

QUESTION BANK
DEPARTMENT OF PHYSICS
+3 2nd year Science

Semester-III

Mathematical Physics II (Core 5)

Short Questions

1. What is periodic function?
2. What do you mean by period of periodic function?
3. What is the value of period of the function $\sin(nx)$?
4. Find the period of $\sin\left(\frac{\pi x}{l}\right)$
5. What do you mean by even function? Give an example of even function.
6. What do you mean by odd function? Give an example of odd function.
7. State dirichlet conditions.
8. Write the Fourier series of $f(x)$ in the interval $[-L, L]$
9. Write half range Fourier cosine series.
10. Write half range Fourier sine series.
11. Write complex form of Fourier series.
12. State theorem for differentiation of Fourier series.
13. State theorem for integration of Fourier series.
14. Write parseval's identity.
15. Write the value of $\sum_{n=0}^{\infty} \frac{1}{(2n+1)^2}$
16. What do you mean by ordinary point of differential equation?
17. What do you mean by singular point of a differential equation?
18. What are types of singular points?

19. Find the singular points of the equation $(1 - x^2)y'' - 2xy' + n(n + 1)y = 0$
20. Find the nature of singular point of the equation $xy'' + y' + xy = 0$
21. Find the ordinary point and singular points of Legendre's equation.
22. Write Rodrigue's formula for Legendre's polynomial.
23. Write orthogonality condition of Legendre's polynomial.
24. Write orthogonality condition of Hermit's polynomial.
25. Prove that $P'_n(1) = n(n + 1)^2$
26. Show that $P_n(1) = 1$
27. Prove that $P_n(-x) = (-1)^n P_n(x)$
28. Show that $H'_{2n}(0) = 0$
29. Prove that $H_n(-x) = (-1)^n H_n(x)$
30. Write orthogonality property of associated Legendre's polynomial.
31. What do you by generating function?
32. Write laplace's en from spherical harmonic.
33. Write Laplacian operator in spherical polar co-ordinate system.
34. Write Rodrigue's formula for hermit's polynomial.
35. Show that $H_n(x) = 2x$
36. Write gamma function in terms of improper integral.
37. Find the value of $\Gamma(1/2)$
38. Prove that $\Gamma(n + 1) = n\Gamma(n)$
39. Write gamma function in logarithmic function.
40. Write gamma function in infinite limit(Euler's form).
41. Find the value of $\Gamma(1)$
42. Evaluate $\int_0^\infty e^{-ax^2} dx$

43. Evaluate $\int_0^{\infty} x^3 e^{-x} dx$

44. Write the relation between beta function and gamma function

45. Write beta function in terms of trigonometric functions.

46. Show that $\beta(m, n) = \left(\frac{m+n}{n}\right) \beta(m, n+1)$

47. Write different types of errors.

48. What do you mean by systematic errors

49. What do you mean by random errors

50. Define relative error and percentage of error

51. State principle of error in a sum of difference

52. State principle of error in product and quotient.

53. What do you mean by standard error

54. What do you mean by probable error

55. The side of cube measured as (2.00 ± 0.02) cm. Find the volume of the cube.

56. What do you mean by partial differential equation?

57. Give an example of partial differential equation.

58. Write Laplace equation in Cartesian co-ordinate system.

59. Write Laplace equation in spherical polar co-ordinate system.

60. Write Laplace equation in cylindrical co-ordinate system.

61. What is the value of electric field inside a conductor.

62. Write Clausius-Mossotti formula.

63. Write one dimensional wave equation.

64. What do you mean by nodes?

65. What do you mean by antinodes?

66. What do you mean by overtones? Write the frequencies of overtones.

67. What do you mean by harmonics?

68. Write the expression for frequency in 3rd mode vibration.

69. What is the order of partial differential equation?

70. Write the expression for potential in spherical polar co-ordinate system.

Long Questions

1. State fourier series and derive fourier co-efficients.
2. Prove that (i) $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$ and (ii) $\sum_{n=1}^{\infty} \frac{1}{(2n-1)^2} = \frac{\pi^2}{8}$
3. Drive fourier expansion of x^4 in $[\pi, -\pi]$ and prove that $\sum_{n=1}^{\infty} \frac{1}{n^4} = \frac{\pi^4}{90}$
4. Represent $x+x^2$ in fourier series in the internal $-\pi < x < \pi$ and deduce $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots$.
5. Obtain Fourier series to represent the function $f(x) = |x|$ for $-\pi < x < \pi$ and deduce $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots$
6. Find fouries series for $f(x) = |\sin x|$ for $-\pi < x < \pi$.
7. Derive fourier series of a function having arbitrary period. Hence device fourier series for even and odd functions.
8. If $f(x) = x, 0 < x < \pi/2$
 $= (\pi - x) \pi/2 < x < \pi/2$
9. Find the half range four cosine series of $f(x) = x^3$ in $(0,L)$
10. Find the complex fourier series of $f(x) = x, 0 \leq x < 1$
 $= 2x, 1 \leq x < 2$
11. Derive series solution of Legendre's differential en.

