Set No. 1

18P/204/24(i)

Total No. of Printed Pages : 32

Question Booklet No. 01420

(To be filled up by the candidate by blue/black ball-point pen)

Roll No. | | | | | | | | | | |

2018

Serial No. of OMR Answer Sheet .....

Centre Code No. | | | | |

.....

Day and Date .....

(Signature of Invigilator)

INSTRUCTIONS TO CANDIDATES

(Use only ***blue/black ball-point pen*** in the space above and on both sides of the **Answer Sheet**)

1. Within 30 minutes of the issue of the Question Booklet, check the Question Booklet to ensure that it contains all the pages in correct sequence and that no page/question is missing. In case of faulty Question Booklet bring it to the notice of the Superintendent/Invigilators immediately to obtain a fresh Question Booklet.
2. Do not bring any loose paper, written or blank, inside the Examination Hall ***except the Admit Card.***
3. ***A separate OMR Answer Sheet is given. It should not be folded or mutilated. A second OMR Answer Sheet shall not be provided. Only the OMR Answer Sheet will be evaluated.***
4. Write all entries by blue/black pen in the space provided above.
5. ***On the front page of the Answer Sheet, write by pen your Roll Number in the space provided at the top and by darkening the circles at the bottom. Also, write the Question Booklet Number, Centre code Number and the Set Number wherever applicable in appropriate places.***
6. ***No overwriting is allowed in the entries of Roll No., Question Booklet no. and Set no. (if any) on OMR Answer Sheet and Roll No. and OMR Answer Sheet no. on the Question Booklet.***
7. ***Any change in the aforesaid entries is to be verified by the invigilator, otherwise it will be taken as unfairmeans.***
8. ***Each question in this Booklet is followed by four alternative answers. For each question, you are to record the correct option on the Answer Sheet by darkening the appropriate circle in the corresponding row of the Answer Sheet, by pen as mentioned in the guidelines given on the first page of the OMR Answer Sheet.***
9. For each question, darken only one circle on the **OMR** Answer Sheet. If you darken more than one circle or darken a circle partially, the answer will be treated as incorrect.
10. *Note that the answer once filled in ink cannot be changed. If you do not wish to attempt a question, leave all the circles in the corresponding row blank (such question will be awarded zero marks).*
11. For rough work, use the inner back page of the title cover and the blank page at the end of this Booklet.
12. On completion of the Test, the candidate must handover the OMR Answer Sheet to the Invigilator in the examination room/hall. However, candidates are allowed to take away Test Booklet and copy of OMR Answer Sheet with them.
13. Candidates are not permitted to leave the Examination Hall until the end of the Test.
14. If a candidate attempts to use any form of unfair means, he/she shall be liable to such punishment as the University may determine and impose on him/her.

ROUGH WORK
रफ़ कार्य

18P/204/24(i)

No. of Questions : 120

Time : 2 Hours ***Full Marks : 360***

Note : (1) Attempt as many questions as you can. Each question carries **3 (Three)** marks. ***One mark will be deducted for each incorrect answer***. **Zero** mark will be awarded for each unattempted question.

(2) If more than one alternative answers seem to be approximate to the correct answer, choose the closest one.

01. The Fourier series of the function,

$$f(x)=\begin{cases}0 & -\pi \le x \le 0\\ 1 & 0 \le x \le \pi\end{cases}$$

contains :

(1) Even harmonics only

(2) Odd harmonics only

(3) All harmonics

(4) None of the above

02. The amplitudes of the components of the Fourier series of a triangular wave are in the ratio :

(1) $1:\frac{1}{2}:\frac{1}{3}:\frac{1}{4}:\ldots\ldots$

(2) $\frac{1}{1^2}:\frac{1}{3^2}:\frac{1}{5^2}:\ldots\ldots$

(3) $1:\frac{1}{3}:\frac{1}{5}:\frac{1}{7}:\ldots\ldots$

(4) $\frac{1}{1^2}:\frac{1}{2^2}:\frac{1}{3^2}:\frac{1}{4^2}:\ldots\ldots$

03. In an L-C-R series circuit the self inductance L is 100 m H and the capacitance C is $10\mu F$. The time period of oscillation in resonant condition is :

(1) $\frac{1}{2\pi\times10^{-3}}$ sec

(2) $2\pi\times10^{-3}$ sec

(3) $\frac{2\pi}{10^{-3}}$ sec

(4) $\frac{10^{-3}}{2\pi}$ sec

04. A tuning fork A produces 10 beats/sec with another tuning fork B of frequency 300 Hz. If the tuning fork A is filed, the number of beats produced is reduced to 5/sec. The frequency of the tuning fork A is :

(1) 310 Hz

(2) 290 Hz

(3) 300 Hz

(4) 305 Hz

05. A person with his hands stretched horizontally is standing at the centre of a rotating disc. If he folds his hands the rotational speed of the disc :

(1) increases due to conservation of angular momenta

(2) increases due to conservation of energy

(3) decreases due to conservation of angular momenta

(4) decreases due to conservation of energy

06. Radius of gyration of a ring about an axis tangential to its rim and coplanar with the ring is equal to :

(1) its radius

(2) $\frac{1}{\sqrt{2}}$ times its radius

(3) $\frac{\sqrt{3}}{2}$ times its radius

(4) $\sqrt{2}$ times its radius

07. Law of perpendicular axis theorem of moment of inertia is applicabl to :

(1) One dimensional object (2) Two dimensional object

(3) Three dimensional object (4) Point object

08. Moment of inertia is a :

(1) Tensor quantity (2) Scalar quantity

(3) Vector quantity (4) Pseudo vector quantity

09. Two spheres one solid and other hollow, of same mass and externa radii roll down an inclined smooth plane without slipping, then :

