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SECOND SEMESTER

Roll No. 101

B.Tech. (Group A&B)

END SEMESTER EXAMINATION

MAY-2012

AM-111 MATHEMATICS-II

64/70

Time: 3:00 Hours

Max. Marks : 70

**Note :** Answer **ALL** questions selecting Two parts from each question.  
Each question carry equal marks.  
Assume suitable missing data, if any.

1[a] Apply row transformation to find the inverse of the matrix

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

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[b] Find the eigen values and eigen vectors of the matrix

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

If possible form the diagonalizing matrix.

[c] Test for the consistency and if consistent then solve the following system of equation;

$$x + 2y + z = 3$$

$$2x + 3y + 2z = 5$$

$$3x - 5y + 5z = 2$$

$$3x + 9y - z = 4$$

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2[a] Find the general solution of differential equation

$$\frac{d^4 y}{dx^4} + y = 0$$

[b] Solve the differential equation

$$(D^2 + 1)(D - 2)^2 y = e^{2x} \sin x$$

[c] Solve the simultaneous differential equation

$$(3D + 1)y + 3Dx = 3t + 1$$

$$(D - 3)y + Dx = 2t$$

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3[a] Solve the differential equation in series

$$9x(1-x)y'' - 12y' + 4y = 0$$

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\*[b] State and prove Rodrigues formula for Legendre's polynomial.

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[c] State and prove orthogonality of Bessel's function of First kind of order 'n'.

4[a] Solve the differential equation using Laplace transform

$$(D^2 + 1)x = t \cos 2t$$

$$x(0) = 0, \left(\frac{dx}{dt}\right)_{t=0} = 0$$

?? 2

[b] Find the inverse Laplace transform of

(i)  $\frac{s}{s^4 + s^2 + 1}$

(ii)  $\frac{e^{-\pi s}}{s^2 + 1}$

6

[c] If  $f(t)$  is a periodic function with period 'a' then find its Laplace transform.

5[a] Find half range cosine series to represent the function  $x \sin x$  in the interval  $[0, \pi]$ .

[b] Obtain the Fourier series for the function

$$f(x) = \begin{cases} x & -1 \leq x \leq 0 \\ x+2 & 0 < x \leq 1 \end{cases}$$

and hence deduce that

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$$

[c] Find the Fourier transform of

$$f(x) = e^{-ax^2} \quad a > 0$$

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and using this find the Fourier transform of  $f(x) = xe^{-ax^2}, a > 0$

SECOND SEMESTER

B.Tech. (Group A & B)

END SEMESTER EXAMINATION

MAY-2012

AP-113 APPLIED PHYSICS-II

53/70

Time: 3:00 Hours

Max. Marks : 70

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

- 1[a] What is Compton effect? Derive an expression for the change in wavelength expected for a photon which is scattered through the angle  $\phi$  by a particle of rest mass  $m_0$ . 5 7

- [b] Show that the de Broglie wavelength of a particle of rest mass  $m_0$  and kinetic energy  $KE$  is given by

$$\lambda = \frac{hc}{\sqrt{KE(KE + 2m_0c^2)}} \quad 4$$

- [c] The phase velocity of ocean waves is  $\sqrt{\frac{g\lambda}{2\pi}}$ , where  $g$  is the acceleration of gravity. Find the group velocity of ocean waves. 3 3

- 2[a] Write the Schrodinger's equation, energy eigen values and energy eigen functions for a harmonic oscillator. Draw the first four energy eigen functions for the harmonic oscillator. Find the expectation values  $\langle x \rangle$  for the first two states of a harmonic oscillator. 7

- [b] A beam of electrons is incident on a barrier 6.00 eV high and 0.200 nm wide. Find the energy they should have if 1.00 percent of them are to get through the barrier. 3

- [c] Find the momentum eigenfunctions and momentum eigen values for a particle trapped in an infinite potential box of width  $L$ . 4

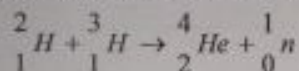
- 3[a] What are Fermions? Write the Fermi-Dirac distribution law. Apply Fermi-Dirac statistics to electron gas to find the expression for the Fermi energy of electrons in a metal. 6 7

- [b] Find the Fermi energy (in eV) in copper on the assumption that each copper atom contributes one free electron to the electron gas. The density of copper is  $8.94 \times 10^3 \text{ kg/m}^3$  and its atomic mass is 63.5 u. 4

[c] Distinguish clearly between Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics. 3

4 What are bosons? Derive the Bose-Einstein distribution law. Apply Bose-Einstein statistics to photon gas and hence derive Planck's law for the spectral distribution of energy in black body radiation. 14

5[a] Define Q-value of a nuclear reaction. Explain its physical significance. For the d-t fusion reaction



Calculate (i) the Q-value of the reaction and (ii) the rate at which deuterium and tritium are consumed to produce 1 MW. (Assume all energy from the fusion reaction is available). 7

[b] What is Thermonuclear fusion? Explain the proton-proton cycle which is the chief nuclear reaction sequence that takes place in stars like the sun and cooler stars. What conditions should be fulfilled to produce Thermonuclear fusion in the laboratory. 7

6[a] What is liquid drop model of a nucleus. Derive Von-Weizsacker semi empirical binding energy formula. 6 7

[b] Find the energies needed to remove a proton from  ${}^4_2\text{He}$ , then to remove a neutron, and finally to separate the remaining neutron and proton. Compare the total with the binding energy of  ${}^4_2\text{He}$ . 7

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7[a] Show that the electric and magnetic field vectors,  $\vec{E}$  and  $\vec{B}$ , in plane electromagnetic waves are mutually perpendicular in a plane normal to the direction of propagation. How are phases of  $\vec{E}$  and  $\vec{B}$  related to each other. 4

1 4[b] Show that the pointing vector  $\vec{S} = (\vec{E} \times \vec{H})$  represents the energy flow per unit area per unit time both in magnitude and direction in case of a plane electromagnetic wave. 4

3 [c] Write down and derive the wave equation for propagation of electric field  $\vec{E}$  and magnetic field  $\vec{B}$  in a non conducting medium. 6

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8 Write short notes on any **TWO** of the following:

- [a] Nuclear reactor 5
- [b] Poynting theorem 5
- [c] Nuclear Shell model
- [d] Alpha and beta spectrum

Atomic Masses:-

$${}^4_2\text{He} : 4.002603 \text{ u}$$

$${}^3_1\text{H} : 3.016050 \text{ u}$$

$${}^2_1\text{H} : 2.014102 \text{ u}$$

$${}^1_1\text{H} : 1.007825 \text{ u}$$

$${}^1_0\text{n} : 1.008665 \text{ u}$$