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PDPM-Indian Institute of Information Technology, Design and Manufacturing

End Semester Examination *NS-104*

Time: 3 hours *Total Marks=40*

Instructions: (1) Answer Section A and Section B in separate answer sheets. (2) Marks are indicated on right (3) The values of constants are given below: h=6.6 x 10^{-34} J.S, k=1.38 x 10^{23} jk^{-1}, $\sigma = 5.67x10^{-8} Wm^{-2}K^{-4}$, M_e=9.1 x 10^{-31} kg etc. (4) All questions are compulsory.

Section A

1. (a) By using separation of variable method, derive Schrodinger's time independent equation and find the value of $\psi\,(r, t)$. [3+1]
   (b) Prove that the constant (E) used during the separation of variable is real. [2]
   (c) Define the Hamiltonian operator and show that its expectation value is equal to the above constant (E). [1+1]

2. A particle is trapped in a one-dimensional box of rigid and elastic walls at $x = -a \; and \; x = a$ along the x-axis. The potential function for this system is defined as follows.

$$V(x) = 0, \qquad -a < x < a$$
$$= \infty, \qquad elsewhere$$

   (a) Show that the energy eigenfunctions are mixtures of odd and even parities. [4]
   (b) Find the energy eigenvalues corresponding to each of the above eigen functions. [2]

3. If the potential energy is imaginary i.e. $U(x) = U_1(x) + iU_2(x)$, where U_1 and U_2 are real, prove that $\frac{\partial P}{\partial t} + \frac{\partial j}{\partial x} = \frac{4\pi}{h} PU_2$, where P and j are probablity density and probability current density respectively. [3]

4. Prove that $< p_x x >$ is not hermitian. [3]

$A^2\sqrt{\frac{L}{2}}$ $\sqrt{\frac{2}{L}}$

Section B

1. The wave function (not normalised) for a system is defined as given below, where "a" is a constant.

$$\psi(r) = \frac{1}{\sqrt{(\pi a^3)}} e^{-r/a}$$

Find $< r >$. [4]

Hints: Use sphereical polar co-ordinate system.

2. A mono-energetic beam of protons is incident on a one-dimensional potential step of height 10 eV. Find the reflection co-efficient, for the incident energies (a) 1 eV, (b) 10 eV and (c) 20 eV. [1+1+2]

3. The probability of finding a particle of mass m confined in an infinitely deep potential well of width 2a in the ground, first excited, and second excited states are 60%, 30% and 10% respectively. If the potential energy is zero within the potential well,
   (a) Find the normalized wave function. [2]
   (b) What is the average energy of the particle? [2]

4. Using uncertainty principle prove that the minimum energy allowed for a simple harmonic oscillator is $\frac{1}{2}h\nu$, where ν is the frequency of oscillation. [4]

5. Prove that $[e^{\hat{A}}, \hat{A}] = 0$ [2]

6. If $\psi_1(r,t) and\ \psi_2(r,t)$ are solutions of the schrodinger's time dependent equation, prove that the linear combination of these solutions i.e. $\psi(r,t) = c_1\psi_1(r,t) + c_2\psi_2(r,t)$, where c_1 and c_2 are constants is also a solution of the schrodinger equation. [2]

-----------------Best of Luck---------------------

(18)

Indian Institute of Information Technology, Design and Manufacturing Jabalpur
Quiz II Examination: 2015-2016
Sub:NS103: Mathematics for Continuous and Discrete domain

Time: 45 min.

Max. Marks: 15

- *All questions are compulsory.*
- *Start each question from new page and write every step for proper evaluation.*

1. Let A is a real skew symmetric matrix and $I + A$ is a non-singular, I being the identity matrix. Prove that the matrix $B = (I + A)^{-1}(I - A)$ is orthogonal. [5]
2. Let V be a real vector space. Let S_1 and S_2 be two subspaces of V. Then show that the intersection $S_1 \cap S_2$ is also a subspace of V. [5]
3. Let U and V be the subspaces of the vector space T. Let $W = U + V$ defined as $W = \{w = u + v : u \in U, v \in V\}$. Show whether or not W is a subspace. [5]

