SUBJECT CODE	SUBJECT	PAPER
A-16-02	PHYSICAL SCIENCES	II

HALL TICKET NUMBER	QUESTION BOOKLET NUMBER

OMR SHEET NUMBER

DURATION	MAXIMUM MARKS	NUMBER OF PAGES	NUMBER OF QUESTIONS
1 HOUR 15 MINUTES	100	16	50

This is to certify that, the entries made in the above portion are correctly written and verified.

Candidates Signature _____ **Name and Signature of Invigilator** _____

Instructions for the Candidates

1. Write your Hall Ticket Number in the space provided on the top of this page.
2. This paper consists of fifty multiple-choice type of questions.
3. At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested **to open the booklet and compulsorily examine it as below** :
   (i) To have access to the Question Booklet, tear off the paper seal on the edge of this cover page. Do not accept a booklet without sticker-seal and do not accept an open booklet.
   (ii) **Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.**
   (iii) After this verification is over, the Test Booklet Number should be entered in the OMR Sheet and the OMR Sheet Number should be entered on this Test Booklet.
4. Each item has four alternative responses marked (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
   Example: (A) (B) ● (D)
   where (C) is the correct response.
5. Your responses to the items are to be indicated in the **OMR Answer Sheet given to you**. If you mark at any place other than in the circle in the Answer Sheet, it will not be evaluated.
6. Read instructions given inside carefully.
7. Rough Work is to be done in the end of this booklet.
8. If you write your name or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, you will render yourself liable to disqualification.
9. **The candidate must handover the OMR Answer Sheet to the invigilators at the end of the examination compulsorily** and must not carry it with you outside the Examination Hall. The candidate is allowed to take away the carbon copy of OMR Sheet and used Question paper booklet at the end of the examination.
10. **Use only Blue/Black Ball point pen.**
11. **Use of any calculator or log table etc., is prohibited.**
12. **There is no negative marks for incorrect answers.**

