Engineering Physics VTU CBCS Question Paper Set 2018

CBCS Scheme

USN | | | | | | | | | |

17PHY12

First Semester B.E. Degree Examination, Dec.2017/Jan.2018
Engineering Physics

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing one full question from each module.***

2. ***Physical constants :*** ***Velocity of light, $c = 3 \times 10^8$ m/s***
Planck's constant, $h = 6.63 \times 10^{-34}$ JS
Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg
Charge of electron, $e = 1.6 \times 10^{-19}$ C
Boltzmann constant $= 1.38 \times 10^{-23}$ JK^{-1}
Avagadro number $= 6.02 \times 10^{23}$/mol

Module-1

1 a. Write the assumptions of Planck's law of radiation. Deduce Wein's law and Rayleigh-Jeans law from Planck's law of radiation. **(07 Marks)**

b. Set up time independent one dimensional Schrodinger wave equation. **(06 Marks)**

c. What is Compton effect? Explain its physical significance. **(03 Marks)**

d. An electron is bound in an one dimensional potential well of width 1 Å, but if infinite wall height. Find its energy values in the ground state, and also in the first excited states. **(04 Marks)**

OR

2 a. State Heisenberg's uncertainty principle. Show that electrons cannot exist inside the nucleus. **(07 Marks)**

b. State de Broglie hypothesis and show that group velocity is equal to particle velocity. **(06 Marks)**

c. Briefly explain three properties of wave function. **(03 Marks)**

d. Compute the de Broglie wavelength for an electron moving with one tenth part of the velocity of light. **(04 Marks)**

Module-2

3 a. Explain Fermi energy and Fermi factor. Explain the variation of Fermi factor with temperature. **(07 Marks)**

b. Derive the expression for electrical conductivity of an intrinsic semiconductor. **(05 Marks)**

c. Write a note on Meglave vehicles. **(04 Marks)**

d. The electron concentration in a semiconductor is 5×10^{17} m^{-3}. Calculate the conductivity of the material if the drift velocity of electron is 350 ms^{-1} in an electric field of 1000 Vm^{-1}. **(04 Marks)**

OR

4 a. Discuss the merits of quantum free electron theory. **(06 Marks)**

b. What is superconductivity? Explain Type-I and Type-II superconductors. **(06 Marks)**

c. What is (i) mean collision time, (ii) drift velocity, (iii) Meissner effect? **(04 Marks)**

d. Calculate the Fermi velocity and the mean free path for the conduction electrons in silver, given that its Fermi energy is 5.5 eV and the relaxation time for electrons is 3.83×10^{-14} S. **(04 Marks)**

Module-3

5 a. Define angle of acceptance and numerical aperture. Obtain an expression for the numerica aperture of an optical fiber. **(07 Marks)**

b. What is holography? Explain the principle of construction of hologram with suitable ray diagram. **(05 Marks)**

c. Explain the processes of spontaneous emission and stimulated emission. **(04 Marks)**

d. A medium in thermal equilibrium at temperature 300 K has two energy levels with a wavelength separation of 1 μm. Find the ratio of population densities of the upper and lower levels. **(04 Marks)**

OR

6 a. Describe the construction of CO_2 laser and explain its working with the help of energy level diagram. **(06 Marks)**

b. Discuss the three types of optical fibers with suitable diagrams. **(06 Marks)**

c. Mention four applications of LASER. **(04 Marks)**

d. The angle of acceptance of an optical fiber is 30° when kept in air. Find the angle of acceptance when it is in a medium of refractive index 1.33. **(04 Marks)**

Module-4

7 a. Explain in brief the seven crystal systems with neat diagrams. **(07 Marks)**

b. Explain the crystal structure of diamond with neat sketch and calculate its atomic packing factor. **(06 Marks)**

c. Define unit cell, primitive cell and Bravias lattice. **(03 Marks)**

d. Calculate the glancing angle for incidence of x-rays of wavelength 0.58 Å on the plane (132) of NaCℓ which results in second order diffraction maxima taking the lattice constant as 3.81 Å. **(04 Marks)**

OR

8 a. What are Miller indices? Derive an expression for interplanar distance interms of Miller indices. **(07 Marks)**

b. Define coordination number and packing factor. Calculate the packing factor for SCC and FCC structure. **(06 Marks)**

c. Derive Bragg's law. **(04 Marks)**

d. Draw the following planes in a cubic unit cell: i) (1 1 1) ii) (1 0 1) iii) (0 $\bar{1}$ 1). **(03 Marks)**