12. Derive series solution of hermite's differential equation.
13. Derive sol of associated Legendre's differential equation.
14. Derive orthogonality relation of legendre's polynomial.
15. Derive orthogonality relation of hermite's polynomial.
16. Derive Rodroigues formula for Legendre's polynomial.
17. Derive rodrigues formula for hermites polynomial.
18. Derive orthogonality relation of associated Legendre's polynomial.
19. Solve the differential equation
20. Derive Legendre's polynomial from its generating function.
21. Derive weierstrass form of gamma function
22. Find the value of $\Gamma(1/2)$.
23. Derive the relation between beta function and gamma function.
24. (a) prove that $\Gamma(m)\Gamma(1 - m) = \frac{\pi}{\sin mx} \quad 0 < m < 1$
- (b) show that $\int_0^{\frac{\pi}{2}} \sin^m \theta \cos^n \theta d\theta = \frac{\Gamma(\frac{m+n}{2})\Gamma(\frac{n+1}{2})}{2\Gamma(\frac{m+n+2}{2})}$
25. (a) show that $\beta(m,n) = \beta(m+1,n) + \beta(m,n+1)$.
- (b) prove that $\Gamma(2n) = 2^{2n+1} \pi^{-1/2} \Gamma(n) \Gamma(n+(1/2))$
26. (a) show that $\frac{\beta(m,n+1)}{n} = \frac{\beta(m+1,n)}{m} = \frac{\beta(m,n)}{m+n}$
- (b) Find the value of $\Gamma(-5/2)$
27. What is error function? Write the characteristics of error function.

28. Prove that $\int_0^1 \frac{x^2}{\sqrt{1+x^4}} dx + \int_0^1 \frac{1}{1+x^4} dx = \frac{\pi}{4\sqrt{2}}$
29. Evaluate $\int_0^\infty e^{-x^2} \{4x^4 - 12x^2 + 3\} dx$
30. Find $\Gamma(3/2)$, $\Gamma(5/2)$, $\Gamma(-3/2)$, $\Gamma(-5/2)$
31. Find the solution of $2 \frac{\partial u}{\partial x} + 5 \frac{\partial u}{\partial y} = 0$ using the method of separation of variables.
32. Find the solution Laplace equation in Cartesian co-ordinate system.
33. Find the solution Laplace equation in spherical polar co-ordinate system.
34. Find the solution of Laplace equation in cylindrical co-ordinate system.
35. Using Laplace equation find the electric field at any point due to conducting sphere placed in uniform electric
Field.
36. Find the potential and electric field of an dielectric placed in a uniform electric field.
37. Derive one dimensional wave equation and find its solution.
38. A tightly stretched string with fixed end points $x=0$ and $x=l$ is initially in a position given by $y=y_0 \sin^2 (\pi x/l)$.
If it is released from rest to this position, find the displacement $y(x,t)$.
39. Solve $\frac{\partial u}{\partial x} = 4 \frac{\partial u}{\partial y}$, $u(0, y) = 8e^{-2y}$ by the method of separation of variables.
40. Solve $y^3 \frac{\partial z}{\partial x} + x^2 \frac{\partial z}{\partial y} = 0$ by the method of separation of variables.

Thermal physics (Core 6)

Short Answer Questions:-

1. What is thermodynamics.
2. State the zeroth law of thermodynamics.
3. What do you mean by thermal equilibrium.
4. Explain the concept of temperature on the basis of thermodynamics.

5. Define a thermodynamics. Distinguish between open and closed system.
6. What do you mean by indicator diagram or P-V diagram.
7. What is the area of P-V diagram represent.
8. State the first law of thermodynamics.
9. What is the significance 1st law of Thermodynamics.
10. What is the quasi-static process.
11. What is Isothermal Process.
12. What is an adiabatic process.
13. What is isobaric process.
14. What is isochoric process.
15. What is the equation of state for isothermal process.
16. What is the equation of state for adiabatic process.
17. Compare the slope of isothermal and adiabatic curve.
18. Which quantity is constant in adiabatic process.
19. The first law of thermodynamics is the conservation of _____.
20. What is a heat engine.
21. What is reversible process.
22. What is irreversible process.
23. Why Carnot's engine is called reversible engine.
24. State second law of thermodynamics.
25. State Carnot's theorem.
26. Explain the efficiency of a heat engine.
27. Why both source and necessary for heat engine.
28. Why efficiency of an engine can not be 100%.
29. Show that on absolute scale of temperature, negative temperature is not possible.
30. Calculate the efficiency of a Carnot engine working between 500k and 1000k.
31. The device which converts heat into mechanical work is _____.
32. What is a refrigerator.
33. What will happen the efficiency of the Carnot's engine if the temperature of the source is increased.
34. How do you define zero on absolute scale of temperature.
35. What do you mean by entropy?

