex number $(1+i)^4$ is

(A) 135 (B) 90 (C) 180 (D) 45

6. The normal to the curve X=a(1+cos q), Y= a(sin q) at 'q' always passes through the fixed point

(A) (a,0) (B) (0,a) (C) (0,0) (D) (a,a)

7. The sum of the series $\frac{1}{1.2}-\frac{1}{2.3}+\frac{1}{3.4}-...$ up to ∞ is equal to

(A) 2 $\log_e(2)$ (B) $\log_e(2) - 1$ (C) $\log_e(2)$ (D) $\log_e(4/e)$

8. The radius of convergence of the power series $f(z)=\sum\frac{1}{n^p}z^n$ is

(A) 1 (B) 2 (C) 0 (D) ∞

9. The value of the Wronskian of the functions x^2, 3x+2, 2x+3 is

(A) 10 (B) 12x+5 (C) $-10+x^2$ (D) -10

10. The eigen values of the matrix $\begin{bmatrix}1 & 2 & 0\\ 2 & 1 & 0\\ 0 & 0 & -1\end{bmatrix}$ lie in the disc

(A) $|\lambda+1|\le 1$ (B) $|\lambda-1|\le 1$ (C) $|\lambda+1|\le 0$ (D) $|\lambda-1|\le 2$

11. The equation $\frac{d^2y}{dx^2}-\frac{2dy}{dx}+10y=0$ has characteristic roots

(A) $1\pm 3i$ (B) $1\pm 2i$ (C) $1+(3/2)i$ (D) $1-(3/2)i$

12. The distribution $f(x)=\frac{1}{\pi}\frac{a}{a^2+x^2}$, $-\infty < x < \infty$ is similar to that of

(A) Normal distribution
(B) Cauchy's distribution
(C) Poisson distribution
(D) Exponential distribution

13. The series $\sum_{n=1}^{\infty}\frac{z^n}{n\sqrt{n+1}}$, $|z|\le 1$ is

(A) Uniformly but not absolutely convergent
(B) Uniformly and absolutely convergent
(C) Absolutely convergent but not uniformly convergent
(D) Convergent but not uniformly convergent

14. The value of $\nabla.(r^{-2}\hat{e_r})$ where, $\hat{e_r}$ is the unit vector along the radial direction, is

(A) Zero (B) $4\pi\,\delta(r)$ (C) 4π (D) $2\pi\,\delta(r)$

15. A particle has initial velocity $(3\hat{i} + 4\hat{j})$ and has acceleration $(0.4\hat{i} + 0.3\hat{j})$. Its speed after 10 s is

(A) 10 units (B) 7 units (C) $7\sqrt{2}$ units (D) 8.5 units

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Test-II
for candidates with Engineering as qualifying degree

Choose the correct answer and WRITE IN CAPITAL LETTER viz., A, B, C, or D in the RESPONSE SHEET given separately.

SAMPLE QUESTIONS

1) A broadcast super heterodyne receiver has an intermediate frequency of 500 kHz and a local oscillator at 10 Mhz. The desired signal channel is at 9500 kHz. The image frequency is
(A) 10 MHz (B) 9.5MHz (C) 10.5 MHz (D) 19.5 MHz

2) For a PCM system has the following parameters: maximum analog input frequency 4 kHz, total number of PCM bits 9, maximum decoded voltage at the receiver ±2.55V. The minimum sample rate is
(A) 1.57 kHz (B) 8 kHz (C) 4 kHz (D) 2 kHz

3) If the frequency spectrum of a signal has a bandwidth of 500 Hz with the highest frequency at 600 Hz, what should be the sampling rate, according to the Nyquist theorem?
(A) 200 samples/s (B) 500 samples/s
(C) 1000 samples/s (D) 1200 samples/s

4) Which of the following combinations of gates **does not allow** the implementation of an arbitrary Boolean function?
(A) OR gates and inverters only
(B) NAND gates only
(C) NOR gates only
(D) OR gates and AND gates.