అభ్యర్థులకు సూచనలు

1. ఈ పుట పై భాగంలో ఇవ్వబడిన స్థలంలో మీ హాల్ టికెట్ నంబరు రాయండి.
2. ఈ ప్రశ్న పత్రము యాభై బహుళైచ్ఛిక ప్రశ్నలను కలిగి ఉంది.
3. పరీక్ష ప్రారంభమున ఈ ప్రశ్నాపత్రము మీకు ఇవ్వబడుతుంది. మొదటి ఐదు నిమిషములలో **ఈ ప్రశ్నాపత్రమును తెరిచి కింద తెలిపిన అంశాలను తప్పనిసరిగా పరిచూసుకోండి.**
   (i) ఈ ప్రశ్న పత్రమును చూడడానికి కవర్‌పేజి అంచున ఉన్న కాగితపు సీలును చించండి. స్టిక్కర్ సీలులేని మరియు ఇదివరకే తెరిచి ఉన్న ప్రశ్నాపత్రమును మీరు అంగీకరించవద్దు.
   (ii) **కవరు పేజి పై ముద్రించిన సమాచారం ప్రకారం ఈ ప్రశ్నపత్రములోని పేజీల సంఖ్యను మరియు ప్రశ్నల సంఖ్యను సరిచూసుకోండి. పేజీల సంఖ్యకు సంబంధించి గానీ లేదా సూచించిన సంఖ్యలో ప్రశ్నలు లేకపోవుట లేదా నిజప్రతి కాకపోవుట లేదా ప్రశ్నలు క్రమపద్ధతిలో లేకపోవుట లేదా ఏవైనా లేదాలుండుట వంటి దోషపూరితమైన ప్రశ్న పత్రాన్ని వెంటనే మొదటి ఐదు నిమిషాల్లో పరీక్షా పర్యవేక్షకునికి తిరిగి ఇచ్చివేసి దానికి బదులుగా సరిగ్గా ఉన్న ప్రశ్నపత్రాన్ని తీసుకోండి. తదనంతరం ప్రశ్నపత్రము మార్చబడదు అదనపు సమయం ఇవ్వబడదు.**
   (iii) పై విధంగా సరిచూసుకొన్న తర్వాత ప్రశ్నాపత్రం సంఖ్యను OMR పత్రము పై అదేవిధంగా OMR పత్రము సంఖ్యను ఈ ప్రశ్నాపత్రము పై నిర్దిష్టస్థలంలో రాయవలెను.
4. ప్రతి ప్రశ్నకు నాలుగు ప్రత్యామ్నాయ ప్రతిస్పందనలు (A), (B), (C) మరియు (D) లుగా ఇవ్వబడ్డాయి. ప్రతిప్రశ్నకు సరైన ప్రతిస్పందనను ఎన్నుకొని కింద తెలిపిన విధంగా OMR పత్రములో ప్రతి ప్రశ్నా సంఖ్యకు ఇవ్వబడిన నాలుగు వృత్తాల్లో సరైన ప్రతిస్పందనను సూచించే వృత్తాన్ని బాల్ పాయింట్ పెన్‌తో కింద తెలిపిన విధంగా పూరించాలి.
   ఉదాహరణ : (A) (B) ● (D)
   (C) సరైన ప్రతిస్పందన అయితే
5. ప్రశ్నలకు ప్రతిస్పందనలను ఈ ప్రశ్నపత్రముతో ఇవ్వబడిన OMR పత్రము పైన ఇవ్వబడిన వృత్తాల్లోనే పూరించి గుర్తించాలి. అలాకాక సమాధాన పత్రంపై వేరొక చోట గుర్తిస్తే మీ ప్రతిస్పందన మూల్యాంకనం చేయబడదు.
6. ప్రశ్న పత్రము లోపల ఇచ్చిన సూచనలను జాగ్రత్తగా చదవండి.
7. చిత్తుపనిని ప్రశ్నపత్రము చివర ఇచ్చిన ఖాళీస్థలములో చేయాలి.
8. OMR పత్రము పై నిర్ణీత స్థలంలో సూచించవలసిన వివరాలు తప్పించి ఇతర స్థలంలో మీ గుర్తింపును తెలిపే విధంగా మీ పేరు రాయడం గానీ లేదా ఇతర చిహ్నాలను పెట్టడం గానీ చేసినట్లయితే మీ అనర్హతకు మీరే బాధ్యులవుతారు.
9. **పరీక్ష పూర్తయిన తర్వాత మీ OMR పత్రాన్ని తప్పనిసరిగా పరీక్ష పర్యవేక్షకుడికి ఇవ్వాలి.** వాటిని పరీక్ష గది బయటకు తీసుకువెళ్లకూడదు. పరీక్ష పూర్తయిన తరువాత అభ్యర్థులు ప్రశ్న పత్రాన్ని, OMR పత్రం యొక్క కార్బన్ కాపీని తీసుకువెళ్లవచ్చు.
10. **నీలి/నల్ల రంగు బాల్ పాయింట్ పెన్ మాత్రమే ఉపయోగించాలి.**
11. **లాగరిథమ్ టేబుల్స్, క్యాలిక్యులేటర్‌లు, ఎలక్ట్రానిక్ పరికరాలు మొదలగునవి పరీక్షగదిలో ఉపయోగించడం నిషేధం.**
12. **తప్పు సమాధానాలకు మార్కుల తగ్గింపు లేదు.**

PHYSICAL SCIENCES
Paper – II

1. If $f(x,y,z) = x^2 + y^2 + z^2$ than $\nabla^2 f$ is

(A) 0

(B) 4

(C) 6

(D) 8

2. Which of the following pair of vectors are orthogonal to each other ?

(A) [1, 2, 3], [3, 2, 1]

(B) [1, 0, 0], [2, 0, 0]

(C) [1, 1, 1], [0, 2, 0]

(D) [3, 0, 2], [0, 4, 0]