Module-5

9 a. Describe the construction and working of Reddy's shock tube. **(06 Marks)**

b. Discuss the variation of density of energy states for 3D, 2D, 1D and 0D structures. **(06 Marks)**

c. Describe sol gel method of producing nano particles. **(05 Marks)**

d. Mention any three applications of nano particles. **(03 Marks)**

OR

10 a. Describe the principle, construction and working of a scanning electron microscope. **(08 Marks)**

b. Define: i) Mach number ii) Subsonic waves
ii) Supersonic waves iv) Ultrasonic waves. **(04 Marks)**

c. Explain pyrolysis method of obtaining carbon nanotubes. **(04 Marks)**

d. The distance between the two pressure sensors in a shock tube is 100 mm. The time taken by a shock wave to travel this distance is 100 microsecond. If the velocity of sound under the same conditions is 340 ms^{-1}, find the Mach number of the shock wave. **(04 Marks)**

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CBCS Scheme

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15PHY12/22

First/Second Semester B.E. Degree Examination, June/July 2016
Engineering Physics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing one full question from each module.
2. Physical Constants: Planck's constant h = 6.63×10^{-34} JS, Mass of electron m = 9.11×10^{-31} kg, Boltzmann constant K = 1.38×10^{-23} JK^{-1}, Avogadro number $N_A = 6.025 \times 10^{26}$/K mol, Velocity of light C = 3×10^{8} ms^{-1}.

Module-1

1 a. Mention the assumptions of Planck's law. Arrive at the relation for Wien's law from Planck's law. **(06 Marks)**

b. State Heisenberg's uncertainty principle. Show that electrons cannot exist inside the nucleus. **(06 Marks)**

c. Calculate the deBroglie wavelength associated with neutron of mass 1.674×10^{-27} kg with one tenth part of the velocity of light. **(04 Marks)**

OR

2 a. What is phase velocity and group velocity? Show that group velocity is equal to particle velocity. **(06 Marks)**

b. Obtain normalized wave function, with respect to a particle inside an one dimensional potential well. **(06 Marks)**

c. An electron is bound in one dimensional potential well of width 0.18 nm. Find the energy value in eV of the second excited state. **(04 Marks)**

Module-2

3 a. Explain the failure of classical free electron theory. **(06 Marks)**

b. State law of mass action and derive the expression for electrical conductivity of a semiconductor. **(06 Marks)**

c. A superconducting tin has a critical field of 306 gauss at 0 K and 217 gauss at 2 K. Find the critical temperature of superconducting tin. **(04 Marks)**

OR

4 a. What is Fermi factor? Discuss the variation of fermifactor with temperature. **(06 Marks)**

b. Write a note on High temperature super conductors. **(06 Marks)**

c. Calculate the mobility of electrons in copper assuming that each atom contribute one free electron for conduction. Resistivity of copper = 1.7×10^{-8} Ωm, atomic weight = 63.54, density = 8.96×10^{3} kg/m^3. **(04 Marks)**

Module-3

5 a. Explain the construction and working of semiconductor laser. **(06 Marks)**

b. Discuss the three different types of optical fibres. **(06 Marks)**

c. The ratio of population of two energy levels out of which one corresponds to metastable state is 1.059×10^{-30}. Find the wavelength of light emitted at 330 K. **(04 Marks)**

OR

6 a. Describe the recording and reconstruction process in holography with the help of suitable diagrams. **(06 Marks)**

b. What is attenuation? Explain the factors contributing to the fibre loss. **(06 Marks)**

c. The refractive indices of the core and cladding of a step-index optical fibre are 1.45 and 1.40 respectively and its core diameter is 45 μm. Calculate its fractional refractive index change and numerical aperture. **(04 Marks)**

Module-4

7 a. Define unit cell. Derive the expression for the interplanar spacing in terms of Miller indices. **(06 Marks)**

b. Calculate the glancing angle for incidence of X-rays of wave length 0.058 nm on the plane (1 3 2) of NaCl which results in 2nd order diffraction maxima taking the lattice spacing as 3.81 Å. **(06 Marks)**

c. Calculate the atomic packing factor for SC, bCC and fCC. **(04 Marks)**

OR

8 a. Describe the construction and working of a Bragg's X-ray spectrometer. **(06 Marks)**

b. Explain the crystal structure of diamond with neat sketch and calculate its atomic packing factor. **(06 Marks)**

c. Monochromatic X-rays of wavelength 0.82 Å undergo first order Bragg reflection from a crystal of cubic lattice with lattice constant 3 Å at a glancing angle of 7.855°. Identify the possible planes which give rise to this reflection in terms of their Miller indices. **(04 Marks)**

Module-5

9 a. What is Mach number? Define subsonic and supersonic with Mach number and give example. **(06 Marks)**

b. Describe the synthesis of carbon nanotubes using Pyrolysis method. **(06 Marks)**

c. In a Reddy tube experiment, it was found that, the time taken to travel between the two sensors is 195 μs. If the distance between the two sensors is 100 mm, find the Mach number. **(04 Marks)**