36. What is the unit of entropy?
37. State 3rd law of thermodynamics.
38. Calculate the entropy of Steam and ice.
39. Explain that 2nd law of thermodynamics is the law of increase of entropy.
40. Explain the concept of entropy and disorder.
41. Is the absolute zero of temperature achieved?
42. Formulate the 2nd law of thermodynamics in terms of entropy.
43. Explain why unavailable energy in universe tends to increase.
44. Show that the entropy of universe increase in natural process.
45. What is temperature entropy diagram. what is its importance.
46. Find the expression for efficiency of Carnot's engine with the help of T-S diagram.
47. 10kg of ice at 0^oc is converted at the same temperature. Calculate the change in entropy. Latent heat of ice is 3.4×10^5 J/Kg.
48. The gain in entropy of working substance in Carnot's cycle is _____.
49. When water vapour condenses into water its entropy_____.
50. In adiabatic process entropy_____.
51. The entropy of a system in an irreversible process_____.
52. What do you mean by extensive variables.
53. What do you mean by intensive variables.
54. Define internal energy.
55. Define enthalpy.
56. Define Helmholtz free energy.
57. Define Gibb's free energy.
58. What are the thermodynamic potentials.
59. How does surface tension vary with temperature.
60. Using adiabatic demagnetization, the minimum temperature produced is _____.
61. Change of entropy in Carnot's cycle is _____.
62. A piece of ice is added to water in a cup. The entropy_____.
63. In a reversible process, the entropy of the system_____.
64. In all natural process, the entropy of the universe_____.
65. What do you mean by phase transition.

66. What is Latent heat.
67. Define latent heat of fusion.
68. Define latent heat of vapourisation.
69. What is the unit of latent heat.
70. What is the latent heat of fusion of ice.
71. What is latent heat of vapourisation of water.
72. Why steam produces severe burn than boiling water?
73. Explain 1st order phase transition.
74. Explain 2nd order phase transition.
75. When the pressure is increased, the melting point of ice_____.
76. The melting point of a solid is lowered by increase in pressure. When this solid melts its volume_____.
77. Specific heat of saturated water vapour at 100^oc is _____.
78. During a change of phase the Gibbs function of a system_____.
79. Explain why the temperature of a gas drops when it is subjected to aidiabatic expansion.
80. What do you understand by inversion temperature.
81. Define specific heat at constant pressure.
82. Define specific heat of a gas at constant volume.
83. Why C_p is greater than C_v .
- 86.State postulates of kinetic theory of gases.
87. What do mean by free path.
88. What is kinetic interpretation of temperature.
89. Define degrees of freedom.
90. What is the degrees of freedom of a mono-atomic gas.
91. What is the degrees of freedom of a di-atomic gas.
92. What is the degrees of freedom a poly-atomic gas.
93. State law of equipertition of energy.
94. Define mean energy or internal energy.

95. Define most probable speed.
96. Define average speed.
97. Define RMS speed of gas.
98. The average energy of monoatomic gas at temp. T is _____.
99. The RMS speed of the molecule of an ideal gas is _____.
100. How the mean square speed of gas molecule is proportional to temperature.
101. What is the difference between a perfect gas and a real gas?
102. How real gas behavior has been explained by Vander Waal's equation.
103. What is Vander Waal's equation of state?
104. Write a note on Andrew's experiment on Carbon dioxide.
105. Define Critical temperature.
106. During Joules expansion, what remains constant.
107. In which process the enthalpy remains constant.
108. In Joule-Thomson effect, cooling is due to _____.
109. In Joule-Thomson effect, the temperature of a perfect gas _____.
110. What is Boyle's temperature.
111. State law of corresponding states.
112. Define critical pressure.
113. Define critical volume.
114. Define gas and vapour.
115. Define temperature of inversion.

Long Answer Questions:-

1. Derive the expression for work done due to isothermal and adiabatic process.
2. Derive the equation of state for adiabatic process.
3. State and explain 1st law of thermodynamics and apply it to isothermal and adiabatic process.
4. What is Carnot's engine? Explain Carnot's cycle and derive the expression for the efficiency of Carnot's cycle.
5. State and prove Carnot's theorem.
6. Explain the Principle of absolute scale of temperature. Compare the ideal gas scale with absolute scale of temperature.
7. Deduce the thermodynamics scale of temperature? Show how this scale agrees with an ideal gas scale.
8. Derive an expression for the change of entropy of a perfect gas.
9. What is T-S diagram. Find the expression for efficiency of a reversible Carnot's engine with the help of T-S diagram.
10. Define thermodynamic potentials and derive Maxwell's equations.
11. Deduce the Maxwell's four thermodynamic relations.
12. Explain the four thermodynamic potentials U, F, G and H.
13. Which do you mean by adiabatic demagnetisation? How it is used to produce at lowest temperature.
14. Establish Clausius Clapeyron equation.
15. Derive the second latent heat equation of Clausius.
16. Derive Ehrenfest's equation for second order phase transitions.
17. Derive Maxwell's thermodynamic relations.
18. What is Joule Thomson effect? Derive expression for Joule Thomson cooling.

19. Explain “inversion temperature in relation to Joule Thomson effect. Obtain an expression for it for a Vander

Waal’s gas.

