

DU PhD in informatics IIC

Topic:- INFO PHD

1) The electrostatic potential $V(x,y)$ in free space in a region where the charge density ρ is zero is given by $V(x,y) = 4e^{2x} + f(x) - 3y^2$. Given that the x-component of the electric field E_x , and V are zero at the origin, $f(x)$ is:[Question ID = 3622]

1. $3x^2 - 4e^{2x} + 8x$ [Option ID = 14485]
2. $4e^{2x} - 8x$ [Option ID = 14486]
3. $3x^2 - 4e^{2x} + 16x$ [Option ID = 14487]
4. $3x^2 - 4e^{2x}$ [Option ID = 14488]

2) A solenoid of inductance L and resistance R is connected to a battery, the time taken for the magnetic energy to reach $\frac{1}{4}$ of its maximum value is[Question ID = 3623]

1. $(L/R)\log_e(1)$ [Option ID = 14489]
2. $(L/R)\log_e(2)$ [Option ID = 14490]
3. $(L/R)\log_e(3)$ [Option ID = 14491]
4. $(L/R)\log_e(4)$ [Option ID = 14492]

3) The depth of penetration of electromagnetic wave in a medium having conductivity σ at a frequency of 1 MHz is 25 cm. The depth of penetration at a frequency of 4 MHz will be[Question ID = 3624]

1. 12.5 cm [Option ID = 14493]
2. 25.0 cm [Option ID = 14494]
3. 50.0 cm [Option ID = 14495]
4. 100.0 cm [Option ID = 14496]

4) A one dimensional harmonic oscillator has Hamiltonian $H = \frac{1}{2} p^2 + \frac{1}{2} \omega^2 q^2$. Hamiltonian's equations of motion are given by[Question ID = 3625]

1. $\dot{q} = -p, \dot{p} = -\omega^2 q$
[Option ID = 14497]
2. $\dot{q} = -p, \dot{p} = \omega^2 q$
[Option ID = 14498]
3. $\dot{q} = +p, \dot{p} = -\omega^2 q$
[Option ID = 14499]
4. $\dot{q} = +p, \dot{p} = \omega^2 q$
[Option ID = 14500]

5) The Hamiltonian of a system is given by $H = \frac{1}{2} p^2 + p \sin(q)$, which of the following represents the corresponding Lagrangian of the system[Question ID = 3626]

1. $\frac{1}{2} p^2 + \cos(q)$ [Option ID = 14501]
2. $\frac{1}{2} p^2$ [Option ID = 14502]
3. $\frac{1}{2} p^2 + p$ [Option ID = 14503]
4. $\frac{1}{2} p^2 - \cos(q)$ [Option ID = 14504]

6) Consider the following statements:

- A. Poisson Bracket of two dynamical variables u and v under canonical transformation is invariant.
- B. Poisson Bracket of two constants of the motion is also constant of motion.
- C. If the Hamiltonian and a quantity G are constants of the motion then $\frac{dG}{dt}$ must also be a constant.

Choose the correct answer from the options given below:

[Question ID = 3627]

1. Only B
[Option ID = 14505]
2. A and B only
[Option ID = 14506]
3. A, B and C
[Option ID = 14507]
4. Only C
[Option ID = 14508]

7) Electron is moving with velocity 3×10^7 m/sec, the uncertainty in the position of electron is

[Question ID = 3628]

1. $0.0038 \text{ \AA}$
[Option ID = 14509]
2. $0.0083 \text{ \AA}$

[Option ID = 14510]

3. 0.038 **A**

[Option ID = 14511]

4. 0.083 **A**

[Option ID = 14512]

8) A particle of mass m trapped in the potential $V(x) = 0$ for $-a \leq x \leq a$ and $V(x) = \infty$ for otherwise. What is the probability of finding the particle between $x = 0$ and $x = a/n$ when it is in n^{th} state

[Question ID = 3629]

1. n

[Option ID = 14513]

2. $2/n$

[Option ID = 14514]

