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SECOND SEMESTER

Roll No.

B.Tech. (ALL)

MID SEMESTER EXAMINATION

MARCH-2012

AM-111 MATHEMATICS II

Time: 1 Hour 30 Minutes

Max. Marks : 20

Note : Answer ALL questions selecting any TWO parts from each.
Assume suitable missing data, if any.

1[a] Define rank of a matrix. Find the rank of the matrix.

$$A = \begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 4 & 3 & 2 \\ 3 & 2 & 1 & 3 \\ 6 & 8 & 7 & 5 \end{bmatrix}$$

3.5

[b] Show that the matrix $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ is diagonalizable. Obtain the diagonalizing matrix P.

3.

[c] State Cayley Hamilton theorem. Verify this theorem for the matrix $\begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$ and hence find its inverse.

2[a] Solve the following differential equations:

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(i) $\frac{d^2y}{dx^2} + a^2y = \sec ax$

(ii) $\frac{d^2y}{dx^2} - 4y = x \sinh x$

3.

[b] Solve $x^2 \frac{d^2y}{dx^2} + 4x \frac{dy}{dx} + 2y = e^x$

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[c] Solve the following system of differential equations
 $\frac{dx}{dt} + 5x - 2y = t$

$$\frac{dy}{dt} + 2x + y = 0, \quad x = y = 0 \text{ when } t = 0.$$

3[a] Solve in series the differential equation

$$\frac{d^2y}{dx^2} + xy = 0$$

[b] Obtain the series solution of the equation

$$x(1-x)\frac{d^2y}{dx^2} - (1+3x)\frac{dy}{dx} - y = 0$$

[c] Obtain the series solution of the equation

$$xy'' + y' + xy = 0$$

$$D^2 + 3D + 2 = e^{ct}$$

$$(D+2)(D+1) = 0$$

$$2t = \ln x^2$$

$$Ae^{-2t} + Be^{-t}$$

$$\frac{A}{x^2} + \frac{B}{x}$$

$$\frac{1}{x^2}$$

$$\frac{1}{x}$$

$$-\frac{2}{x^3}$$

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

$$e^{-2t} \quad e^{-t}$$

$$2e^{-2t} \quad -e^{-t}$$

$$e$$

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AP-113 APPLIED PHYSICS-II

Time: 1 Hour 30 Minutes

Max. Marks : 20

Note : Answer ALL questions.
Assume suitable missing data, if any.

- 1[a] An electron has a de Broglie wavelength of 2.00×10^{-12} m. Find its kinetic energy and the phase and group velocities of its de Broglie waves. Rest mass of the electron is $0.511 \frac{\text{MeV}}{c^2}$. 2
- [b] X-rays of wavelength 10.0 pm are scattered from a target (i) find the wavelength of the x-rays scattered through 45° (ii) find the maximum wavelength present in the scattered x-rays (iii) find the maximum kinetic energy of the recoil electrons. 2
- [c] An electron and a positron are moving side by side in the $+\hat{x}$ direction at $0.500 c$ when they annihilate each other. Two photons are produced that move along the x-axis. What is the energy of each photon? 2
- 2[a] Show that the operations \hat{x} and \hat{p}_x do not commute. Get the commutator $[\hat{x}, \hat{p}_x]$ and explain its physical significance. 1
- [b] Which of the following wave functions can not be solutions of Schrodinger's equation for all values of x ? Why not?
(i) $\psi = A \tan x$ (ii) $\psi = A e^{x^2}$. 1
- [c] Write the energy eigen values and energy eigen function for a particle trapped in an infinite potential box of width L . Draw the first three energy eigen function for (i) infinite potential box of width L and (ii) finite potential box of width L . Compare the two. 3
- 3[a] Define poynting vector and explain its significance. The electric field vector for an electromagnetic field traveling in vacuum is given by
$$\vec{E} = E_0 \cos(kz - \omega t) \hat{i}$$

Calculate the poynting vector for the wave and show that its magnitude is equal to the energy density of the wave time the velocity of light.

3

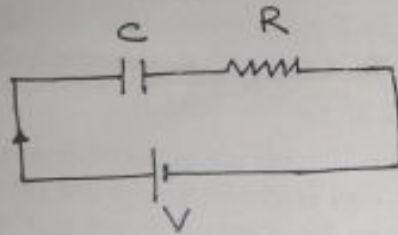
[b] Write down and derive the wave equation for propagation of electric field \vec{E} and magnetic field \vec{B} in free space.

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4[a] Describe physical significance of the displacement current considering the example of current flow through a capacitor.

2

[b] A 50 pf parallel plate capacitor is getting charged at such a rate that its voltage is increasing at 300V/s.



The plates are circular with a radius of 10 cm. Calculate displacement current density and displacement current.

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