Code No.	L – 4038

Entrance Examination for Admission to the P.G. Courses in the Teaching Departments, 2021

CSS

PHYSICS (APPLIED ELECTRONICS/SPACE PHYSICS/ RENEWABLE ENERGY)

General Instructions

1. The Question Paper is having two Parts — Part 'A' Objective type (60%) & Part 'B' Descriptive type (40%).
2. Objective type questions which carry 1 mark each are to be (✓) 'tick marked' in the response sheets against the appropriate answers provided.
3. 8 questions are to be answered out of 12 questions carrying 5 marks each in Part 'B'.
4. **Negative marking** : 0.25 marks will be deducted for each wrong answer in Part 'A'.

Time : 2 Hours **Max. Marks : 100**

To be filled in by the Candidate									
Register Number	in Figures								
	in words								

PART – A

(Objective Type)

Choose appropriate answer from the options in the questions. **One** mark **each**.

(60 × 1 = 60)

1. The packing fraction for an SC lattice as compared to that of fcc lattice is

   a) Greater b) Smaller

   c) Can be both greater or smaller d) Not possible to say

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2. A photon has the properties except
   a) Zero intrinsic angular momentum
   b) Its momentum is $\frac{h\vartheta}{c}$
   c) Its total energy is kinetic
   d) It has zero rest mass

3. Which one of the following molecules does not exhibit a rotational spectrum?
   a) H_2 b) CO c) HCl d) HBr

4. The numerical value of the radius of the first orbit of hydrogen atom is

a) 0.529 nm b) 0.0529 A° c) 5.29 A° d) 0.0529 nm

5. The half life of one of the atoms of a radio active sample is

a) $e^{-\lambda/2}$ b) $\frac{\ln 2}{\lambda}$ c) $\frac{\ln \lambda}{2}$ d) $\frac{\lambda}{2}$

6. An oscillator differs from an amplifier because

a) It has more gain b) It requires no input signal
c) It requires no dc supply d) It always has the same output

7. The Gibb's potential is defined as

a) G = U-PV+TS b) G = U+PV+TS
c) G = U-PV-TS d) G = U+PV-TS

8. Bohr postulated in his model quantisation of

a) Energy b) Linear momentum
c) Angular momentum d) Spin

9. The Pauli exclusion principle states that

a) Particle with half integral spin cannot exist in the same state
b) Particle with integral spin exist in same state
c) Particle with half integral spin can exist in the same state
d) Particle with integral spin cannot exist in the same state

10. The force which is always directed away or towards a fixed centre and magnitude of which is a function only of the distance from the fixed centre, known as

a) Coriolis force b) Centripetal force
c) Centrifugal force d) Central force

11. A physical system is invariant under rotation about a fixed axis. Then the following quantity is conserved

a) Total linear momentum
b) Linear momentum along the axis of rotation
c) Total angular momentum
d) Angular momentum along the axis of rotation

12. The period of oscillation for compound pendulum is

a) $2\pi\sqrt{\frac{k^2+l^2}{gl}}$ b) $2\pi\sqrt{\frac{gl}{k^2+l^2}}$

c) $2\pi\sqrt{\frac{k^2+l^2}{mgl}}$ d) $2\pi\sqrt{\frac{mgl}{k^2+l^2}}$

13. A field is irrotational if

a) grad A =0 b) div $\vec{A}$ = 0 c) curl $\vec{A}$ = 0 d) None of these

14. In a differentiator, the feedback element is a

a) Resistor b) Capacitor c) Zener diode d) Voltage divider

15. The magnetic moment associated with the first orbit in hydrogen atom is given by

a) $\frac{h}{4\pi me}$ b) $\frac{4\pi m}{he}$ c) $\frac{eh}{4\pi m}$ d) $\frac{ehm}{4\pi}$

16. The splitting of a spectral line in the presence of an electric field is called

a) Stark effect b) Zeeman effect
c) Paschen-Back effect d) Raman effect

17. When an electron and positron annihilate?

a) Nothing is created b) One photon created
c) Two photons created d) Two neutrons created

18. The change in entropy is

a) Positive in a reversible change
b) Negative in an irreversible change
c) Positive in an irreversible cycle
d) Negative in a reversible change