3. $1/n$

[Option ID = 14515]

4. 0

[Option ID = 14516]

9) By using the single particle shell model predict the ground state spins of ${}_{83}\text{Bi}^{209}$ and ${}_{82}\text{Pb}^{209}$ [Question ID = 3630]

1. $9/2, 13/2$ [Option ID = 14517]

2. $9/2, 7/2$ [Option ID = 14518]

3. $11/2, 9/2$ [Option ID = 14519]

4. $11/2, 13/2$ [Option ID = 14520]

10) To penetrate the Coulomb barrier of a light nucleus, a proton must have a minimum energy of the order of[Question ID = 3631]

1. 1 keV [Option ID = 14521]

2. 1 MeV [Option ID = 14522]

3. 1 GeV [Option ID = 14523]

4. 10 MeV [Option ID = 14524]

11) A microcanonical ensemble represents[Question ID = 3632]

1. A system in contact with a heat reservoir [Option ID = 14525]

2. An isolated system in equilibrium [Option ID = 14526]

3. A system that can exchange particles with its surroundings [Option ID = 14527]

4. A system under constant external pressure [Option ID = 14528]

12) Consider a symmetric elastic collision between a particle of mass m and kinetic energy T and a particle of the same mass at rest. Relativistically, what is the cosine of the angle between the two particles after the collision?[Question ID = 3633]

1. 1 [Option ID = 14529]

2. $T/(T + 4m)$ [Option ID = 14530]

3. $T/(T + 5m)$ [Option ID = 14531]

4. $T/(T + 2m)$ [Option ID = 14532]

13) The ground state of a quantum system of identical bosons (using the Hartree-Fock approximation and the pseudo potential interaction model) is described by:[Question ID = 3634]

1. Topological Insulator [Option ID = 14533]

2. Anderson Localization [Option ID = 14534]

3. Bose-Hubbard Model [Option ID = 14535]

4. Gross-Pitaevski equation [Option ID = 14536]

14) A relation R on the set $A = \{0, 1, 2, 3\}$ is given as: $R = \{(0,0), (1,1), (1,2), (2,1), (2,2), (3,3)\}$ The relation R is[Question ID = 3635]

1. only reflexive [Option ID = 14537]

2. only symmetric [Option ID = 14538]

3. only transitive [Option ID = 14539]

4. an equivalence relation. [Option ID = 14540]

15) If R and S be relations on a set represented by the matrices A and B , Find the matrix that represent $R \oplus S$.

$$M_R = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix} \quad \text{and} \quad M_S = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix},$$

Find the matrix that represent $R \oplus S$.

[Question ID = 3636]

1. $\begin{bmatrix} 0 & 1 & 0 \\ 1 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix}$

[Option ID = 14541]

2. $\begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 1 \end{bmatrix}$

[Option ID = 14542]

3. $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix}$

[Option ID = 14543]

4. $\begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$

[Option ID = 14544]

16)

If $M = \begin{bmatrix} b+c & a+b & a \\ c+a & b+c & b \\ a+b & c+a & c \end{bmatrix}$ then find $\det M$.

[Question ID = 3637]

1. $a^3 + b^2 + c^2 - 2abc$

[Option ID = 14545]

2. $a^3 + b^3 + c^2 + 2abc$

[Option ID = 14546]

3. $a^3 + b^3 + c^3 + 3abc$

[Option ID = 14547]

4. $a^3 + b^3 + c^3 - 3abc$

[Option ID = 14548]

17) Determine the rank of the following matrix

$$M = \begin{bmatrix} 1 & 1 & -1 & 1 \\ -1 & 1 & -3 & -3 \\ 1 & 0 & 1 & 2 \\ 1 & -1 & 3 & 3 \end{bmatrix}$$

[Question ID = 3638]

1. 1 [Option ID = 14549]

2. 2 [Option ID = 14550]

3. 3 [Option ID = 14551]

4. 4 [Option ID = 14552]