20. Derive T ds equations.

21. Explain maxwell’s distribution law of velocities. How can it be verified experimentally?

22. Derive the expression for Maxwell distribution of velocities.

23. State and prove law of equipartition of energy.

24. Derive the expression of most probable speed, average speed and RMS speed of molecules.

25. What is mean free path. Derive its mathematical expression.

26. What are transport phenomenon. Derive the expression of viscosity on the basis of Kinetic theory.

27. Explain transport of mass and transport of energy on the basis of kinetic theory.

28. What is Brownian motion. Discuss Einstein’s theory of Brownian motion.

29. Derive and discuss Vander Waal’s equation of state.

30. Draw Andrew’s curves for a gas at different temperature and obtain expression for critical constants.

31. Derive reduced equation of state.

32. Discuss Joule-Thomson Porous plug experiment.

33. Discuss Joule Thomson effect for real and Vander Waal gas.

Digital Systems and Applications (Core 7)

Short questions:

1. Write the difference between analog and digital circuits

2. What do you mean by decimal number system?
3. What do you mean by binary number system?
4. Convert $(101.01)_2$ to decimal system.
5. What do you mean by octal system?
6. What do you mean by Hexadecimal number system?
7. Express $(13.12)_8$ in decimal system.
8. Convert $(38)_{10}$ to binary system.
9. Convert $(749)_{10}$ to BCD.
10. Convert $(3A2)_{16}$ to octal.
11. What is AND gate?
12. Write Boolean equation for AND gate.
13. Write truth table of OR gate with three inputs.
14. Write truth table of AND gate with three inputs.
15. Give circuit for OR gate.
16. Give circuit for AND gate.
17. Write truth table? Write logic symbol of NOT gate.
18. What is NOR gate? Write truth table for NOR gate.
19. What is NAND gate? Write truth table for NAND gate?
20. What is XOR gate?
21. What is multiplexer?
22. What is multiplexing?
23. What is de multiplexing?
24. What is encoding?
25. What is decoding?
26. Distinguish between multiplexing and demultiplexing.
27. Distinguish between an encoder and a decoder.
28. Why is a multiplexer called a data selector?
29. Why is a demultiplexer called a distributor?
30. What is binary adder?
31. What is half adder?
32. What is full adder?
33. What is binary subtractor?
34. What is half subtractor?
35. What is full subtractor?
36. What is 4-Bit binary adder?
37. What is 4-bit binary subtractor?
38. Add binary numbers 101.11 and 111.01.

39. Write rules of binary addition.
40. Write rules for binary subtractor
41. What are active components?
42. Write the examples of active components?
43. What are passive components?
44. Write the examples of passive components
45. What is a chip?
46. What is a water?
47. What do you mean by medium scale integration?
48. What do you mean by small scale integration?
49. What do you mean by large scale integration?
50. What do you mean by very large scale integration?
51. Write examples of linear ICS.
52. Write examples of digital ICS.
53. What do you mean by multiple ICS?
54. What do you mean by linear integrated circuits?
55. What do you mean by digital integrated circuits?
56. What do you mean by monolithic ICS?
57. What is the function of trigger circuit of a CRO?
58. Why is a fluorescent screen used in a CRT?
59. How can the current be measured by a CRO?
60. White different types of CRO
61. What are analog computers?
62. What are digital computers?
63. What is micro-computer?
64. What do you mean by software?
65. What do you mean by hardware?
66. What is main memory?
67. What is data memory?
68. What is program memory?
69. What do you mean DVD?
70. Explain about hard disk
71. Write note on magnetic memory
72. Write note on magnetic tape
73. What do you mean by compact disk?
74. Explain about floppy disk
75. What are counters?

76. What is decade counter?
77. What is a ring counter?
78. What do you mean by shift register?
79. What is twisted ring counter?
80. What do you mean by memory map?

Long questions:

1. Explain NAND gate as Universal gate.
2. Explain NOR gate as Universal gate.
3. Explain XOR gate and X-NOR gate.
4. With neat logic symbol explain the operation of AND gate and give its truth table.
5. What is an OR gate? Explain the operation of OR gate with neat circuit diagram and write its truth table.
6. State and prove De Morgan's theorem.
7. Write short notes on sum of products and product of sums.
8. Simplify the Boolean function $Y=AB'C'D'+AB'C'D$.
9. Explain canonical form of Boolean function.
10. Simplify the Boolean function
 $Y=A'BC'D'+A'BCD'+AB'CD'+ABCD'+A'B'CD+A'BCD+AB'CD+ABCD$ by using Karnaugh Map.
11. What is multiplexer? Explain 2-to-1 and 4-to-1 multiplexers
12. What is demultiplexer? Explain 1-to-4 line and 1-to-8 line demultiplexers.
13. What is decoder? Explain 3-to-8 line decoders.
14. Explain 8-to-3 line encoder and 10-to-4 line encoder.
15. Explain full adder with logic circuit.
16. Write short notes of half adder and half subtractor.
17. Explain full subtractor.
18. Explain 4-bit binary adder and subtractor
19. Draw the block diagram of an IC-555 timer and describe the functions of all the parts of IC-555 timer.
20. Describe the application of IC-555 timer as astable multivibrator and mono stable multivibrator.
21. Describe the construction and working of CRT.
22. Draw the block diagram of a CRO and explain briefly the function of each component.