3. Of the following statements, which is true for a skew symmetric matrix ?

I. It is a square matrix

II. For all i, j, $a_{ij} = -a_{ji}$

III. The transpose of the matrix is the matrix itself, i.e. $A^T = A$

(A) Only II is true

(B) I, II and III are true

(C) II, III are true and I is false

(D) I and II are true, III is false

4. The Eigen values of the matrix $\begin{bmatrix} 5 & 3 \\ 3 & -3 \end{bmatrix}$ are

(A) 6, 4

(B) $-6, -4$

(C) $6, -4$

(D) $-6, 4$

5. Which of the following is true for a Bessel differential equation ?

I. $e^{\left(\frac{xt}{2} - \frac{x}{2t}\right)} = \sum_{n=-\infty}^{\infty} t^n J_n(x)$

II. $J_{-n}(x) = (-1)^n J_n(x)$

(A) I is true and II is false

(B) I and II are true

(C) I and II are false

(D) Only I is true

6. Match the following :

I. $\int_c f(z)\,dz = 0$	1. Laurent series
II. $f(a) = \frac{1}{2\pi i}\int_c \frac{f(z)\,dz}{z-a}$	2. Cauchy's theorem
III. $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$ and $\frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y}$	3. Cauchy's integral formula
IV. $f(z) = \sum_{n=-\infty}^{\infty} a_n (z-c)^n$	4. Cauchy-Riemann equations

	I	II	III	IV
(A)	4	3	2	1
(B)	2	3	4	1
(C)	2	3	1	4
(D)	4	3	1	2

7. The Fourier transform of the function $f(x) = \frac{1}{x}$ is

(A) πi

(B) $\frac{\pi i}{2}$

(C) $\frac{\pi i}{4}$

(D) $2\pi i$

8. Laplace transform of {sin at} is

(A) $\frac{s}{s^2 + a^2}$

(B) $\frac{a^2}{s^2 + a^2}$

(C) $\frac{a}{s^2 + a^2}$

(D) $\frac{s^2}{s^2 + a^2}$

9. When two coins are tossed simultaneously, the probability of getting two heads is

(A) $1/2$

(B) 0

(C) 1

(D) $1/4$

10. The central limit theorem speaks of convergence to _____ distribution.

(A) Poisson

(B) Normal

(C) Uniform

(D) Chi-square

11. If a rod is moving with a velocity (v) parallel to its length relative to the stationary observer, then it appears to be contracted by a factor

(A) $\left(1-\frac{v^2}{c^2}\right)^{\frac{1}{2}}$

(B) $\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}$

(C) $\left(1-\frac{v}{c}\right)^{-\frac{1}{2}}$

(D) $\left(1-\frac{v^2}{c^2}\right)^{2}$

12. The number of degrees of freedom possessed by a single particle when it is moving in space will be

(A) 3N

(B) One

(C) 6N

(D) Three

13. For a system characterized by the Lagrangian

$L=\frac{1}{2}(\dot{x}^2+\dot{y}^2)-\frac{1}{2}\omega_0^2(x^2+y^2)+\alpha\dot{x}\dot{y}$,

what restriction should be imposed on α for the normal modes of vibrations

(A) $\alpha > 0$

(B) $\alpha \neq 1$

(C) $\alpha < 0$

(D) $\alpha > 1$

14. In a laboratory system for equal masses of a particle, the maximum angle of scattering will be

(A) $\frac{\pi}{2}$

(B) $3\frac{\pi}{2}$

(C) π

(D) $\frac{\pi}{4}$

15. If a particle moves in a circular orbit under the action of a central force $F(r) = -kr^{-3}$ and if the potential energy is zero at infinity, the total energy of the particle becomes