19. The energy per unit time, per unit area transported by the electromagnetic fields is expressed as

a) $\vec{S}=\left(\frac{1}{\mu_0}\right)\left(\vec{E}\times\vec{B}\right)$ b) $\vec{S}=\left(\vec{E}\times\vec{B}\right)$

c) $\vec{S}=\mu_0\left(\vec{E}\times\vec{B}\right)$ d) $\vec{S}=\frac{1}{\varepsilon_0}\left(\vec{E}\times\vec{B}\right)$

20. For a full wave rectifier, the minimum number of diodes required is

a) 2 b) 3 c) 4 d) 1

21. A ray of light is incident on the surface of glass plate at an angle of incidence equal to the Brewster's angle φ. If μ represents the refractive index of glass w.r.t. air, then angle between the reflected and refracted rays is

a) $90^\circ + \varphi$ b) $\sin^{-1}(\mu \cos\varphi)$ c) 90° d) $-\sin^{-1}\left(\frac{\sin\varphi}{\mu}\right)$

22. If a star is moving towards earth, then the lines are shifted towards

a) Red b) Green c) Infrared d) Blue

23. A double slit interference experiment is carried out in air and the entire arrangement is dipped in water. The fringe width

a) Increases b) Decreases

c) Remains unchanged d) Fringe pattern disappears

24. The gate for which output is high, if at least on input is low is

a) NAND b) NOR c) AND d) OR

25. Of the following which is preferred modulation scheme for digital communication

a) Pulse code modulation b) Pulse amplitude modulation

c) Pulse width modulation d) Pulse position modulation

26. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude is 48 V m^{-1}. The amplitude of oscillating magnetic field is

a) 3.2×10^{-8} T b) 3×10^{7} T c) 16×10^{-7} d) 1.6×10^{-7} T

27. In a transformer, the number of turns of primary coil and secondary coil are 5 and 4 respectively. If 240V is applied on the primary, then the ratio of currents in the primary and secondary coils is

a) 4:5 b) 5:4 c) 1:3 d) 3:1

28. The relation between relative permeability and magnetic susceptibility is

a) $\mu_r = 1 - \chi_m$ b) $\mu_r = 1 + \chi_m$

c) $\mu_r = 3(1 + \chi_m)$ d) $\mu_r = 1/\chi_m$

29. A surface encloses an electric dipole. The electric flux through the surface is

a) Positive b) Negative c) Zero d) Infinite

30. The rest mass of an electron is m_0. when it moves with a velocity $v = 0.6c$, then its rest mass is

a) m_0 b) $\frac{5}{4}m_0$ c) $\frac{4}{5}m_0$ d) $2m_0$

31. Constraint in the case of a rigid body is

a) Dynamic constraint b) Scleronomous constraint

c) Rheonomous constraint d) Static constraint

32. The zero point energy of harmonic oscillator is

a) $\hbar\omega$ b) $\frac{1}{2}\hbar\omega$ c) $2\hbar\omega$ d) $\frac{1}{4}\hbar\omega$

33. Which of the following is not a boson?

a) Neutral helium atom b) α-particles

c) photon d) muons

34. The energy of photo-electron in photo electric effect

a) Changes with intensity of light

b) Changes with frequency of light

c) Changes with velocity of falling light

d) None of these

35. The hydrogen atom is in d-state. For this state the value of *m* are

a) 2, 1, 0
b) –1, 0, 1
c) –2, –1, 0, 1, 2
d) –3, –1, 0, 1, 3

36. When applied to solar radiation, Planck's law reduces to Wien's law in the

a) Ultraviolet region
b) Microwave region
c) Infrared region
d) Visible region

37. If the degree of freedom of a gas is n, then the ratio of C_p and C_v is

a) $1+\frac{2}{n}$
b) $1+\frac{1}{n}$
c) $1+\frac{1}{2n}$
d) $\frac{2n}{2n+1}$

38. According to Maxwell's law of distribution of velocities of molecules, the most probable velocity is

a) Greater than the mean velocity
b) Equal to the mean velocity
c) Equal to the root mean square velocity
d) Less than the root mean square velocity