(1) the solid sphere will reach the bottom first

(2) the hollow sphere will reach the bottom first

(3) both the spheres will reach at the same time

(4) data is insufficient to conclude

10. In an LCR circuit in series with R=0 the current amplitude a resonance is :

(1) zero

(2) infinite

(3) maximum and finite

(4) minimum and different from zero

11. A rotating disc with constant angular velocity is :

(1) a non-inertial frame

(2) an inertial frame

(3) a non-accelerated frame

(4) a frame with constant linear velocity

12. Acceleration of a particle :

(1) is invariant under Galilean transformation

(2) is not invariant under Galilean transformation

(3) may or may not be invariant under Galilean transformation

(4) has nothing to do with the Galilean transformation

13. Centrifugal force is :

(1) a real force

(2) a pseudo force

(3) directed towards the centre

(4) due to inertial nature of the reference frame

14. A particle of mass m is moving with velocity $\vec{v}$ at 90^0 to the axis of rotation in a rotating frame rotating with angular velocity $\vec{\omega}$. The coriolis force on the particle has magnitnde :

(1) $m\omega^2 r$ (2) $m\omega v$

(3) $2m\omega v$ (4) 0

15. For a conservative force $\vec{F}$ one has the relation :

(1) $\vec{\nabla}\times\vec{F}=0$

(2) $\vec{\nabla}.\vec{F}=0$

(3) $\vec{\nabla}\left(|\vec{F}|\right)=0$

(4) $\vec{\nabla}\times\vec{F}$ is constant vector of finite non-zero magnitude.

16. For a thin spherical shell of mass M and radius R which statement is wrong ?

(1) Potential V is zero and attraction $\left(\vec{F}\right)$ is constant for $r < R$

(2) Potential is constant and attraction is zero for $r < R$

(3) V varies as $\frac{1}{r}$ for $r > R$

(4) $\vec{F}$ varies as $\frac{1}{r^2}$ for $r > R$

17. For an undamped oscillator the quality factor Q has the value :

(1) 0

(2) ∞

(3) which depends on the frequency of oscillation

(4) which depends on the stored energy of the oscillator

18. The path of one projectile as seen from another projectile will always be :

(1) a parabolic path

(2) a circular path

(3) an elliptic path

(4) a straight line

19. The conservative force $\vec{F}$ and potential energy V are related by :

(1) $\vec{F} = -\vec{\nabla}V$

(2) $\vec{F} = \vec{\nabla}V$

(3) $\vec{F} = \vec{\nabla} \times V$

(4) $\vec{F} = \vec{\nabla}.V$

20. When two simple harmonic vibrations with same frequency, but different amplitudes, at 90^0 to each other combine the resulting vibration is :

(1) a circular vibration

(2) an elliptic vibration

(3) a linear vibration

(4) none of the above three type of vibration

21. A satellite, revolving round a planet of density ρ in a circular orbit very close to the planet surface, has the time period of revolution :

(1) $\sqrt{G\rho}$ (2) $\sqrt{3G\rho/\pi}$

(3) $\sqrt{G/3\pi\rho}$ (4) $\sqrt{3\pi/G\rho}$

22. Total energy of a simple pendulum is E. When the displacement is half of the amplitude, its potential energy is :

(1) $\frac{E}{4}$ (2) $\frac{3E}{4}$

(3) E (4) $\frac{E}{2}$

23. Two SHMs at 90^0 to each other having time periods in the ratio 1 : 2 combine. If the phase difference between the two vibrations is $\frac{\pi}{2}$ the resultant vibration is :

(1) of shape eight-digit (8) (2) of circular shape

(3) of elliptic shape (4) of parabolic shape

24. In a resonance vibration, if the frictional forces are zero, the sharpness of the resonance :

(1) is minimum

(2) maximum

(3) depends on the vibration frequency

(4) depends on the mass of the oscillating body

25. Moment of inertia of a hoop of mass M and radius R about an axis perpendicular to its plane and tangential to its circumference is :

(1) MR^2 (2) $2MR^2$

(3) $\frac{3}{2}MR^2$ (4) $\frac{MR^2}{2}$

26. A top of mass m, moment of inertia I is spinning with an angular velocity $\vec{\omega}$ in a gravitation field of acceleration due to gravity g. The centre of mass is at a distance r from the tip of the peg of the top. Then the precessional frequency of the top depends on :

(1) m, g, r (2) m, g, ω

(3) m, r, ω (4) m, g, r, I and ω

27. For angular momentun $\vec{J}$, torque $\vec{\tau}$ and angular velocity $\vec{\omega}$ the following relation holds :

(1) $\vec{\tau} = \vec{\omega} \times \vec{J}$ (2) $\vec{\tau} = \vec{J} \times \vec{\omega}$

(3) $\vec{J} = \vec{\omega} \times \vec{\tau}$ (4) $\vec{J} = \vec{\tau} \times \vec{\omega}$

28. The equation of state for an ideal gas is PV = RT. The values of volume expansivity β and isothermal compressibility K are given as :

(1) $\beta = \frac{1}{T}, K = P$ (2) $\beta = \frac{1}{T}, K = \frac{1}{P}$

(3) $\beta = T, K = \frac{1}{P}$ (4) $\beta = T, K = P$

29. The correct form of first law of thermodynamics is written as :

(1) $dQ = du + dw$ (2) $\delta Q = du + \delta w$

(3) $\delta Q = du + dw$ (4) $dQ = \delta u + dw$

30. A molecule of a gas impinges on the wall of a containing vessel and retraces back its path after collision with the wall. If the mass of the molecule be m and its velocity normal to the wall be u, the change in its momentum will be :