5) Given a MOD-14 ripple counter using J-K flip-flops. If the clock frequency to the counter is 30 kHz, then the output frequency of the counter will be
(A) 2.14 kHz (B) 2.2 kHz (C) 3.2 kHz (D) 30 kHz

6) Signal voltage Vs = 0.923 μV; Noise voltage Vn = 0.267 μV, then the signal-to-noise ratio
(A) 11.95 (B) 0.083 (C) 3.456 (D) 0.289

7) For parallel plane waveguide of height d, the cut off wavelength for a particular mode 'm' is λ_C =

(A) d/m (B) md (C) 2d/m (D) d/2m

8) The most suitable material for making an LDR (Light dependent resistor) is a semiconductor material having
(A) $E_g >> h\nu$ (B) $E_g > h\nu$ (C) $E_g = h\nu$ (D) $E_g < h\nu$

9) Which of the following statements is incorrect?
(A) The output voltage of a switching regulator is controlled by altering the switching frequency.
(B) Switching regulators use switching speeds of 20 kHz or more.
(C) Both bipolar transistors and FETs have very good switching characteristics.
(D) A great advantage of switching regulators is that their power consumption is very low.

10) Rayleigh Scattering is proportional to
(A) λ^4 (B) $1/\lambda^4$ (C) $1/\lambda^2$ (D) λ^2

11) Consider the following statements regarding fundamentals of light propagation
I) In reflection, the angle of incidence is equal to the angle of reflection
II) Two mirrors placed at right angles to each other can return a light ray to be parallel to its original direction
III) A reflection can occur at an interface between differing refractive indices.

(A) All statements are correct
(B) I and III are correct, II is false
(C) I and II are correct and III is false
(D) all statements are false.

12) The angle of deviation of a prism is determined by
(A) The refracting angle
(B) Angle of incidence of the ray
(C) Refractive index of the prism material
(D) All of the above

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Test-II
for candidates with M.Sc.(Physics) as qualifying degree

Choose the correct answer and WRITE IN CAPITAL LETTER viz., A, B, C, D or E in the RESPONSE SHEET given separately.

SAMPLE QUESTIONS

1) In order to measure a maximum of 4 V with a resolution of 1mV using a n-bit A/D converter, working under the principle of ladder network, the minimum value of n is

A) 10 B) 9 C) 11 D) 12

2) Two substances have specific heat capacities C and 2C. If heat Q and 4Q are supplied to these respectively, they undergo equal change in their temperatures. If substance A has mass m, then the mass of B in terms of m is

(A) m (B) 2m (C) m/2 (D) cannot be determined

3) In an interference pattern formed by two coherent sources, the maximum and the minimum of the intensities are $9I_0$ and I_0, respectively. The intensities of the individual waves are

(A) $3I_0$ and I_0 (B) $4I_0$ and I_0 (C) $5I_0$ and $4I_0$ (D) $9I_0$ and I_0

4) Two metallic rings A and B, identical in shape and size but having different resistivities ρ_A and ρ_B, are kept on top of two identical solenoids. When current I is switched on in both the solenoids in identical manner, the rings A and B jump to heights h_A and h_B respectively, with $h_A > h_B$. The possible relation between their resistivities and their masses m_A and m_B is

(A) $\rho_A > \rho_B$ and $m_A = m_B$ (B) $\rho_A < \rho_B$ and $m_A = m_B$
(C) $\rho_A > \rho_B$ and $m_A > m_B$ (D) $\rho_A < \rho_B$ and $m_A > m_B$

5) Signal voltage Vs = 0.923 μV; Noise voltage Vn = 0.267 μV, then the signal-to-noise ratio

(A) 11.95 (B) 0.083 (C) 3.456 (D) 0.289

6) In a hydrogen atom in the ground state suppose the orbital speed of the electron is 'v'. If the mass of the electron is 'm' and the magnitude of its charge is 'e', what is the radius of the orbit of the electron?

(A) $e^2/4\pi\varepsilon_0 mv^2$ (B) $e^2/4\pi\varepsilon_0 mv$
(C) $e/4\pi\varepsilon_0 mv^2$ (D) $mv^2/4\pi\varepsilon_0 e^4$

7) The H_α line is the first member of the Balmer series of the hydrogen spectrum and it occurs due to the transition of the electron from the 3rd orbit to the 2nd orbit. If its wave length is λ, the wave length of the last member of the Balmer series will be

(A) (4/9) λ (B) (5/9) λ (C) (7/9) λ (D) (1/3) λ

8) A bar magnet is dropped onto a copper ring at room temperature and the procedure is repeated keeping the ring in ice. If the acceleration of the magnet during the fall is a_1 and a_2 in the two cases respectively, and g is the acceleration due to gravity, then

A) $a_1 < a_2 < g$ B) $a_1 > a_2 > g$ C) $g > a_1 > a_2$ D) $g > a_2 > a_1$

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