18) The set of columns in the following matrix

$$M = \begin{bmatrix} 1 & 4 & 2 \\ 3 & 1 & 1 \\ 7 & -5 & 1 \end{bmatrix}$$

are [Question ID = 3639]

1. Linearly dependent [Option ID = 14553]

2. Linearly independent [Option ID = 14554]

3. Do not form basis [Option ID = 14555]

4. $|M| = 0$

[Option ID = 14556]

19)

For the differential equation $a_0(x)y'' + a_1(x)y' + a_2(x)y = 0$, let $a_i(x)$, $i = 0, 1, 2$ be continuous and $a_0(x) \neq 0$ on I. If c is an arbitrary constant, the Wronskian is given by

[Question ID = 3640]

1. $W(x) = ce^{-\int \frac{a_1(x)}{a_0(x)} dx}$

[Option ID = 14557]

2. $W(x) = ce^{\int \frac{a_1(x)}{a_0(x)} dx}$

[Option ID = 14558]

3. $W(x) = ce^{-\int \frac{a_1(x)}{a_0(x)} dx}$

[Option ID = 14559]

4. $W(x) = ce^{-\int \frac{a_1(x)}{a_2(x)} dx}$

[Option ID = 14560]

20) Solve the initial value problem

$4y'' - 8y' + 3y = 0$, $y(0) = 1$, $y'(0) = 3$.

[Question ID = 3641]

1. $\left[5e^{3x/2} - 3e^{x/2} \right]$

[Option ID = 14561]
2. $\left[5e^{3x/2} - 3e^{-x/2}\right]$

[Option ID = 14562]
3. $\left[5e^{-3x/2} - 3e^{x/2}\right]$

[Option ID = 14563]
4. $\left[5e^{-3x/2} - 3e^{-x/2}\right]$

[Option ID = 14564]

21) Find the solution of the differential equation

$$x^2 y'' + 2xy' - 2y = 0.$$

[Question ID = 3642]

1. $y(x) = Ax^2 + \frac{B}{x}$

[Option ID = 14565]
2. $y(x) = Ax^2 + \frac{B}{x\sqrt{x}}$

[Option ID = 14566]
3. $y(x) = Ax^2 + \frac{B}{x^2\sqrt{x}}$

[Option ID = 14567]
4. $y(x) = Ax^2 + \frac{B}{x^2}$

[Option ID = 14568]

22) Find a fourth degree polynomial approximation (a power series about $x = 0$) to the solution of the initial value problem $y'' - y = 0$; $y(0) = 2$, $y'(0) = 0$.

[Question ID = 3643]

1. $y(x) = 2 \left[1 - \frac{x^2}{2!} + \frac{x^4}{4!} \right]$

[Option ID = 14569]
2. $y(x) = 2 \left[1 + \frac{x^2}{2!} + \frac{x^4}{4!} \right]$

[Option ID = 14570]
3. $y(x) = 2 \left[1 + \frac{x^2}{3!} - \frac{x^4}{4!} \right]$

[Option ID = 14571]
4. $y(x) = 2 \left[1 - \frac{x^2}{3!} + \frac{x^4}{4!} \right]$

[Option ID = 14572]

23) Find the Laplace transform of the piecewise continuous function,

$$f(t) = \begin{cases} 0, & 0 \leq t < 2 \\ k, & t \geq 2, k - \text{constant}. \end{cases}$$

[Question ID = 3644]

1. $\mathcal{L}(f(t)) = \frac{k}{s} e^{-2s}, s > 0$

[Option ID = 14573]
2. $\mathcal{L}(f(t)) = \frac{s}{k} e^{-2s}, s > 0$

[Option ID = 14574]
3. $\mathcal{L}(f(t)) = \frac{k}{s} e^{-s}, s > 0$

[Option ID = 14575]
4. $\mathcal{L}(f(t)) = \frac{s}{k} e^{-s}, s > 0$

[Option ID = 14576]