23. Derive an expression for the electrostatic deflection sensitivity of a CRT
24. Derive an expression for the magnetic deflection sensitivity of a CRO
25. Discuss the advantages and disadvantages of integrated circuits.
26. Discuss the classification of integrated circuits
27. What do you mean by scale of integration? Explain SSI, MSI, LSI, VLSI, SLI and VSLI
28. Explain different parts of integrated circuits
29. Discuss the applications of CRO
30. Describe the function of various controls of a CRO.
31. Draw the block diagram of a digital computer. Explain the function of its different units.
32. Explain the working of a microprocessor with neat block diagram.
33. Write short notes on memory map and memory interface.
34. Explain in details about memory organization and addressing.
35. Explain the working of a serial-in-serial-out phase shift register and serial-in-parallel-out shift register
36. Explain the working of parallel-in-serial-out and parallel-in-parallel-out shift registers
37. With a neat logic diagram explain the working of a twisted ring counter
38. Explain the working of a decade counter.
39. Explain the working of synchronous counter.
40. Explain the working of a ring counter.

Semester-IV

Mathematical Physics III (Core 8)

SHORT QUESTION:

1. Find the real part and imaginary part in $3+4i$.
2. If $z_1=x_1+ iy_1$ and $z_2=x_2+ iy_2$, find z_1z_2 .
3. What is addition identity of z .
4. What do you mean by Argand diagram?
5. What do you mean modulus of complex number?

6. Write complex conjugate of $z=x+iy$.
7. Write Euler's formula.
8. Find the value of i' .
9. Express $\frac{1}{1+i}$ in terms of $x+iy$.
10. Find the complex conjugate of
11. State de Moivre's theorem.
12. Express circular function of the complex variable Z .
13. What do you mean by analytic function?
14. Write Cauchy –Riemann conditions in polar co-ordinates.
15. Show that z^* is not analytic.
16. Show that $\sin z$ is analytic.
17. What do you mean by harmonic function?
18. Evaluate $\int_0^{1+i} z^2 dz$.
19. What do you mean by simply connected region
20. Find $\oint e^z dz$ where C is the unit circle.
21. State Taylor's theorem.
22. Write Taylor expansion of e .
23. Write Laurent's theorem.
24. Find Taylor expansion of $\frac{1}{1+z}$.
25. What do you mean by singular point of a function?
26. What do you mean by isolated singularity?
27. What do you mean by zeros of complex functions.
28. What do you mean by removable singularity?
29. Find the order of zeros of $f(z)=\sin z$
30. Classify the singular points of $f(z)=\frac{1}{z-z^3}$.
31. Write the expression for residue at simple pole.
32. Write an expression for residue at multiple pole.
33. State Cauchy's residue theorem.
34. State Fourier integral theorem.
35. Write Fourier cosine integral.
36. Write Fourier sine integral.
37. Write Dirac delta function in terms of Fourier integral.
38. Find the singularities of $f(z)=\frac{1}{(z+1)(z+2)}$.
39. What you mean by essential singularity?

40. Find the order of zeros of $f(z) = e^z$.
41. Prove linearity property of Fourier transform.
42. If $F(w)$ is the Fourier transform of $f(t)$, then show that Fourier transform of $f(at) = \frac{1}{a}F\left(\frac{w}{a}\right)$.
43. If $F(w)$ is the Fourier transform of $f(t)$, then show that Fourier transform of $f(t \pm a) = e^{\pm iwa}F(w)$.
44. Show that Fourier transform of $f(t)\cos(at) = \frac{1}{a}F(w-a) + \frac{1}{a}F(w+a)$.
45. Write finite Fourier sine transform.
46. Write finite Fourier cosine transform.
47. State convolution theorem.
48. Write Fourier transform in three dimensions.
49. Write delta function in Fourier transform. ∞
50. Find derivative of Fourier sine transform.
51. Find derivative of Fourier cosine transform.
52. Find finite Fourier sine transform of $\sin 2x$.
53. What is the value of $\int_{-\infty}^{\infty} e^{x^2} dx$.
54. Find the integral $\int e^x \cos bx dx$.
55. Find the integral $\int e^x \sin bx dx$.
56. Write Laplace transform of $f(t)$.
57. Find the Laplace transform of 1.
58. Obtain the Laplace transform of t .
59. Find the Laplace transform of t^n .
60. Obtain the Laplace transform of a constant.
61. Find the Laplace transform of e^{at} .
62. Find the Laplace transform of $\sin(at)$.
63. Find the Laplace transform of $\cos(at)$.
64. Find the Laplace transform of $\sinh(at)$.
65. Find the Laplace transform of $\cosh(at)$.
66. Obtain Laplace transform of $t \sin(at)$.
67. Obtain Laplace transform of $t \cos(at)$.
68. Find the Laplace transform of $\cos^2 2t$.
69. Find the Laplace transform of $\sin t \cos t$.
70. Prove linearity property of Laplace transform.
71. Find the Laplace transform of $e^{3t} + e^{-2t}$.

72. If $L\{f(t)\}=F(s)$, then show that $L\{f(at)\}=\frac{1}{a}F\left(\frac{s}{a}\right)$.
73. If $L\{f(t)\}=F(s)$, then show that $L\{e^{at} f(at)\}=F(s-a)$
74. If $L\{\cos t\}=\frac{s}{1+s^2}$, find $L\{\cos 2t\}$.
75. Find the Laplace transform of $\frac{\sin 4t}{t}$.