(1) 2 mu (2) zero

(3) mu (4) $\sqrt{2m\mu}$

31. A real gas at temperature of inversion is suffering Joule-Kelvin expansion. Enthalpy of the gas :

(1) Increases (2) Decreases

(3) Remains Constant (4) None of these

32. The inversion temperature for a gas is 200 K. The Boyle temperature of the gas will be :

(1) 400 K (2) 100 K

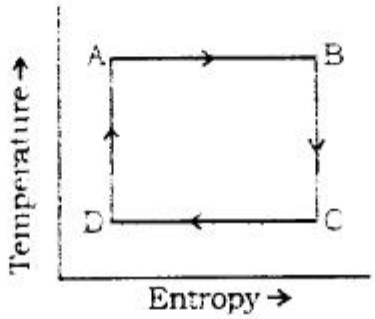
(3) 675 K (4) 1350 K

33. If pressure on an ice block is increased, its melting point :

(1) Increases (2) Decreases

(3) Remains unchanged (4) None of these

34. In the temperature – entropy diagram shown below, part AB of the cycle ABCD corresponds :



(1) An isothermal process (2) An adiabatic process

(3) An isochoric process (4) An isobasic process

35. Specific heat of water at 100^{0} C = 1.01 cal/gm degree, latent heat of vaporization decreases at the rate of 0.64 cal/K, latent heat of vaporization of steam = 540 cal/gm. The specific heat of steam is :

(1) 1.08 cal/gm-degree (2) –1.08 cal/gm-degree

(3) 1.08 J/Kg-degree (4) –1.08 J/Kg-degree

36. If Wien's constant b = 0.3 cm – K, the temperature of the sun whose radiation has maximum energy at wavelength λ = 5500 A^{0} will be :

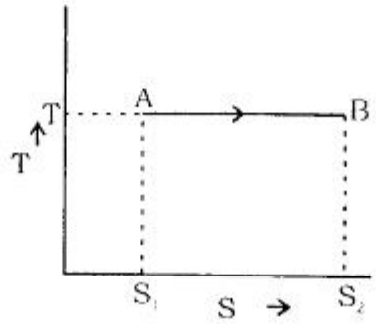
(1) 5000 °C (2) 5455 K

(3) 3000 K (4) 8000 K

37. An isentropic process on a T-S diagram is represented by :

(1) A horizontal line
(2) A Vertical line
(3) A line inclined at 45^0
(4) None of the these from the S-axis

38. Work done in a thermodynamic process from A to B as represented by an isotherm on a T-S indicator diagram shown below is given by :



(1) $S_2 - S_1$ (2) $T(S_2 - S_1)$
(3) $T S_2$ (4) $T/(S_2 - S_1)$

39. The multiplier to be used for making δQ integrable along a reversible path between an initial and a final state is :

(1) $\frac{1}{Q}$ (2) $\frac{1}{S}$ (3) T (4) $\frac{1}{T}$

40. Irregular stirring of a viscous thermally insulating liquid is an example of :

(1) Adiabatic dissipation of work into internal energy of a system
(2) The transformation of internal energy of a system into mechanical energy
(3) Process exhibiting external thermal irreversibility
(4) None of these

41. Conduction of heat from a system to its cooler surroundings is an example of :

(1) A reversible process
(2) An irreversible process
(3) An isentropic process
(4) An isenthalpic process

42. If H is enthalpy, then change in enthalpy between an initial and final states of a system during a thermodynamic process $H_f - H_i = Q$ corresponds to :

(1) Throttling process
(2) Reversible process
(3) Isobaric process
(4) Adiabatic process

43. Helmholtz function remains constant during :

(1) an isothermal process
(2) an adiabatic process
(3) a reversible isothermal and isochoric process
(4) a reversible isothermal and isobaric process

44. Which relation gives correct Maxwell's thermo dynamical equation ?

(1) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial P}\right)_S$
(2) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$
(3) $\left(\frac{\partial T}{\partial V}\right)_S = \left(\frac{\partial P}{\partial S}\right)_V$
(4) $\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$

45. At 4^0C, for water :

(1) $C_p < C_v$
(2) $C_v < C_p$
(3) $C_p = C_v$
(4) $\frac{C_p}{C_v} = \infty$

46. Pressure exerted by diffuse radiation equals :

(1) Half of the energy density of radiation

(2) One third of the energy density of the radiation

(3) The energy density of the radiation

(4) Twice the energy density of radiation

47. The number of modes of vibration associated with black body radiation, inside a black body radiation-chamber of volume v, is :

(1) $\frac{4\pi v \upsilon^2}{c^2} d\upsilon$ (2) $\frac{8\pi v \upsilon^2}{c^3} d\upsilon$

(3) $\frac{4\pi\upsilon^2}{c^2} d\upsilon$ (4) $\frac{8\pi\upsilon^2}{c^3} d\upsilon$

Where range of frequencies lies between υ and $\upsilon + d\upsilon$

48. The radiant emittance of a black body at a temperature of 4000 K is :

(1) 1452 watts/m^2 (2) 14520 watts/m^2

(3) 14520 Kw/m^2 (4) 1452 Kw/m^2

Given, Stefan's Constant $\sigma = 5.672 \times 10^{-8}$ S.I. Units.