24) Find the solution of the initial value problem

$$y' + 3y + 2 \int_0^t y(x) dx = t, y(0) = 0.$$

[Question ID = 3645]

1. $y(t) = \frac{1}{2} e^{-3t} - e^{-t} + \frac{1}{2}$

[Option ID = 14577]

2. $y(t) = \frac{1}{2}e^{-3t} - e^{-t} - \frac{1}{2}$

[Option ID = 14578]

3. $y(t) = \frac{1}{2}e^{-2t} - e^{-t} + \frac{1}{2}$

[Option ID = 14579]

4. $y(t) = \frac{1}{2}e^{-2t} - e^{-t} - \frac{1}{2}$

[Option ID = 14580]

25) Find the Fourier series expansion of the function. $f(x) = x^2, -2 \leq x \leq 2$.

[Question ID = 3646]

1. $f(x) = \frac{4}{3} + \frac{16}{\pi^2} \sum_{n=1}^{\infty} \frac{(-1)^n}{n^2} \cos\left(\frac{n\pi x}{2}\right)$

[Option ID = 14581]

2. $f(x) = \frac{4}{3} - \frac{16}{\pi^2} \sum_{n=1}^{\infty} \frac{(-1)^n}{n^2} \sin\left(\frac{n\pi x}{2}\right)$

[Option ID = 14582]

3. $f(x) = \frac{3}{4} + \frac{\pi^2}{16} \sum_{n=1}^{\infty} \frac{(-1)^n}{n^2} \cos\left(\frac{n\pi x}{2}\right)$

[Option ID = 14583]

4. $f(x) = \frac{3}{4} + \frac{\pi^2}{16} \sum_{n=1}^{\infty} \frac{(-1)^n}{n^2} \sin\left(\frac{n\pi x}{2}\right)$

[Option ID = 14584]

26) Evaluate the integral $I = \int Re(z^2)dz$ over C from 0 to $2 + 4i$ along the line segment joining the points (0,0) and (2,4).

[Question ID = 3647]

1. $I = 8(1 + 2i)$

[Option ID = 14585]

2. $I = -8(1 - 2i)$

[Option ID = 14586]

3. $I = 8(1 - 2i)$

[Option ID = 14587]

4. $I = -8(1 + 2i)$

[Option ID = 14588]

27)

Evaluate $I = \oint \frac{dz}{z(z+2)}$ where the contour c is any rectangle containing the point $z = 0$ and $z = -2$ inside it.

[Question ID = 3648]

1. $I = 0$

[Option ID = 14589]

2. $I = \pi i$

[Option ID = 14590]

3. $I = 2\pi i$

[Option ID = 14591]

4. $I = \pi$

[Option ID = 14592]

28) A fair dice is rolled 5 times. Find the probability that 1 shows twice, 3 shows twice and 6 shows once.[Question ID = 3649]

1. 0.0019 [Option ID = 14593]

2. 0.0029 [Option ID = 14594]

3. 0.0039 [Option ID = 14595]

4. 0.0049 [Option ID = 14596]

29) A random variable X has the following probability distribution.

X:	-2	0	1	2	3
P(x):	0.1K	0.22K	0.33K		

Find K?

[Question ID = 3650]

1. $\frac{1}{3}$

[Option ID = 14597]

2. $\frac{1}{5}$

[Option ID = 14598]

3. $\frac{1}{15}$

[Option ID = 14599]

4. $\frac{1}{45}$

[Option ID = 14600]

30) In a book of 600 pages, there are 60 typographical errors. Assuming Poisson law for the number of errors per page, find the probability that a randomly chosen 4 pages will contain no errors.[Question ID = 3651]

1. 0.6703 [Option ID = 14601]

2. 0.7408 [Option ID = 14602]

3. 0.8187 [Option ID = 14603]

4. 0.9048 [Option ID = 14604]

31)

If $G(V, E)$ is an undirected graph, Let $V = \{v_1, v_2, \dots, v_n\}$, where v_i represents nodes i and E the set of edges then