Long Questions:

1. State and prove Cauchy's theorem.
2. Derive Cauchy's integral formula.
3. Derive Cauchy-Riemann conditions.
4. State and prove De-moivre's theorem.
5. Use De-moivre's theorem to solve $x^7 + x^4 + x^3 + 1 = 0$.
6. If $u(x,y)=y^2-x^2$, show that it is harmonic. find harmonic conjugate $v(x,y)$ and $f(z)$.
7. Show that $v(x,y)=e^{-x}(y \cos x - x \sin y)$ is harmonic and obtain it's conjugate harmonic function.
8. (a) Derive Milne Thomson method to find harmonic conjugate.
(b) find the analytic function if $u=x^3-3xy^2$ is harmonic.
9. Evaluate $\oint \frac{e^z}{z^2+1} dz$ if C is the circle such that $|z|=2$.
10. Evaluate $\oint \frac{e^z}{z^2(z+1)^3} dz$ where $C:|z|=2$.
11. State and derive Taylor expansion.
12. State and derive Laurent expansion.
13. Express $f(z)=\frac{1}{(z+3)(z+5)}$ in Laurent's series for (i) $|z|>5$ (ii) $3<|z|<5$ (iii) $|z|<3$.
14. Expand $f(z)=\frac{4z+3}{z(z-3)(z+2)}$ in Laurent's series in the annular region between $|z|=2$ and $|z|=3$
15. Find Laurent series for $f(z)=\frac{1}{z^2+1}$ about its singular points.
16. Expand $f(z)=\frac{1}{(z+1)^2}$ in Taylor series about the point $z=-i$.
17. State and prove Cauchy's residue theorem.
18. (a) Evaluate $\oint \frac{z}{\sin z} dz$ where $C:|z|=5$.

(b) Evaluate $\oint \frac{5z-2}{z(z+1)} dz$ where $C:|z|=5$.

19. Evaluate the integral $\int_0^{2\pi} \frac{1}{3+2\cos\theta} d\theta$ by using residual theorem.
20. Find the Fourier cosine and sine integrals of $f(x)=e^{-ax}$, $x \geq 0$ and a is positive constant.
21. Obtain Fourier transform of a derivative and integral. Find Fourier sine and cosine transform of derivative.
22. State and prove convolution theorem.
23. Find the Fourier transform of e^{-ar^2} , where 'a' is a constant and $r=\sqrt{x^2 + y^2 + z^2}$
24. Find the finite Fourier sine and cosine transform of e^{-ax} in $(0, \pi)$.
25. Obtain the solution of one dimensional wave equation by using Fourier transform.
26. Obtain the solution of heat equation by using Fourier transform.
27. Obtain the solution of differential equation of damped harmonic oscillator using Fourier transform.

28. (a) Find Fourier finite cosine transform of $f(x)=\begin{cases} 1, 0 < x < \frac{\pi}{2} \\ -1, \frac{\pi}{2} < x < \pi \end{cases}$.

(b) Find the finite Fourier sine and cosine transform of e^{-ax} in $(0, \pi)$.

29. Verify convolution theorem of Fourier transform if $f(x)=g(x)=e^{-x^2}$.

30. Solve the equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 y}{\partial x^2}$ for $0 \leq x \leq \infty$, $t > 0$ if the initial conditions are (i) $u(x,0)=0$ for $x \geq 0$ (ii) $\frac{du(0,t)}{dx} = -\lambda$ where λ is a constant (iii) $u(u,t)$ is bounded.

31. State and prove Laplace transform of periodic function.

32. Find the Laplace transform of $f(t) = \begin{cases} t^2, 0 < t < 1 \\ t - 1, 1 < t < 2 \\ 4, t > 2 \end{cases}$.

33. State and prove Laplace transform of derivatives and integrals.

34. Find Laplace transform of the functions (i) $f(t)=t \sin(3t) \cos(2t)$, (ii) $f(t)=t^2 e^t \sin 2t$.

35. Find Laplace transform of $\frac{1-\cos t}{t^2}$

36. State and prove convolution theorem of Laplace transform.

37. Solve the equation $y''+y=2e^t$ by using Laplace transform $y(0)=0$ and $y'(0)=2$.

38. Using Laplace transform solve R-L circuit.
39. Solve R-C circuit by using Laplace transformation.
40. Sol the differential equation of damped harmonic oscillator by using Laplace transform. Hence obtain the sol for simple harmonic oscillator.

Elements of Modern Physics (core 9)

Very Short Answer Questions

1. What is a black body?
2. State Stefan's law of black body radiation.
3. What is Wien's displacement law?
4. Write down Rayleigh-Jeans law?
5. Write down Planck's law?
6. What is the absorbing power of a black body?
7. What is the reflecting power of a perfect black body?
8. What is photo-electric effect?
9. Define threshold frequency.
10. Define work function of a metal.
11. What is Compton effect?
12. What is the use of a photocell?
13. Define stopping potential.
14. How photo electric current varies with intensity of light.
15. Stopping potential depends upon _____ of incident light.
16. What is Compton wave length?
17. What is inadequacy of classical physics.
18. Which part of atom was discovered by Rutherford?
19. What are the postulates of Rutherford atomic model.
20. What are the failures of Rutherford's model.
21. Write down postulates of Bohr's atomic model.
22. What are the limitations of Bohr's atomic model.
23. What do you mean by fine structure?
24. What is the value of fine structure constant?
25. What is the value of Rydberg's constant?