49. In order to increase the kinetic energy of ejected photoelectrons, there should be an increase in :

(1) Intensity of radiation

(2) Wavelength of radiation

(3) Frequency of radiation

(4) Both the wavelength and intensity of radiation

50. Which of the following statements about photon is incorrect ?

(1) Its rest mass is zero (2) It's momentum is $h\upsilon/c$

(3) Its energy is $h\upsilon$ (4) Photons exert no pressure

51. In Compton scattering, the change in wavelength of X-ray photons scattered at scattering angle 90^0 is :

(1) 0.048 Å (2) 0.024 Å (3) 2.4 Å (4) 4.8 Å

52. A certain excited state of a H-atom has a life time 10^{-8} sec, the minimum error with which the energy of the given excited state can be measured is :

(1) 10^{-16} Joule (2) 10^{-26} Joule

(3) 1.6×10^{-19} Joule (4) None of these

53. With exciting line 2536 A^0. a Raman line for a sample is observed at 2612 A^0. The Raman shift is :

(1) $2 \times 10^{-5}\ m^{-1}$ (2) $1 \times 10^{-1}\ m^{-1}$

(3) $1.15 \times 10^{5}\ m^{-1}$ (4) $3 \times 10^{8}\ m^{-1}$

54. The distance between two successive positions of a movable mirror of a Michelson's interferometer giving distinct fringes in the case of sodium light having wavelengths 5890 Å and 5896 Å will be :

(1) 2.894 cm (2) 0.02894 cm

(3) 28 94 cm (4) 2.894 mm

55. In a Michelson's interferometer experiment, 260 fringes cross the field of view when the movable mirror is displaced through a distance 0.0589 mm. The wavelength of monochromatic light used will be :

(1) 5890 Å (2) 5896 Å (3) 4531 Å (4) 4.531 μm

56. In the standardisation of metre, which type of, fringes are useful ?

(1) Curved fringes which are monochromatic

(2) White light fringes

(3) Broad fringes

(4) None of these

57. When a stretched wire is cut, then it snaps. In this process ;

(1) First, internal energy of the system is converted to mechanical energy and then back into internal energy

(2) External Mechanical irreversibility occurs

(3) This is a reversible process

(4) This is a thermally irreversible process

58. With what velocity a rod lying along x-direction should move in this direction, so that its length is contracted by 50% ?

(1) $\frac{C}{2}$ (2) $\frac{2}{3}C$ (3) $\frac{\sqrt{3}}{2}C$ (4) $\frac{C}{4}$

Where C is the velocity of light.

59. The function of emitter resistance R_E in CE transistor amplifier is :

(1) To have desirable value of I_{CQ}

(2) To provide positive feedback

(3) To provide negative feedback

(4) To provide larger amplification

60. The direction of propagation of electromagnetic wave is given by direction of :

(1) Vector $\vec{E}$ (2) Vector $\vec{H}$

(3) Vector $(\vec{E} \times \vec{H})$ (4) None of these

61. The rank of the matrix $A = \begin{bmatrix} 1 & 1 & 1 \\ b+c & c+a & a+b \\ bc & ca & ab \end{bmatrix}$ where $a \neq b \neq c$, is :

(1) <3 (2) <2 (3) 3 (4) 2

62. Which of the following statement is **true** ?

(1) Every square matrix can be unequely expressed as the sum of a symmetric and a skew symmetric matrix.

(2) In a skew symmetric matrix at least one diagonal element is non zero.

(3) If A and B are both symmetric matrix then AB is symmetric if and only if $AB \neq BA$.

(4) If A is a square matrix then (A - A') is symmetric and (A + A') is skew symmetric.

63. Let A be a square matrix of order n then adjoint of the adjoint of A is

(1) $|A|^{n-1}$ (2) $|A|^{n-2}$ (3) $|A|^{n-1}.A$ (4) $|A|^{n-2}.A$

64. If $A=\begin{bmatrix}1 & 2 & 3\\ 1 & 3 & 4\\ 1 & 4 & 3\end{bmatrix}$, then A^{-1} is :

(1) $\begin{bmatrix}\frac{7}{3} & -3 & \frac{1}{3}\\ -\frac{1}{3} & 0 & \frac{1}{3}\\ -\frac{1}{3} & 1 & -\frac{1}{3}\end{bmatrix}$

(2) $\begin{bmatrix}\frac{7}{2} & -3 & \frac{1}{2}\\ -\frac{1}{2} & 0 & \frac{1}{2}\\ -\frac{1}{2} & 1 & -\frac{1}{2}\end{bmatrix}$

(3) $\begin{bmatrix}-\frac{7}{3} & 3 & -\frac{1}{3}\\ \frac{1}{3} & 0 & -\frac{1}{3}\\ \frac{1}{3} & -1 & \frac{1}{3}\end{bmatrix}$

(4) $\begin{bmatrix}-\frac{7}{2} & 3 & -\frac{1}{2}\\ \frac{1}{2} & 0 & -\frac{1}{2}\\ \frac{1}{2} & -1 & \frac{1}{2}\end{bmatrix}$

65. The eigen values of a Hermitian matrix are :

(1) Always all zero
(2) Always all imaginary
(3) All reals
(4) Zero or one

66. The eigen values of the matrix $A=\begin{bmatrix}6 & -2 & 2\\ -2 & 3 & -1\\ 2 & -1 & 3\end{bmatrix}$ are :

(1) 2, 4, 6
(2) 2, 2, 8
(3) 2, 4, 4
(4) 2, 3, 8

67. Which of the following relation is true for the matrix $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$

(1) $A^3 + 7A^2 + 11A - 5I = 0$ (2) $A^3 - 7A^2 + 11A - 5I = 0$

(3) $A^3 - 7A^2 - 11A + 5I = 0$ (4) $A^3 + 7A^2 - 11A + 5I = 0$

68. The real value of λ for which the system of equations $x + 2y - 3z = \lambda x$, $3x + y + 2z = \lambda y$, $2x + 3y + z = \lambda z$ has a non zero solution, is :