[Question ID = 3652]

1. $\sum_i \text{degree}(v_i) = |E|$

[Option ID = 14605]

2. $\sum_i \text{degree}(v_i) = |E|/2$

[Option ID = 14606]

3. $\sum_i \text{degree}(v_i) = 2|E|$

[Option ID = 14607]

4. $\sum_i \text{degree}(v_i) = |E| - |V|$

[Option ID = 14608]

32)

If A is the adjacency matrix of a graph G (with multiple edges and loops allowed) then the number of different path of length L from a vertex v_i to another vertex v_j is equal to (i, j) th entry of

[Question ID = 3653]

1. G

[Option ID = 14609]

2. A^L

[Option ID = 14610]

3. L^A

[Option ID = 14611]

4. A^{L^2}

[Option ID = 14612]

33)

Obtain the least squares polynomial approximations of degree one for $f(x) = \sqrt{x}$ on $(0,1)$.

[Question ID = 3654]

1. $\frac{4}{3}(1 + 3x)$

[Option ID = 14613]

2. $\frac{4}{15}(1 + 3x)$

[Option ID = 14614]

3. $\frac{4}{3}(1 - 3x)$

[Option ID = 14615]

4. $\frac{4}{15}(1 - 3x)$

[Option ID = 14616]

34)

Consider a two-state Markov chain with transition matrix $T = \begin{bmatrix} 1-\alpha & \alpha \\ \beta & 1-\beta \end{bmatrix}, 0 < \alpha, \beta < 1$. Find $\lim_{n \rightarrow \infty} T^n$?

[Question ID = 3655]

1. $\frac{1}{\alpha+\beta} \begin{bmatrix} \beta & \alpha \\ \beta & \beta \end{bmatrix}$

[Option ID = 14617]

2. $\frac{1}{\alpha+\beta} \begin{bmatrix} \alpha & \alpha \\ \beta & \beta \end{bmatrix}$

[Option ID = 14618]

3. $\frac{1}{\alpha+\beta} \begin{bmatrix} \beta & \alpha \\ \beta & \alpha \end{bmatrix}$

[Option ID = 14619]

4. $\frac{1}{\alpha+\beta} \begin{bmatrix} \alpha & \alpha \\ \alpha & \beta \end{bmatrix}$

[Option ID = 14620]

35)

$$T = \begin{bmatrix} \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{bmatrix}.$$

A three-state Markov chain has a transition matrix Therefore it defines a

[Question ID = 3656]

1. Regular Markov chain

[Option ID = 14621]

2. Irregular Markov chain

[Option ID = 14622]

3. Ergodic chain

[Option ID = 14623]

4. Reducible chain

[Option ID = 14624]

36) In an M/M/1: ∞ /FIFO queue, if λ is the average arrival rate and μ the average service rate then the average waiting time of customer in the queue is

[Question ID = 3657]

1. $\frac{\lambda}{\mu}(\lambda - \mu)$

[Option ID = 14625]

2. $\frac{\lambda}{\mu(\lambda - \mu)}$

[Option ID = 14626]

3. $\frac{\mu}{\lambda(\lambda - \mu)}$

[Option ID = 14627]

4. $\frac{\lambda}{\mu(\mu - \lambda)}$

[Option ID = 14628]

37) Thermal runaway will take place if the quiescent point is such that [Question ID = 3658]

1. $V_{CE} > \frac{1}{2} V_{CC}$

[Option ID = 14629]

2. $V_{CE} < 2V_{CC}$

[Option ID = 14630]

3. $V_{CE} < V_{CC}$

[Option ID = 14631]

4. $V_{CE} < \frac{1}{2} V_{CC}$

[Option ID = 14632]

38) A small concentration of minority carries is injected into a homogeneous Semiconductor crystal at one point. An electric field

of 10V/cm is applied across the crystal and this moves the minority carries a distance of 1cm in 20μsec. The mobility (in cm² /v-sec) will be[Question ID = 3659]