April 13, 2016

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Indian Institute of Information Technology, Design and Manufacturing Jabalpur
Mid Semester Examination: 2015-2016
Sub:NS103: Mathematics for Continuous and Discrete domain

Time: 2 Hours **Max. Marks: 30**

- *All questions are compulsory.*
- *Start each question from new page and write every step for proper evaluation.*

1. Let $f(z) = u + iv$ be analytic function. Suppose v be the harmonic conjugate of u. Then show that uv is also harmonic. [5]

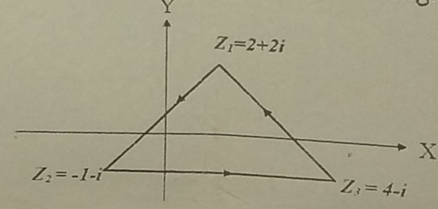
2. Suppose $u(x, y) = 2x(1 - y)$.
   (a) Prove that the function $u(x, y)$ is harmonic. [1]
   (b) Find a function $v(x, y)$ such that $f(z) = u(x, y) + iv(x, y)$ is analytic. [2]
   (c) Express $f(z)$ in terms of z and $\overline{z}$. [2]

3. Find the Laurent series of $f(z) = (z - 2)e^{\frac{z}{z-2}}$ about $z = 2$, determine the region of convergence, and classify the singularity at $z = 2$. Hence find $\int_C (z - 2)e^{\frac{z}{z-2}} dz$, where C is any simple closed curve encloses 2. [5]

4. Show that $\int_C \frac{e^{kz}}{z^2 + 1} dz \overset{2\pi i}{=} \sin k$, where $k > 0$ is real constant and $C : |z| = 3$. [4]

5. Use Cauchy residue theorem to evaluate the integral $I = \int_C \frac{e^z - 1}{z(z - 1)(z - i)^2} dz$, where $C : |z| = 2$. [5]

6. Evaluate $\int_C \overline{z} dz$, along the sides of the given triangle in the counterclockwise direction. [6]



$x^2+y^2 = z\bar{z}$

$\frac{|z|^2 + |z|^2 + 2(|z|)^2}{2}$

$2x^2 \times y^2$

$2|z|^2$

$.5 - \frac{15}{2}$

$2i - 1 - 3ie^i$
$+ 2 + i + 3e^i$

$2\pi i \lim_{z \to z_0}$

$-\frac{5}{2}i$ $8 + 4i - (\frac{1}{2} - i)$

$f^n z_0$

$2 - (-3 + 10) = -5$

$\frac{15}{2} + 5i$

$\frac{1}{2} - 2$

$-ie^i$
$\frac{-2ie^i + e^i}{2i - 1}$

$8 - (-12 + 20) = 0$

$\frac{15}{2} - 8$ $\frac{-1}{2}$

$(1 - i)$

$2i - 1 - 3ie^i$

PDPM Indian Institute of Information Technology, Design and Manufacturing Jabalpur

Mid semester Examination

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NS104

Instructions:

- The numbers inside square bracket on the right side of a question indicates the mark assigned for that question.
- Don't skip any step even if the steps are trivial.
- There is *no partial* or step marking.

Full Marks 30

Time: 2 hour

02 March 2016

1. If the expression for the electric potential at a point $\boldsymbol{a}$ in terms of the electric field is given by

$$V_a = -\int_{\infty}^{a} \vec{E}.\vec{dl}$$

then show that $\vec{E} = -\vec{\nabla}V$.

[2]

2. Prove that if the potential at each and every point on the boundary is known, then the potential at each and every point in the region enclosed by the boundary is uniquely determined by Laplace's equation (there are no charges in the said region).

[2]

3. Write an expression for dipole moment of a charge distribution given by charge density $\rho(\vec{r})$. Show that if total charge of the charge distribution is zero, then the dipole moment is independent of origin chosen.