(1) 2 (2) 3

(3) 1 (4) 6

69. The equation which has roots 1,-3,4 is :

(1) $x^3 + 2x^2 - 11x - 12 = 0$ (2) $x^3 - 2x^2 + 12x - 11 = 0$

(3) $x^3 - 2x^2 - 11x + 12 = 0$ (4) $x^3 - 2x^2 - 12x + 11 = 0$

70. Let r_1, r_2, r_3 be the roots of the equation $2x^3 - 3x^2 + kx - 1 = 0$ and the sum of two roots is 1 then the value of constant k is :

(1) 2 (2) 1

(3) 4 (4) 3

71. If the roots of the equation $x^3 - px^2 + qx - r = 0$ are in H.P. then the following is **true** :

(1) $9r^2 - 27pqr + 2q^3 = 0$ (2) $27r^2 - 9pqr - 3q^3 = 0$

(3) $27r^2 - 9pqr + 2q^3 = 0$ (4) $9r^2 - 27pqr - 3q^3 = 0$

72. If the roots of the equation $x^3 + 3px^2 + 3qx + r = 0$ are in G.P. then the following relation is **true** :

(1) $p^3 = rq^2$ (2) $p^3 = rq^3$

(3) $p^2r = q^3$ (4) $p^3r = q^3$

73. If α, β, γ are the roots of the equation $x^3 + ax^2 + bx + c = 0$ then the value of $(\beta+\gamma)(\gamma+\alpha)(\alpha+\beta)$ is :

(1) $2ab - c$ (2) $c - ab$

(3) $ab - 2c$ (4) $2ab + c$

74. The equation whose roots are three times of the roots of the equation $x^3 + 2x^2 - 2x + 1 = 0$ is :

(1) $y^3 + 6y^2 - 18y + 27 = 0$ (2) $y^3 - 18y^2 + 6y + 27 = 0$

(3) $y^3 - 6y^2 + 18y - 27 = 0$ (4) $y^3 + 18y^2 - 6y - 27 = 0$

75. For which values of λ and μ the system of equation $x + y + z = 6$, $x + 2y + 3z = 10$, $x + 2y + \lambda z = \mu$ has no solution :

(1) $\lambda = 10, \mu = 3$ (2) $\lambda = 2, \mu = 10$

(3) $\lambda = 3, \mu = 10$ (4) $\lambda = 3, \mu \neq 10$

76. If n is any positive integer, then the value of $(1 + i)^n + (1 - i)^n$ is :

(1) $2^{(n/2)+1} \cos\frac{n\pi}{4}$ (2) $2^{(n/2)-1} \cos\frac{n\pi}{4}$

(3) $2^{(n/2)+1} \sin\frac{n\pi}{4}$ (4) $2^{(n/2)-1} \sin\frac{n\pi}{4}$

77. All values of $(1)^{1/3}$ are :

(1) $1, \frac{1}{2}(1 \pm \sqrt{3}i)$ (2) $1, \frac{1}{2}(-1 \pm \sqrt{3})$

(3) $-1, \frac{1}{2}(1 \pm \sqrt{3})$ (4) $1, \frac{1}{2}(-1 \pm \sqrt{3}i)$

78 The value of $\lim_{x \to 0} \frac{\sin n\theta - n \sin \theta}{\theta(\cos n\theta - \cos \theta)}$ is :

(1) $\frac{n}{2}$ (2) $\frac{n}{3}$

(3) n (4) $\frac{2n}{3}$

79. Solution of $\tan^{-1} 2x + \tan^{-1} 3x = \pi/4$ is :

(1) $x = 1/3$ (2) $x = 1/2$

(3) $x = 1/6$ (4) $x = 1$

80. The value of $\log(-1)$ is :

(1) π (2) $\frac{\pi}{2}$ (3) $-i\pi$ (4) $i\pi$

81. Principal value of $(i)^i$ is :

(1) e^{π} (2) $e^{-\pi}$ (3) $e^{-\pi/2}$ (4) $e^{\pi/2}$

82. If $f(x) = xe^{x(1-x)}$ then $f(x)$ is :

(1) increasing on $\mathbb{R}$ (2) decreasing on $\mathbb{R}$

(3) decreasing on $\left[-\frac{1}{2}, 1\right]$ (4) increasing on $\left[-\frac{1}{2}, 1\right]$

53. Real part of the expression log sin (x + iy) is :

(1) $\frac{1}{2}$ log [1/2 (cos h y – cos x)]

(2) $\frac{1}{2}$ log [(cos h 2y – cos 2x)]

(3) $\frac{1}{2}$ log [1/2 (cos h 2y – cos 2x)]

(4) $\frac{1}{2}$ log (cos h y – cos x]