1. 1,000 [Option ID = 14633]
2. 2,000 [Option ID = 14634]
3. 5,000 [Option ID = 14635]
4. 500,000 [Option ID = 14636]

39) If the differential voltage gain and the common mode voltage gain of a differential amplifier are 48dB and 2dB respectively, then its common mode rejection ratio is[Question ID = 3660]

1. 23 dB [Option ID = 14637]
2. 25 dB [Option ID = 14638]
3. 46 dB [Option ID = 14639]
4. 50 dB [Option ID = 14640]

40) The density of dynamic RAM is[Question ID = 3661]

1. the same as static RAM [Option ID = 14641]
2. less than that of static RAM [Option ID = 14642]
3. more than that of static RAM [Option ID = 14643]
4. either equal or less than that of static RAM [Option ID = 14644]

41) Choose the correct statements(s) from the following[Question ID = 3662]

1. PROM contains a programmable AND array and a fixed OR array. [Option ID = 14645]
2. PLA contains a fixed AND array and a programmable OR array. [Option ID = 14646]
3. PROM contains a fixed AND array and a programmable OR array. [Option ID = 14647]
4. PLA contains a programmable OR array. [Option ID = 14648]

42) A 10 bit D/A converter given a maximum output of 10.23V. The resolution is[Question ID = 3663]

1. 10 mV [Option ID = 14649]
2. 20 mV [Option ID = 14650]
3. 15 mV [Option ID = 14651]
4. 25 mV [Option ID = 14652]

43) Manchester code is a[Question ID = 3664]

1. Bi-polar code [Option ID = 14653]
2. non return to zero code [Option ID = 14654]
3. tri-polar code [Option ID = 14655]
4. uni-polar code [Option ID = 14656]

44) Bit stuffing refers to[Question ID = 3665]

1. inserting a '0' in user data stream to differentiate it with a flag [Option ID = 14657]
2. inserting a '0' in flag stream to avoid ambiguity [Option ID = 14658]
3. appending a nibble to the flag sequence appending a nibble to the user data stream [Option ID = 14659]
4. appending a nibble to the user data stream [Option ID = 14660]

45) Maximum data rate of a channel for a noiseless 3kHz binary channel is[Question ID = 3666]

1. 3000bps [Option ID = 14661]
2. 6000bps [Option ID = 14662]
3. 1500bps [Option ID = 14663]
4. 1000bps [Option ID = 14664]

46) Which of the following is not a standard RS-232C signal?[Question ID = 3667]

1. RTS [Option ID = 14665]
2. CTS [Option ID = 14666]
3. DSR [Option ID = 14667]
4. VDR [Option ID = 14668]

47) In Ethernet when Manchester encoding is used, the bit rate is[Question ID = 3668]

1. half the baud rate [Option ID = 14669]
2. twice the baud rate [Option ID = 14670]
3. same as the baud rate [Option ID = 14671]
4. thrice the baud rate [Option ID = 14672]

48) The message 11001001 is to be transmitted using the CRC polynomial $x^3 + 1$ to protect it from errors. The message that should be transmitted is[Question ID = 3669]

1. 11001001000 [Option ID = 14673]
2. 11001001011 [Option ID = 14674]
3. 11001010 [Option ID = 14675]
4. 110010010011 [Option ID = 14676]

49) Which one of the following is not a client-server application?[Question ID = 3670]

1. Internet chat [Option ID = 14677]
2. Web browsing [Option ID = 14678]
3. E-mail [Option ID = 14679]
4. Ping [Option ID = 14680]

50) An AM signal and a narrow-band FM signal with identical carriers, modulating signals and modulation indices of 0.1 are added

together. The resultant signal can be closely approximated by[Question ID = 3671]

- 1. Broadband FM [Option ID = 14681]
- 2. SSB with carrier [Option ID = 14682]
- 3. DSB-SC [Option ID = 14683]
- 4. SSB without carrier [Option ID = 14684]