26. The radius of the 1st electron orbit of a hydrogen atom is 5.3×10^{-11} m. What is the radius of the second orbit?
27. Explain the significance of the Frank Hertz experiment.
28. Lyman series of hydrogen spectrum lies in the _____ region.
29. Which of the following series of hydrogen spectrum lies in the visible region.
30. What is atomic spectra.
31. What is Bohr's correspondence principle.
32. Explain the assumption made by Sommerfeld to explain the fine structure of specified lines of hydrogen atom.
33. What is a photon?
34. What is wave particle duality?
35. What is the relation between the energy and momentum of a photon?
36. Write down de-Broglie wave equation?
37. What is matter wave?
38. An electron is accelerated through a potential difference of 100V. What is its energy in electron volt?
39. Define phase velocity.
40. What do you understand by group velocity.
41. A photon and an electron have same de-Broglie wave length. Which particle is moving faster.
42. Distinguish between normal and anomalous dispersion.
43. In which condition group velocity is equal to phase velocity.
44. What do you mean by wave function.
45. What is the condition for normalised wave function.
46. Write the equation of a wave packet.
47. What is an operator.
48. The linear momentum operator is _____.
49. The energy operator is _____.
50. Write the relation between group velocity and phase velocity.
51. Write down expectation value of position, momentum and energy.
52. State Heisenberg's uncertainty principle.
53. What is time-energy uncertainty relation?

54. Uncertainty principle states that the error in measurement is due to _____.
55. If the uncertainty in position of an electron is 4×10^{-10} m. calculate the uncertainty in its position.
56. Find the uncertainty in the momentum of a determined within 0.01 cm.
57. Calculate the wave length of a matter waves associated with a particle of mass 0.5 gm moving with a speed of 40 cm/sec.
58. Is it possible to observe de-Broglie wave associated with a material particle of 10^{-4} gm moving with a velocity of light? Planck's constant = 6.6×10^{-27} erg.sec.
59. In which units size of nucleus is measured?
60. What do you mean by mass defect?
61. What is the binding energy of the nucleus?
62. Define packing fraction of nucleus.
63. Give three properties of Nuclear forces.
64. Calculate energy equivalent to 1 a.m.u.
65. Show that the nuclear density is constant.
66. How the radius of nucleus varies with mass number.
67. The density of nuclear matter is of the order of _____.
68. Isobars have the same _____.
69. Nuclei having same number of neutrons are called _____.
70. Quadrupole moment for a spherical nucleus is _____.
71. What is shell model.
72. Shell model was suggested by _____.
73. What do you mean by parity.
74. Write down semi-empirical mass formula.
75. What are the failures of liquid drop model.
76. What are magic numbers.
77. What are the failures of shell model.
78. Derive the relation between mass number and nuclear radius?
79. What do you understand by radioactive substance?
80. Define radioactive decay constant.
81. What is half life of a radio active substance?

82. What is mean life?
83. What are the laws of radio active decay.
84. What is the activity of a radioactive substance.
85. Explain nuclear fission reaction.
86. The amount of energy released due to fission of one uranium atom.
87. What is nuclear fusion reaction give an example.
88. Why nuclear fusion reaction is called thermo-nuclear reaction.
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Long Answer Questions

1. State Bohr's postulates of atom model and find out an expression for total energy of an electron in nth orbit.
2. Explain Bohr's correspondence principle and mathematically prove it.
3. Describe Frankz-Hertz experiment for the verification of the discrete energy states in atoms.
4. Discuss analytically the Bohr-Sommerfeld theory of elliptical orbits of hydrogen atom and compare its results with those of Bohr's theory of circular orbits.
5. Write down laws of photoelectric effect. Explain these laws from Einstein's photoelectric equation.
6. What is Compton effect? Derive an expression for change in wave length of scattered photon.
7. What is quantum theory of radiation? Derive Planck's law and derive wien's law and Rayleigh-Jeans law from it.
8. Describe Davisson and Germer experiment to verify the wave nature of electrons.
9. Define particle velocity, phase velocity and group velocity of a wave packet. Show that particle velocity is equal to group velocity of wave packet.
10. Derive the expression for expectation value of position, momentum and energy.
11. Explain Gaussian wave packet and derive the expression for it.
12. Explain uncertainty principle and show that it does not allow the presence of electrons in the atomic nucleus.

13. Using the uncertainty relation for position and momentum. Find the energy-time uncertainty. Write its physical interpretation.
14. Explain uncertainty principle and find the minimum energy of harmonic oscillator using uncertainty principle.
15. What do you understand by binding energy of the nucleus. Show how the energy of the nucleus. Show how the concept of binding energy is related to the stability of nucleus.
16. Write short notes on
 1. Electric quadrupole moment and its importance.
 2. Parity.
17. What is semi-empirical mass formula? Explain significance of various terms.
18. What are the main assumptions of liquid drop model of nucleus? Give the significance of the various terms of the semi-empirical mass formula.
19. What are magic numbers? Give experimental evidence for their existence.
20. Explain Gamow's theory of alpha-decay.
21. Discuss beta-decay and gamma-decay.
22. State Geiger-Nuttall law and discuss its importance.
23. State and explain laws of radioactive disintegration. Define disintegration constant and half life period.
24. What are nuclear reactions? What is meant by Q-value of a nuclear reaction?
25. Explain nuclear fission on the basis of liquid drop model.