54. If y = sin (a sin^{-1}x) then $(1 - x^2) y_2$ is :

(1) $2x y_1 - a^2y$ (2) $-x y_1 + a^2y$

(3) $x y_1 - a^2y$ (4) $x y_1 - 2a^2y$

55. If $y = e^{\tan^{-1}x}$ then which of the following is **true** :

(1) $(1 + x^2) y_2 + (2x - 1) y_1 = 0$ (2) $(1 - x^2) y_2 - (2x + 1) y_1 = 0$

(3) $(1 + x^2) y_2 - (2x - 1) y_1 = 0$ (4) $(1 - x^2) y_2 + (2x + 1) y_1 = 0$

56. If y = cos (m sin^{-1} x) then $(1 - x^2) y_{n+2}$ is :

(1) $(2n + 1) xy_{n+1} - (m^2 + n^2) y_n$

(2) $(2n - 1) xy_{n+1} + (m^2 - n^2) y_n$

(3) $(2n - 1) xy_{n+1} - (m^2 + n^2) y_n$

(4) $(2n + 1) xy_{n+1} - (m^2 - n^2) y_n$

57. The asymptotes parallel to x axis of the curve $y^4 - x^2y^2 + 2xy^2 - 4x^2 - y + 1 = 0$ are :

(1) $x + y = 0$ (2) $x - y + 1 = 0$

(3) $x = \pm 2$ (4) $y = \pm 2$

88. The radius of curvature at the point (p, r) on the cardioid $r^3 = 2ap^2$ is :

(1) $1/3\ \sqrt{2ar}$ (2) $2/3\ \sqrt{ar}$

(3) $2/3\ \sqrt{2ar}$ (4) $1/3\ \sqrt{3ar}$

89. If the function $f(x) = 2x^3 - 9ax^2 + 12a^2x + 1$, where $a > 0$, attains its maximum and minimum at p and q respectively such that $p^2 = q$, then a is :

(1) 1/2 (2) 3

(3) 1 (4) 2

90. The maximum value of the function $(x-1)(x-2)(x-3)$ is :

(1) $\frac{2}{3}$ (2) $\frac{2}{3\sqrt{3}}$

(3) $\frac{2}{\sqrt{3}}$ (4) $\frac{1}{3\sqrt{3}}$

91. For the function $f(x) = (x-1)(x-3)(x-5)$ in $[0,4]$ the value of C of Lagrange's mean value theorem is :

(1) $\frac{6-\sqrt{21}}{3}$ (2) $\frac{6+\sqrt{21}}{3}$

(3) $\frac{8-\sqrt{23}}{2}$ (4) $\frac{9-\sqrt{21}}{3}$

92. The value of $I = \int_0^{\pi/2} \frac{\sin^{2018} x\, dx}{\sin^{2018} x + \cos^{2018} x}$ is :

(1) $\frac{\pi}{2}$ (2) $\frac{2\pi}{3}$ (3) $\frac{\pi}{4}$ (4) $\frac{\pi}{3}$

93. The value of $I = \int x \sinh x \, dx$ is :

(1) $x \cos h\, x - \sin h\, x$ (2) $x \cos h\, x + \sin h\, x$

(3) $\cos h\, x - x \sin h\, x$ (4) $\cos h\, x + x \sin h\, x$

94. The value of $I = \int_0^{\pi/2} \sin^6 x \cos^5 x \, dx$ is :

(1) $\frac{8}{369}$ (2) $\frac{8}{693}$

(3) $\frac{8}{639}$ (4) $\frac{8}{396}$

95. The whole area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is :

(1) $4\pi ab$ (2) $\frac{\pi ab}{4}$

(3) πab (4) $\frac{\pi ab}{2}$

96. The entire length of the cardioid $r = a(1 + \cos\theta)$ is :

(1) 2a (2) 4a

(3) 8a (4) 6a

97. The volume of the solid generated by revolving the cardioid $r = a(1 + \cos\theta)$ about the initial line is :

(1) $\frac{2}{3}\pi a^3$ (2) $\frac{8}{3}\pi a^3$

(3) $4\pi a^3$ (4) $\frac{4\pi a^3}{3}$

98. The surface of the solid generated by the revolution of the astroid $x^{2/3} + y^{2/3} = a^{2/3}$ about x – axis is :

(1) $\frac{12\pi a^2}{5}$ (2) $\frac{6\pi a^2}{5}$

(3) $\frac{12\pi a^3}{5}$ (4) $\frac{6\pi a^3}{5}$

99. The locus of a point (x, y) satisfying the equation

$3(3x - 2y + 4)^2 + 2(2x + 3y - 5)^2 = 39$ is :

(1) a Parabola (2) an Ellipse

(3) a Hyperbola (4) a Circle

100. The equation of circle orthogonal to the circles $x^2 + y^2 - 6x + 8 = 0$ and $x^2 + y^2 - 2x - 2y - 7 = 0$ and passing through the origin is :

(1) $3x^2 + 3y^2 - 8x + 29y = 0$ (2) $2x^2 + 2y^2 - 8x + 7y = 0$

(3) $3x^2 + 3y^2 - 8x + 2y = 0$ (4) $2x^2 + 2y^2 - 8x - 2y = 0$

101. $\frac{\ell}{r} = e\cos\theta + \cos(\theta - \alpha)$ is the tangent at point α of the conic :

(1) $\frac{\ell}{r} = 1 + e\cos\theta$ (2) $\frac{\ell}{r} = 1 - e\cos\theta$

(3) $\frac{\ell}{r} = -1 + e\cos\theta$ (4) $\frac{\ell}{r} = 1 + e\cos(\theta - \alpha)$

102. The equation of the right circular cone whose vertex is the origin, axis as z axis and semivertical angle α, is :

(1) $x^2 + y^2 = 2z^2 \tan^2 \alpha$ (2) $x^2 + y^2 = z^2 = \tan^2 \alpha$

(3) $x^2 - y^2 = z^2 \tan^2 \alpha$ (4) $x^2 + y^2 = z^2 \tan^2 \alpha$

103. Condition that plane $ux + vy + wz = 0$ cuts cone $xy + yz + zx = 0$ in perpendicular lines is :

(1) $u + v + w = 0$ (2) $u^2 + v^2 + w^2 = 0$

(3) $\frac{1}{u} + \frac{1}{v} + \frac{1}{w} = 0$ (4) $\frac{1}{u^2} + \frac{1}{v^2} + \frac{1}{w^2} = 0$