[2]

4. Write all four Maxwell's equations in appropriate integral form which can be used across the interface of two different media. At the interface between the two different dielectric media with permittivity $\boldsymbol{\varepsilon_1}$ and $\boldsymbol{\varepsilon_2}$ respectively, find out how the electric field changes as we cross from one medium to other if the interface contains a surface charge density $\boldsymbol{\sigma}$. Define each term you introduce during the formulation.

[2+4]

5. How Maxwell modified Ampere's law in vacuum and why? What is the physical significance of it?

[3]

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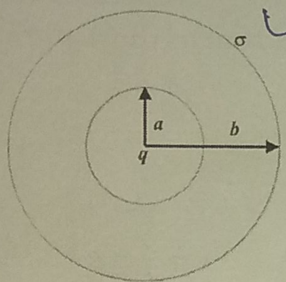
6. An cylinder of radius $\boldsymbol{R}$ and height $\boldsymbol{H}$ carries a magnetization $\vec{M} = k\rho\hat{z}$ where $\boldsymbol{k}$ is a constant and $\boldsymbol{\rho}$ is distance from the axis of cylinder. Find out the bound volume current density $\vec{J_b}$. Also find the bound surface current density $\vec{K_b}$ at the curved surface. [2]

7. A static charge configuration gives rise to an electrostatic potential in free space of the form $V = \frac{\cos\varphi}{r}$ in spherical polar coordinate system. Find the volume charge density $\boldsymbol{\rho}$ at a point $(2, \frac{\pi}{6}, \frac{\pi}{3})$. [2]

8. A straight wire of length $\boldsymbol{l}$ placed along **Z** axis carrying a current $\boldsymbol{I}$. Find the magnetic vector potential $\vec{A}$ at a distance $\boldsymbol{d}$ ($\boldsymbol{d} \ll \boldsymbol{l}$) from the wire. [3]



9. In the equilibrium configuration, a spherical conducting cell of inner radius $\boldsymbol{a}$ and outer radius $\boldsymbol{b}$ has a point charge $\boldsymbol{q}$ fixed at the centre and a surface charge density $\boldsymbol{\sigma}$ uniformly distributed on the outer surface. Find the charge density on the inner surface and the electric field at a distance $\boldsymbol{r} < \boldsymbol{a}$ and $\boldsymbol{r} > \boldsymbol{b}$ from the centre. [3]

10. In a medium $\mu = 3 \times 10^{-5}\ N/A^2$ and $\epsilon = 1.5 \times 10^{-10}\ C^2/Nm^2$ and conductivity $\sigma = 0$. If $\vec{H} = 2\cos(10^{10}t - \beta x)\hat{z}\ A/m$, find magnetic field $\vec{B}$, electric field $\vec{E}$, dielectric displacement $\vec{D}$ and constant β using Maxwell's equation. [1+2+1+1]

Good Luck

PDPM INDIAN INSTITUTE OF INFORMATION TECHNOLOGY DESIGN AND MANUFACTURING

Btech 2015 Mid- Sem Examination 2016

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HS 102 Culture and Human Values

Note: All the questions are compulsory

Time: 2 hrs Marks: 30

Q.1. Expand on any one of the following. (200 words) **5 marks**

1. Look before you leap

2. Beauty lies in the eye of the beholder.

Q. 2. Use the following words in your own sentence. Do any Six. **3 marks**

1. Affectation 2. Effulgent 3. Posterity 4. Diligence 5. Immanent, 6. Assimilate,

7. contemporary.

Q.3. Short answers questions. Do any four. (100 words) **12 marks**

1. What Shakespeare has to say about 'thought and action'?

2. What does Tagore mean by Deliverance?

3. Why is it difficult to be poor and not grumble?

4. Who is the person who finds Happiness in Truth?

5. What standard does a great man set, which is followed by the entire world?

Q. 4. Explain the following passages in your own words. **200 words. 5*2=10 marks**

1. Reading maketh a full man; conference a ready man; and writing an exact man; and therefore , if a man write little, he had need have a great memory; if he conferred little, he had need have a present wit; and if he read little, he had need have much cunning, to seem to know that he doth not.

2. Whenever walking in a company of three, I can always find my teacher among them. I select a good person and follow his example or I see a bad person and correct it in myself.

helth

health