39. Consider the Fermi-Dirac distribution function $f(E)$ at room temperature (300K) where E refers to energy. If E_F is the fermi energy, which of the following is true?

a) $f(E)$ is a step function
b) $f(E_F)$ has a value of $\frac{1}{2}$
c) States with $E < E_F$ are filled completely
d) $f(E)$ is large and tends to infinity as E decreases much below E_F

40. The fermi energy of a free electron gas depends on the electron density ρ as

a) $\rho^{1/3}$
b) $\rho^{2/3}$
c) $\rho^{-1/3}$
d) $\rho^{-2/3}$

41. The entropy of a photon gas is proportional to

a) T b) T^2 c) T^3 d) T^4

42. A voltage follower

a) Has a gain of 1
b) Is non-inverting
c) Has no feedback resistor
d) Has all of these

43. A Zener diode works on the principle of

a) Tunnelling of charge carriers across the junction
b) Thermionic emission
c) Diffusion of charge carriers across the junction
d) Hoping of charge carriers across the junction

44. A phase shift oscillator has

a) Three RC circuit
b) Three LC circuits
c) A T-type circuit
d) A π-type circuit

45. L value for the state $2_{D_{3/2}}$ is given by

a) 0 b) 1 c) 2 d) 3

46. The variation of the intensity of X-rays with the thickness of the absorbing material is given by

a) $I = I_0 \exp(-\mu x)$
b) $I = I_0 \exp(\mu x)$
c) $I = I_0 \exp\left(-\frac{\mu}{x}\right)$
d) $I = I_0 \exp\left(\frac{\mu}{x}\right)$

47. A covalently bonded crystal is

a) Aluminium
b) Sodium chloride
c) Germanium
d) Lead

48. For Bragg's reflection by a crystal to occur, the X-ray wave length λ and interatomic distance d must be as

a) $\lambda > 2d$ b) $\lambda = 2d$ c) $\lambda \leq 2d$ d) $\lambda < 2d$

49. Which of the following is NOT a property of conventional superconductors?

a) The superconductors are perfect diamagnets

b) Superconductivity can be destroyed by application of a magnetic field

c) The specific heat of superconductors decreases exponentially with decrease in the temperature

d) The energy spectrum of a superconductor shows a band gap of the order of 1eV

50. According to Debye theory the heat capacity of a solid at low temperature is proportional to

a) T^4 b) T^3 c) T^2 d) T

51. The Curie law $\left(\chi = \frac{C}{T}\right)$ holds for

a) Diamagnetic substances b) Paramagnetic substances

c) Ferromagnetic substances d) All substances

52. According to the shell model, the ground state of ${}^{15}_{8}O$ nucleus is

a) $\frac{3^+}{2}$ b) $\frac{1^+}{2}$ c) $\frac{3^-}{2}$ d) $\frac{1^-}{2}$

53. Fast neutrons may be easily slowed down by

a) Passing them through a substance rich in hydrogen

b) Using shield of lead

c) Diffraction through a slit

d) None of these

54. Which of the following decay is forbidden?

a) $\mu^- \rightarrow e^- + \vartheta_\mu + \overline{\vartheta}_e$ b) $\pi^+ \rightarrow \mu^+ + \vartheta_\mu$

c) $\pi^+ \rightarrow e^+ + \vartheta_e$ d) $\mu^- \rightarrow e^+ + e^- + e^-$

55. Hamilton's equations of motion are

a) $\frac{\partial H}{\partial p} = \dot{q},\ \frac{\partial H}{\partial q} = \dot{p}$ b) $\frac{\partial H}{\partial p} = -q,\ \frac{\partial H}{\partial q} = p$

c) $\frac{\partial H}{\partial p} = -\dot{q},\ \frac{\partial H}{\partial q} = \dot{p}$ d) $\frac{\partial H}{\partial p} = \dot{q},\ \frac{\partial H}{\partial q} = -\dot{p}$

56. The work done in moving a charge of 20C from *A* to *B* over a distance of 0.2m is 2*J*. Then $V_a - V_b$ is

a) $2 \times 10^{-2}\ V$ b) $-1 \times 10^{-1}\ V$ c) $3 \times 10^{-1}\ V$ d) $4 \times 10^{-2}\ V$