OR

10 a. Describe the construction and working of Reddy's shock tube. **(06 Marks)**

b. Explain the structure of carbon nanotube. **(06 Marks)**

c. Calculate the wavelength of an electron accelerated under a potential difference of 100 V in scanning electron microscope. **(04 Marks)**

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15PHY12/22

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Engineering Physics

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer FIVE full questions, choosing one full question from each module.*
2. *Physical constants : Velocity of light, $c = 3 \times 10^8$ m/s; $h = 6.625 \times 10^{-34}$ J-S; $k = 1.38 \times 10^{-23}$ J/K; $N_A = 6.02 \times 10^{28}$/Kmole; $m_e = 9.1 \times 10^{-31}$ kg; $e = 1.6 \times 10^{-19}$ C.*

Module-1

1 a. Define phase velocity and group velocity. Derive an expression for group velocity interms of phase velocity. **(05 Marks)**

b. What is wave function? Set up time-in-dependent Schrodinger's wave equation in one dimension. **(07 Marks)**

c. A spectral line of wavelength 5896 Å has a width of 10^{-5} Å. Evaluate the minimum time spent by the electrons in the upper energy state between the excitation and de-excitation processes. **(04 Marks)**

OR

2 a. What is a blackbody? Explain energy spectrum of a Blackbody. **(05 Marks)**

b. Obtain energy values and normalized wave function, with respect to a particle in an one dimensional potential well of infinite height. **(07 Marks)**

c. Compare the energy of a photon with that of an Neutron when both are associated with a wavelength 0.25 nm, mass of neutron is 1.675×10^{-27} kg. **(04 Marks)**

Module-2

3 a. State law of mass action and derive the expression for electrical conductivity of a semiconductor. **(05 Marks)**

b. Write a note on high temperature superconductors and Maglev vehicles. **(07 Marks)**

c. Gold has one free electron/atom. Its density, atomic weight and resistivity are 19300 kg/m^3, 197 and 2.21×10^{-8} Ωm. Calculate the free electron concentration and mobility of conduction electron. **(04 Marks)**

OR

4 a. What is Fermi factor? Discuss the variation of Fermi factor with temperature. **(05 Marks)**

b. What are the assumptions of quantum free electron theory? Derive the expression for electrical conductivity based on quantum free electron theory. **(07 Marks)**

c. Calculate the drift velocity and thermal velocity of conduction electrons in copper at a temperature of 300 K, when a copper wire of length 2 m and resistance 0.02 Ω carries a current of 15 A. Given the mobility of free electrons in copper is 4.3×10^{-3} m^2/V.S. **(04 Marks)**

Module-3

5 a. Explain the construction and working of a semi-conductor laser. **(06 Marks)**

b. Explain three different types of optical fibers with neat diagrams. **(06 Marks)**

c. A pulsed laser emits photons of wavelength 820 nm with 22 mW average power/pulse. Calculate the number of photons contained in each pulse, if the pulse duration is 12 ns. **(04 Marks)**

OR

6 a. Derive the expression for energy density of radiation interms of Einstein's coefficients. **(06 Marks)**

b. What is attenuation? Explain factors contributing to the fiber losses. **(06 Marks)**

c. A glass clad fiber is made with core glass of refractive index 1.5 and cladding is doped to give a fractional index difference of 0.0005. Determine the cladding index and numerical aperture. **(04 Marks)**

Module-4

7 a. Derive the expression for interplanar spacing interms of Miller Indices. **(05 Marks)**

b. Describe how Bragg's spectrometer is used to determine the crystal structure. **(07 Marks)**

c. Draw the following planes in a cubic unit cell.

i) (001) ii) $(1\bar{1}\ 0)$ iii) (1 1 2) iv) (0 2 0). **(04 Marks)**

OR

8 a. Define Allotropy and polymorphism with examples. **(05 Marks)**

b. What are lattice parameters? Explain seven crystal systems. **(07 Marks)**

c. Find the Miller indices of a set of parallel planes which make intercepts in the ratio 3a:4b and parallel to z-axis and also calculate the interplanar distance of the planes taking the lattice to be cubic with a = b = c = 2Å. **(04 Marks)**

Module-5

9 a. What is Mach number? Explain experimental method of finding Mach number of a shock wave by Reddy Shock tube. **(06 Marks)**

b. Describe arc discharge method of obtaining carbon nano tubes with the help of a diagram. **(06 Marks)**

c. Distinguish between acoustic, ultrasonic, subsonic and supersonic waves. **(04 Marks)**

OR

10 a. Discuss the basis of laws of conservation of energy, mass and momentum. **(07 Marks)**

b. Discuss the structure and properties of carbon nano tubes. **(05 Marks)**

c. Explain Sol-gel method of preparing nanomaterials. **(04 Marks)**

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15PHY12

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Engineering Physics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing one full question from each module.

