Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL UNIVERSITY, MANIPAL

I SEMESTER B.TECH END SEMESTER MAKE UP EXAMINATIONS, DEC 2015

SUBJECT: ENGINEERING PHYSICS (PHY1001)
REVISED CREDIT SYSTEM

Time: 3 Hrs. **Date: 29-12-2015** **Max. Marks: 50**

Instructions to Candidates:

- **Answer ALL the questions. Each question carries 10 marks**
- **Missing data may suitably be assumed.**
- **Answer all the sub questions of a main question in a continuous sequence.**
- **Write question number within the margin. Draw neat sketches wherever necessary.**

Physical Constants:

Speed of light in vacuum = 3.00 X 10^{8} m/s **Electron charge = 1.60 X 10^{-19} C**
Mass of electron = 9.11 X 10^{-31} kg
Planck's constant = 6.63 X 10^{-34} J.s **Boltzmann constant = 1.38 X 10^{-23} J/ K**

1A Obtain an expression for the intensity in single-slit diffraction pattern, using the phasor-diagram. **[5 M]**

1B Two slits are separated by **0.180** mm. An interference pattern is formed on a screen **80.0** cm away by 656.3 nm light. Calculate the ratio of intensity at a distance **y = 0.600** cm to that at the central maximum, neglecting diffraction effects. **[3 M]**

1C Light of wavelength **500** nm is incident normally on a diffraction grating. If the third-order maximum of the diffraction pattern is observed at **32.0°,** what is the number of rulings per centimeter for the grating? **[2 M]**

2A Explain the terms reflection phase shift and optical path length with reference to interference of light. **[2 M]**

2B An atom has two energy levels with a transition wavelength of **582** nm. At **300** K, **4.0 x 10^{20}** atoms are in the lower state. (i) How many occupy the upper state under conditions of thermal equilibrium? (ii) Suppose **7.0 x 10^{20}** atoms are

pumped into upper state, with **4.0 x 10^{20}** atoms in the lower state, how much energy could be released in a single laser pulse ? **[3 M]**

2C Write (i) Stefan's law (ii) Wien's displacement law (iii) Rayleigh-Jeans law. Explain all the notations. **[3M]**

2D Show that the group speed of a wave packet is equal to the particle speed for a free non- relativistic quantum particle ((total energy is only kinetic energy). **[2 M]**

3A Briefly explain the step index and graded index optic fibers showing the refractive index profile in them. [**2 M]**

3B Give a brief account of tunnelling of a quantum particle through a potential energy barrier. **[4 M]**

3C An alpha particle in a nucleus can be modeled as a particle moving in a "box" of length **1.0 x 10^{-14} m**. Using this model, estimate the wavelength, momentum and energy of the α- particle in its lowest energy state. How much will be its energy in the first excited state (**n=2**)? Mass of an α- particle is = **4 × 1.66 X10^{-27}** kg. **[4 M]**

4A Give a brief account of quantum model of H-atom. **[3 M]**

4B A particle of mass ***m*** is confined to a one-dimensional box between ***x* = 0** and ***x= L.*** Find the expectation value of the position ***x*** of the particle in the state characterized by quantum number ***n.*** [**4 M]**

4C Calculate the energy of a conduction electron in silver at **800** K, assuming the probability of finding an electron in that state is **0.950**. The Fermi energy is **5.48** eV at this temperature. **[3 M]**

5A Based on the allowed states of a particle in a three dimensional infinite potential well, 'box', derive the density-of-states function ($g(E) = \frac{8\sqrt{2}\pi m^{3/2}}{h^3} E^{1/2}$). **[5 M]**

5B The band gap energy for silicon at **300** K is E_G = **1.14** eV. Find the lowest-frequency (f_{LOWEST}) photon that will promote an electron from the valence band to the conduction band. [**2 M]**

5C Consider a cube of gold (d =) **1.00** mm on an edge. Calculate the approximate number (N) of conduction electrons in this cube whose energies lie in the range E = **4.000** eV to E + ΔE = **4.025** eV. Fermi energy for gold = **5.53** eV. **[3 M]**