Analog Systems and Applications (core-10)

Short questions:

1. What is P-type semiconductor?
2. What is N-type semiconductor?
3. Define mobility.
4. Define conductivity.
5. What is drift velocity and what is the order of drift velocity?
6. Write the relation between current density and drift velocity.
7. What is the value of barrier potential of germanium junction diode?
8. What is rectifier?
9. Define ripple factor of rectifier

10. Define efficiency of rectifier
11. Explain energy level of a conductor
12. What is biasing of diode? Explain forward biasing and reverse biasing of diode
13. What is a photodiode? Explain the function of photodiode
14. What is solar cell?
15. What is LED? Write uses of LED.
16. What do you mean by a transistor? Explain PNP and NPN transistor s
17. Explain the construction of PNP and NPN transistor
18. Discuss the performance of common base amplifier
19. Discuss the performance of common emitter amplifier
20. Explain about operating point
21. What is a load line?
22. Explain active region
23. Explain saturation region
24. Explain cut off region
25. Explain stability factor
26. Explain bias stabilization
27. What is thermal runaway?
28. What are hybrid perometers?
29. What is transistor biasing?
30. Draw a fixed biased circuit
31. What do you mean by coupled amplifier?
32. What is band width?
33. What do you mean positive feedback?
34. Explain negative feedback
35. What do you mean by distortion?
36. What is noise?
37. What is oscillator?
38. Write Barkhausen criterion for oscillator
39. Write advantages of negative feedback
40. Write expression for voltage gain with feedback
41. Write the basic difference between Hartley and Colpits oscillator.
42. Which type feedback used in oscillator?
43. Which type feedback used in amplifier?
44. Draw circuit diagram of phase-shift oscillator
45. Draw circuit diagram of Colpitt oscillator

46. What is an OP-AMP? Draw its equivalent circuit
47. Give block diagram of OP-AMP
48. Explain the open loop and closed loop of an OP-AMP
49. Explain the frequency response of OP-AMP
50. Explain the concept of virtual ground
51. What do you mean by slow rate?
52. Explain ideal and practical OP-AMPs
53. Write characteristics of ideal OP-AMP
54. Write characteristics of practical OP-AMP
55. Draw circuit diagram of inverting OP-AMP amplifier
56. Draw circuit diagram of OP-AMP as subtractor
57. Draw circuit diagram of OP-AMP as differentiator
58. Draw circuit diagram of OP-AMP as integrator
59. Draw the circuit diagram of logarithmic amplifier
60. Draw the circuit diagram of antilogarithmic amplifier

Long questions

1. Discuss the working of full waverectifier. Find its efficiency and ripple factor
2. What is a light emitting diode? Explain working. Write its applications
3. What is Zener Diode? Explain its working. How Zener diode is used as a voltage regulator.
4. Derive expression for current in a step function.
5. Derive expression for barrier potential and barrier width of a step junction
6. Describe current flow mechanism in PN junction
7. Derive relation between current density and drift velocity.
8. Explain the mechanism of current flow on PNP and NPN transistors
9. Draw the circuit diagram of CE amplifier. Explain the circuit operation. Derive the expression for its amplification factor

10. Draw the circuit diagram of common base amplifier. Explain its working. Derive the expression for its amplification factor
11. Draw the input and out characteristics of a transistor in common emitter configuration. Describe the saturation cut off and active regions of CE output characteristics
12. Draw the circuit of common base transistor. Explain the input and output characteristics. Indicate cut-off, active and saturation regions and explain them
13. Draw the DC load line of transistor? Write the importance of load line. Explain operating point
14. Explain a fixed bias circuit. Define the stability factor and obtain its value in fixed bias circuit
15. Explain voltage divider bias and calculate stability factor in this method
16. What are hybrid parameters? Explain the hybrid equivalent of a transistor
17. Explain class A, class B and class C power amplifiers
18. Explain RC coupled amplifier, Discuss the frequency response curve and band width
19. Discuss the effect of positive feedback on input and output impedance of an amplifier
20. Discuss the effect of negative feedback on input and output impedance of an amplifier
21. Discuss the effect of positive feedback on stability, distortion and gain of an amplifier
22. Discuss the effect of negative feedback on stability, distortion, gain and noise
23. Describe phase-shift oscillator and derive its frequency of oscillation
24. Describe Hartley oscillator and derive its frequency of oscillation
25. Describe Colpilt oscillator with near circuit diagram and derive its frequency of oscillation
26. What is an OP-AMP? Give its block diagram. Explain the function of each part.
27. Draw the circuit symbol of CA-741 OP-AMP. Give its packing and pin outs
28. What do you mean by common mode rejection ratio (CMMR)
29. Describe inverting and non-inverting amplifiers
30. Describe OP-AMP as add and subtractor

31. Describe OP-AMP as integrator and differentiator
32. Discuss the OP-AMP operations of logarithmic and antilogarithmic amplifier
33. Discuss Wein-bridge oscillator using OP-AMP
34. Discuss inverting zero crossing detector the obtain the expression for hysteresis.