(A) Infinity

(B) Zero

(C) Constant

(D) One

16. If a generalized coordinate q_k does not appear explicitly in the Lagrangian function then

(A) the corresponding momentum (p_k) becomes constant of motion

(B) q_k is constant

(C) Hamiltonian is constant

(D) p_k becomes cyclic coordinate

17. The moment of inertia of a rigid body about a given axis of rotation depends upon

(A) Distribution of mass in the rigid body

(B) Shape of a rigid body

(C) Position of axis of rotation of a rigid body

(D) All the above

18. For the conservation of energy of a system, Lagrangian and Hamiltonian do not depend explicitly on

(A) momentum

(B) position

(C) Mass

(D) Time

19. Simple pendulum with a variable length is an example for

(A) Rheonomic and Holonomic constraints

(B) Non-holonomic constraints

(C) Scleronomous constraints

(D) Scleronomous and non-holonomic constraints

20. A force which plays an important role in a Lagrangian via a velocity dependent potential is

(A) the force of nature

(B) the normal force

(C) the kinetic friction force

(D) the Lorentz force

21. If the Lagrangian of a system is $L = \frac{1}{2} m \dot{y}^2 - V(y)$ then y component of a conjugate momentum is

(A) $-\frac{\partial V}{\partial y}$

(B) $m\dot{y}$

(C) my

(D) $-\frac{\partial V}{\partial \dot{y}}$

22. A usual expression for the conserved angular momentum (l) in a central force problem is

(A) $l = mr^2 \dot{\theta}$

(B) $l = m / r^2 \dot{\theta}$

(C) $l = \dot{l} / k$

(D) $l = (\frac{1}{2}) mr^2 \dot{\theta}$

23. The ratio $\frac{\vec{E}}{\vec{H}}$ of electric field ($\vec{E}$) and magnetic field $\vec{H}$ has dimensions of

(A) Resistance

(B) Inductance

(C) Capacitance

(D) Product of inductance and capacitance

24. Electromagnetic field equation in terms of Scalar (ϕ) and vector potential (A) is

(A) $\nabla^2\varphi + \frac{\partial}{\partial t}(\nabla \cdot \vec{A}) = -\rho/\epsilon_0$

(B) $\nabla^2\vec{A} + \frac{\partial}{\partial t}(\nabla\phi) = -\rho/\epsilon_0$

(C) $\nabla^2\phi + \frac{\partial}{\partial t}(\nabla \cdot \vec{A}) = +\rho/\epsilon_0$

(D) $\nabla^2\vec{A} + \frac{\partial}{\partial t}(\nabla\varphi) = +\rho/\epsilon_0$

25. An electromagnetic wave is given by $\vec{E} = \frac{1}{\sqrt{2}}\cos\left[4\pi \times 10^7\left(t - \frac{z}{c}\right)\right]\hat{i}$ then the wave is

(A) Plane polarized propagating along z-axis

(B) Plane polarized propagating along y-axis

(C) Plane polarized propagating along x-axis

(D) Circularly polarized propagating along z-axis

26. Magnetic vector potential due to a magnetic dipole is proportional to

(A) r

(B) 1/r

(C) $1/r^2$

(D) $1/r^3$

27. $\nabla^2 V = -4\pi\rho$, where 'V' is potential and ρ is charge density, is

(A) Maxwell equation

(B) Laplace equation

(C) Poisson equation

(D) Gauss equation

28. The Eigen functions of a Hermitian operator belong to different Eigen values are

(A) real

(B) normal

(C) orthogonal

(D) orthonormal

29. A stationary state is a bound one if the corresponding wave function

(A) Vanishes at infinity

(B) Vanishes at finite distance

(C) Is finite at infinity

(D) None of these

30. In the Dirac notation, if $\left| e_x \right\rangle = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ and $\left| e_y \right\rangle = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$, then $\left\langle e_x \middle| e_y \right\rangle$ is equal to

(A) 0

(B) 1

(C) $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

(D) $\begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$

31. If two observables, in quantum mechanics, commute then they

(A) can be measured simultaneously

(B) can not be measured simultaneously

(C) can have different eigen states

(D) have same eigen values

32. In the Stern-Gerlach experiment, beam of silver atoms are used to know the

(A) orbital angular momentum

(B) intrinsic spin angular momentum

(C) generalized angular momentum

(D) orbital and spin angular momentum

33. One of the examples for a barrier penetration in quantum mechanics problems

(A) gamma emission

(B) beta emission

(C) beta and gamma emissions

(D) alpha emission

34. The solutions of the radial equation for a hydrogenic atom are

(A) Hermite polynomials

(B) Associated Legendre polynomials

(C) Associated Laguerre polynomials

(D) Bessel functions

35. If the perturbed Hamiltonian is H' and the unperturbed Hamiltonian is H_o for a system, then the time-independent perturbation theory can be used only when

(A) $H_o \approx H'$

(B) $H_o < H'$

(C) $H_o > H'$

(D) $H_o \geq H'$

36. In quantum mechanics, using the variational method one can find the _____ for the ground state energy of a system, when other methods could not give results.