57. A solenoid is 2 *m* long and 3 cm in diameter. It has 5 layers of winding of 1000 turns each and carries a current of 5*A*. The magnetic field at the centre of the solenoid is

a) $2.5 \times 10^{-3}\ T$ b) $1.4 \times 10^{-5}\ T$ c) $1.3 \times 10^{-4}\ T$ d) $1.57 \times 10^{-2}\ T$

58. The magnetic energy in an inductor changes from maximum value to minimum value in 5 ms when connected to an a.c. source. The frequency of the source is

a) 50 Hz b) 200 Hz c) 500 Hz d) 20 Hz

59. The refractive index of water is 4/3 and that of glass is 5/3. What will be the critical angle of ray of light entering water from glass?

a) $\sin^{-1} 4/5$ b) $\sin^{-1} 5/4$ c) $\sin^{-1} 1/2$ d) $\sin^{-1} 2/1$

60. The amplitude ratio of two superposing waves is 2:1. The ratio of maximum and minimum intensities is

a) 1:1 b) 9:1 c) 4:1 d) 2:1

ANSWER SHEET — P ART – A

1	A	B	C	D	E	21	A	B	C	D	E	41	A	B	C	D	E
2	A	B	C	D	E	22	A	B	C	D	E	42	A	B	C	D	E
3	A	B	C	D	E	23	A	B	C	D	E	43	A	B	C	D	E
4	A	B	C	D	E	24	A	B	C	D	E	44	A	B	C	D	E
5	A	B	C	D	E	25	A	B	C	D	E	45	A	B	C	D	E
6	A	B	C	D	E	26	A	B	C	D	E	46	A	B	C	D	E
7	A	B	C	D	E	27	A	B	C	D	E	47	A	B	C	D	E
8	A	B	C	D	E	28	A	B	C	D	E	48	A	B	C	D	E
9	A	B	C	D	E	29	A	B	C	D	E	49	A	B	C	D	E
10	A	B	C	D	E	30	A	B	C	D	E	50	A	B	C	D	E
11	A	B	C	D	E	31	A	B	C	D	E	51	A	B	C	D	E
12	A	B	C	D	E	32	A	B	C	D	E	52	A	B	C	D	E
13	A	B	C	D	E	33	A	B	C	D	E	53	A	B	C	D	E
14	A	B	C	D	E	34	A	B	C	D	E	54	A	B	C	D	E
15	A	B	C	D	E	35	A	B	C	D	E	55	A	B	C	D	E
16	A	B	C	D	E	36	A	B	C	D	E	56	A	B	C	D	E
17	A	B	C	D	E	37	A	B	C	D	E	57	A	B	C	D	E
18	A	B	C	D	E	38	A	B	C	D	E	58	A	B	C	D	E
19	A	B	C	D	E	39	A	B	C	D	E	59	A	B	C	D	E
20	A	B	C	D	E	40	A	B	C	D	E	60	A	B	C	D	E

PHYSICS (APPLIED ELECTRONICS/SPACE PHYSICS/ RENEWABLE ENERGY)

PART – B

(Descriptive Type)

Answer **any eight** questions. **(8 × 5 = 40 Marks)**

1. What is simple harmonic motion? Show that the total energy of a harmonic oscillator is a constant.

2. Distinguish between type I and type II superconductors.

3. Obtain the steady state form of Schrodinger equation.

4. State the postulates of Bohr atom model obtain expressions for the radius and electron energy of the nth orbit of hydrogen atom.

5. Distinguish between Raman spectra and IR specra.

6. Draw the circuit diagram and explain the working of a Phase shift oscillator.

7. Explain semi- empirical mass formula obtained using the liquid drop model of the nucleus.

8. Explain quarter wave plates and half wave plates.

9. How can an AND gate and OR gate be realized using a NAND gate?

10. Explain Einstein's coefficients.

11. Explain Zeeman effect.

12. Calculate the permitted energy levels of an electron, in a box 1 $\mathring{A}$ wide.