104. The equation of the right circular cylinder of radius a cm and whose axis is x axis is :

(1) $x^2 + y^2 = a^2$ (2) $y^2 + z^2 = a^2$

(3) $x^2 + z^2 = a^2$ (4) $x^2 + y^2 + z^2 = a^2$

105. The equation $\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1$ represents :

(1) An Ellipsoid

(2) An Elliptic paraboloid

(3) A hyperbolic paraboloid

(4) A Hyperboloids of one sheet

106. If $\phi(x, y, z) = 3x^2y - y^3z^2$ then qradient of ϕ at the point $(1,-2,-1)$ is :

(1) $-12\,i - 9j - 16k$ (2) $-12\,i + 9j - 16k$

(3) $-9\,i + 12j - 16k$ (4) $16\,i - 9j - 12k$

107. The angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point (2, –1, 2) is :

(1) $\theta = \cos^{-1}\left(\frac{16}{\sqrt{21}}\right)$ (2) $\theta = \cos^{-1}\left(\frac{16}{3\sqrt{21}}\right)$

(3) $\theta = \cos^{-1}\left(\frac{8}{3\sqrt{21}}\right)$ (4) $\theta = \cos^{-1}\left(\frac{8}{\sqrt{21}}\right)$

108. If $f = xy^2\,i + 2x^2y\,z\,j - 3y\,z^2\,k$ then curl f at the point (1,-1,1) is :

(1) $i - j - 2k$ (2) $2i + j - 2k$

(3) $-i + 2j - k$ (4) $-i - 2k$

109. If $f = x^2y + 2xyz + z^2$ then curl grad f is :

(1) 0 (2) $xi + zk$

(3) $xi - yj - zk$ (4) $-xi + zk$

110. If $F = x^2y^2i + yj$ and the curve C is $y^2 = 4x$ in the xy plane from (0,0) to (4, 4), then $\int_C F.dr$ is :

(1) 256 (2) 264 (3) 64 (4) 72

111. If C is the circle $x^2 + y^2 = 1$ then value of $\int_C$ [{cos x sin y – xy} dx + sin x cos y dy] is :

(1) 4 (2) 2 (3) 0 (4) $\frac{1}{4}$

12. For the vector $F = xi - yj + 2z\,k$ over the sphere $x^2 + y^2 + (z-1)^2 = 1$, the value of $\int_S F.\hat{n}ds$ is :

(1) $\frac{8\pi}{3}$ (2) $\frac{4\pi}{3}$ (3) $\frac{2\pi}{3}$ (4) $\frac{\pi}{3}$

13. Which is the solution of the differential equation $(D^2 - 2D + 2)\,y = 0$, $y = Dy = 1$ when $t = 0$:

(1) $y = e^t \sin t$ (2) $y = e^t \cos t$

(3) $y = \cos t$ (4) $y = e^t$

14. Particular integral of the differential equation $\frac{d^2y}{dx^2} + a^2y = \cos ax$ is :

(1) $\frac{x}{a}\sin ax$ (2) $\frac{x}{a}\cos ax$

(3) $\frac{x}{2a}\cos ax$ (4) $\frac{x}{2a}\sin ax$

15. The complementary function of the differential equation $\frac{d^4y}{dx^4} + \frac{d^2y}{dx^2} + y = ax^2 + b\,e^x \sin 2x$ is :

(1) $e^x\left(c_1\cos\sqrt{3}x + c_2\sin\sqrt{3}x\right) + e^{-x}\left(c_3\cos\sqrt{3}x + c_4\sin\sqrt{3}x\right)$

(2) $e^{\frac{x}{2}}\left(c_1\cos\sqrt{3}x + c_2\sin\sqrt{3}x\right) + e^{-\frac{x}{2}}\left(c_3\cos\sqrt{3}x + c_4\sin\sqrt{3}x\right)$

(3) $e^{\frac{x}{2}}\left(c_1\cos\frac{1}{2}\sqrt{3}x + c_2\sin\frac{1}{2}\sqrt{3}x\right) + e^{-\frac{x}{2}}\left(c_3\cos\frac{1}{2}\sqrt{3}x + c_4\sin\frac{1}{2}\sqrt{3}x\right)$

(4) $e^x\left(c_1\cos\frac{1}{2}\sqrt{3}x + c_2\sin\frac{1}{2}\sqrt{3}x\right) + e^{-x}\left(c_3\cos\frac{1}{2}\sqrt{3}x + c_4\sin\frac{1}{2}\sqrt{3}x\right)$

116. Solution of the integral equation $F(t) = 1 + \int_0^t F(u) \sin(t-u)\,du$ is :

(1) $1+\frac{t^2}{2}$ (2) $1 + t$

(3) $1-\frac{t^2}{2}$ (4) $1 - t$

117. Solution of integral equation $\int_0^t \frac{F(u)du}{\sqrt{t-u}} = 1 + t + t^2$ is :

(1) $F(t)=\frac{1}{\pi}\left(t^{-\frac{1}{2}}-t^{\frac{1}{2}}+\frac{8}{3}t^{\frac{3}{2}}\right)$ (2) $F(t)=\frac{2}{\pi}\left(t^{-\frac{1}{2}}+2t^{\frac{1}{2}}-\frac{8}{3}t^{\frac{3}{2}}\right)$

(3) $F(t)=\frac{1}{\pi}\left(t^{-\frac{1}{2}}+2t^{\frac{1}{2}}+\frac{8}{3}t^{\frac{3}{2}}\right)$ (4) $F(t)=\frac{2}{\pi}\left(t^{-\frac{1}{2}}+t^{\frac{1}{2}}+\frac{8}{3}t^{\frac{3}{2}}\right)$