(A) Upper limit

(B) Lower limit

(C) Intermediate value

(D) Exact value

37. If a matrix is a representative of a component of J which satisfies the relation $J \times J = i\hbar J$, then the trace value is equal to

(A) unity

(B) zero

(C) a complex value

(D) a negative value

38. Match the following :

List – I	List – II
I. Rayleigh – Jean's law	1. $E = \sigma T^4$
II. Stefan's law	2. $\lambda_m T = \text{constant}$
III. Wien's displacement law	3. $u_\lambda d\lambda = \frac{8\pi kT}{\lambda^4} d\lambda$
IV. Kirchoff's law	4. $\frac{e_\lambda}{\alpha_\lambda} = E_\lambda$

	I	II	III	IV
(A)	4	1	2	3
(B)	3	1	2	4
(C)	2	1	3	4
(D)	3	1	4	2

39. Which of the following statements are valid for Canonical ensemble ?

I. The independent assemblies have same temperature, volume and number of identical particles

II. The system can exchange energy

III. The system can exchange particles

(A) Only I and III are true

(B) I, II, and III are true

(C) I, II and III are false

(D) I and II are true, III is false

40. The average energy associated to each degree of freedom is

(A) kT

(B) $\frac{1}{2}$ kT

(C) $\frac{3}{2}$ kT

(D) $\frac{3}{4}$ kT

41. Which of the following statements are valid for Bose-Einstein statistics

I. It is applicable for the particles which are identical and indistinguishable

II. The particles have zero or integer spins

III. The particles obey Pauli's exclusion principle

(A) I, II, III are true

(B) I is true, II and III are false

(C) I and III are true, II is false

(D) I and II are true, III is false

42. Triple point depends on

I. Temperature

II. Pressure

(A) Only I is true

(B) Only II is true

(C) I and II are true

(D) I and II are false

43. As per the laws of thermodynamics, the relation between pressure (P), volume (V), Temperature (T) and entroy (S) is given as

(A) $TdS = -dU - PdV$

(B) $TdS = dU + PdV$

(C) $SdT = -dU - PdV$

(D) $SdT = dU + PdV$

44. In statistical physics, the absolute temperature (T) of a system is related to the number of accessible states (Ω) is

(A) $kT \frac{\partial \Omega}{\partial E}$

(B) $kT \frac{\partial}{\partial E} (\log \Omega)$

(C) $\frac{1}{kT} \frac{\partial}{\partial E} (\log \Omega)$

(D) $\frac{1}{kT} \frac{\partial \Omega}{\partial E}$

45. Which of the following is true for white dwarf stars ?

I. The mass is nearly same as that of Sun

II. The luminosity is 3×10^{-3} times of that of Sun

(A) I is true, II is false

(B) I is false, II is true

(C) I and II are true

(D) I and II are false

46. At the junction of a semiconductor hetero junction PN diode

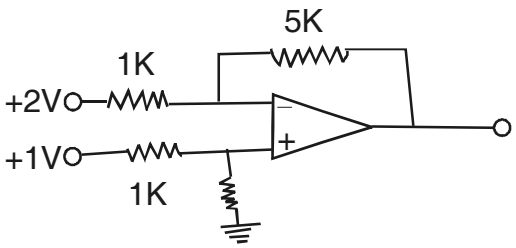
(A) Potential barrier spike is there

(B) Capacitance discontinuity is there

(C) Immobile charges are present

(D) All the above

47. The output voltage of the ideal OP Amp circuit shown below is



(A) –7V

(B) 7V

(C) –5V

(D) 5V

48. The following Boolean expression can be simplified to

$y = \overline{A}\,\overline{B}\,\overline{C}\,\overline{D} + \overline{A}\,B\,\overline{C}\,D + \overline{A}\,\overline{B}\,\overline{C}\,D +$

$\overline{A}\,\overline{B}\,C\,D + \overline{A}\,B\,C\,D + A\,\overline{B}\,\overline{C}\,D$

(A) $\overline{A}\overline{B}C + A\overline{D}$

(B) $\overline{A}B\overline{C} + A\overline{D}$

(C) $A\overline{B}\overline{C} + \overline{A}\,D$

(D) $A\overline{B}C + \overline{A}\cdot D$

49. A 12-bit counter type A/D converter used a 1 MHz clock. Its maximum conversion time is

(A) 1 μs

(B) 12 μs

(C) 4096 μs

(D) 4 μs

50. Einstein's relation for holes in a semiconductor material is

(A) $\frac{D_p}{\mu_p} = \frac{kT}{q}$

(B) $\frac{\mu_p}{D_p} = \frac{kT}{q}$

(C) $\frac{D_p}{\mu_p} = \frac{k}{qT}$

(D) $\frac{D_p}{\mu_p} = \frac{kq}{T}$

Space for Rough Work

Space for Rough Work

Space for Rough Work