118. For a common catenary the relation between x,y and s is :

(1) $s = c \cos h\,(x/c)$ (2) $s = c \sin \psi$

(3) $s = c \tan (x/c)$ (4) $x = c \log\left[\frac{\sqrt{s^2+c^2}+s}{c}\right]$

119. An endless chain of weight w rests in the form of a circular band round a smooth vertical cone which has its vertex upwards. Assuming the vertical angle of the cone to be 2α, the tension in the chain due to its weight is :

(1) $T=\frac{w\tan\alpha}{2\pi}$ (2) $T=\frac{w\cot\alpha}{2\pi}$

(3) $T=\frac{w\tan 2\alpha}{\pi}$ (4) $T=\frac{w\cot 2\alpha}{\pi}$

120. A partical is projected at an angle α with the horizontal from the foot of plane whose inclination to the horizontal is β then it will strike the plane at right angle if ;

(1) $\cot \beta = 2 \tan (\alpha - \beta)$

(2) $\tan \beta = 2 \cot (\alpha \quad \beta)$

(3) $\cot \beta = \frac{1}{2} \tan (\alpha - \beta)$

(4) $\tan \beta = \frac{1}{2} \cot (\alpha - \beta)$

ROUGH WORK
रफ़ कार्य

अभ्यर्थियों के लिए निर्देश

(इस पुस्तिका के प्रथम आवरण पृष्ठ पर तथा उत्तर-पत्र के दोनों पृष्ठों पर केवल नीली/काली बाल-प्वाइंट पेन से ही लिखें)

1. प्रश्न पुस्तिका मिलने के 30 मिनट के अन्दर ही देख लें कि प्रश्नपत्र में सभी पृष्ठ मौजूद हैं और कं प्रश्न छूटा नहीं है। पुस्तिका दोषयुक्त पाये जाने पर इसकी सूचना तत्काल कक्ष-निरीक्षक को देकर सम्पू प्रश्नपत्र की दूसरी पुस्तिका प्राप्त कर लें।
2. परीक्षा भवन में ***प्रवेश-पत्र के अतिरिक्त,*** लिखा या सादा कोई भी खुला कागज साथ में न लायें
3. ***ओ.एम.आर. उत्तर-पत्र अलग से दिया गया है। इसे न तो मोड़ें और न ही विकृत करें। दूसरा ओ.एम.अ उत्तर-पत्र नहीं दिया जायेगा। केवल ओ.एम.आर. उत्तर-पत्र का ही मूल्यांकन किया जायेगा।***
4. सभी प्रविष्टियाँ प्रथम आवरण-पृष्ठ पर नीली/काली पेन से निर्धारित स्थान पर लिखें।
5. ***ओ० एम० आर० उत्तर-पत्र के प्रथम पृष्ठ पर पेन से अपना अनुक्रमांक निर्धारित स्थान पर लिखें त नीचे दिये वृत्तों को गाढ़ा कर दें। जहाँ-जहाँ आवश्यक हो वहाँ प्रश्न-पुस्तिका का क्रमांक, केन्द्र कोड नं तथा सेट का नम्बर उचित स्थानों पर लिखें।***
6. ***ओ० एम० आर० उत्तर पत्र पर अनुक्रमांक संख्या, प्रश्नपुस्तिका संख्या व सेट संख्या (यदि कोई हो) त प्रश्नपुस्तिका पर अनुक्रमांक और ओ० एम० आर० उत्तर पत्र संख्या की प्रविष्टियों में उपरिलेखन अनुमति नहीं है।***
7. ***उपर्युक्त प्रविष्टियों में कोई भी परिवर्तन कक्ष निरीक्षक द्वारा प्रमाणित होना चाहिये अन्यथा यह एक अनुं साधन का प्रयोग माना जायेगा।***
8. ***प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार वैकल्पिक उत्तर दिये गये हैं। प्रत्येक प्रश्न के वैकल्पिक उत्तर के लि आपको ओ० एम० आर० उत्तर-पत्र की सम्बन्धित पंक्ति के सामने दिये गये वृत्त को उत्तर-पत्र के प्र पृष्ठ पर दिये गये निर्देशों के अनुसार पेन से गाढ़ा करना है।***
9. प्रत्येक प्रश्न के उत्तर के लिए केवल एक ही वृत्त को गाढ़ा करें। एक से अधिक वृत्तों को गाढ़ा क पर अथवा एक वृत्त को अपूर्ण भरने पर वह उत्तर गलत माना जायेगा।
10. ***ध्यान दें कि एक बार स्याही द्वारा अंकित उत्तर बदला नहीं जा सकता है। यदि आप किसी प्रश्न का उ नहीं देना चाहते हैं, तो संबंधित पंक्ति के सामने दिये गये सभी वृत्तों को खाली छोड़ दें। ऐसे प्रश्नों पर शू अंक दिये जायेंगे।***
11. रफ कार्य के लिए प्रश्न-पुस्तिका के मुखपृष्ठ के अंदर वाला पृष्ठ तथा उत्तर-पुस्तिका के अंतिम पृ का प्रयोग करें।
12. परीक्षा की समाप्ति के बाद अभ्यर्थी अपना ओ.एम.आर. उत्तर-पत्र परीक्षा कक्ष/हाल में कक्ष निरीक्ष को सौंप दे। अभ्यर्थी अपने साथ प्रश्न पुस्तिका तथा ओ.एम.आर. उत्तर-पत्र की प्रति ले जा सकते
13. अभ्यर्थी को परीक्षा समाप्त होने से पहले परीक्षा भवन से बाहर जाने की अनुमति नहीं होगी।
14. यदि कोई अभ्यर्थी परीक्षा में अनुचित साधनों का प्रयोग करता है, तो वह विश्वविद्यालय द्वारा निर्धा दंड का/की, भागी होगा/होगी।