2. Physical Constants: Velocity of light, $c = 3 \times 10^8$ ms^{-1}
Planck's constant, $h = 6.625 \times 10^{-34}$ JS
Mass of electron, $m = 9.1 \times 10^{-31}$ kg
Boltzmann constant, $K = 1.38 \times 10^{-23}$ JK^{-1}
Avogadro number, $N_A = 6.02 \times 10^{26}$/Kmol.

Module-1

1 a. Show that Planck's law reduces to Wein's law and Rayleigh-Jeans law at lower and higher wavelength limits respectively. **(06 Marks)**

b. Setup time independent Schrodinger wave equation in one dimension. **(06 Marks)**

c. A particle of mass 940 MeV/c^2 has kinetic energy 0.5 KeV. Find its de-Broglie wavelength, c is velocity of light. **(04 Marks)**

OR

2 a. Define phase velocity and group velocity. Obtain the relation between them. **(06 Marks)**

b. Using Heisenberg's uncertainty principle, prove that electrons cannot exist in a nucleus. **(06 Marks)**

c. The first excited state energy of an electron in an infinite well is 240 eV. What will be its ground state energy when the width of the potential well is doubled? **(04 Marks)**

Module-2

3 a. What is Fermi energy? Discuss the probability of occupation of various energy states by electron at T = 0K and T ≥ 0K on the basis of Fermi factor. **(06 Marks)**

b. What is Meissner's effect? Explain Type-I and Type-II super conductors. **(06 Marks)**

c. The effective mass for the electron in germanium is 0.55 m_0, where m_0 is the free electron mass. Find the electron concentration in Germanium at 300 K, assuming that the Fermi level lies exactly in the middle of the energy gap, given that the energy gap for Germanium is 0.66 eV. **(04 Marks)**

OR

4 a. Explain the success of quantum free electron theory. **(06 Marks)**

b. Explain the law of mass action and derive the expression for electrical conductivity of a semiconductor. **(06 Marks)**

c. Find the relaxation time of conduction electrons in a metal of resistivity 1.54×10^{-8} ohm-m, if the metal has 5.8×10^{28} conduction electrons per m^3. **(04 Marks)**

Module-3

5 a. Obtain an expression for energy density of radiation in terms of Einstein's coefficients. **(06 Marks)**

b. What is numerical aperture? Obtain an expression for numerical aperture in terms of refractive indices of core and cladding of an optical fiber. **(06 Marks)**

c. The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted at 330 K. **(04 Marks)**

OR

6 a. Explain construction and working of carbon dioxide laser device. **(06 Marks)**

b. With neat diagrams, explain different types of optical fibers. **(06 Marks)**

c. The attenuation of light in an optical-fiber is 2 dB/km. What fraction of its initial intensity remains after (i) 2 km, (ii) 5 km? **(04 Marks)**

Module-4

7 a. Define lattice points. Explain the crystal structure of diamond with neat sketch. **(06 Marks)**

b. Illustrate the procedure to find miller indices of a given plane and calculate the atomic packing factor for FCC. **(06 Marks)**

c. A beam of x-ray with wavelength 1.5 A; undergoes second order Bragg's reflection from the plane (211) of cubic crystal at glancing angle 54.38°. Calculate the lattice constant. **(04 Marks)**

OR

8 a. What is Bravais lattice? Obtain an expression for the interplanar spacing of planes in terms of Miller indices for cubic lattice. **(06 Marks)**

b. Describe the construction and working of a Bragg's x-ray spectrometer. **(06 Marks)**

c. Draw the following planes in a cubic unit cell:

i) (1 0 2) ii) (1 1 2) iii) (2 0 0) iv) (1 $\bar{1}$ 0) **(04 Marks)**

Module-5

9 a. Describe the construction and working of Reddy's shock tube. **(06 Marks)**

b. What are nanomaterials? Write a note on sol-gel method of preparing nanomaterials. **(06 Marks)**

c. Define Mach number, subsonic waves, supersonic waves and Mach angle. **(04 Marks)**

OR

10 a. Describe the principle, construction and working of a scanning electron microscope. **(06 Marks)**

b. Explain the structures and applications of Carbon nanotubes. **(06 Marks)**

c. The distance between the two pressure sensors in a shock tube is 150 mm. The time taken by a shock wave to travel this distance is 0.3 ms. If the velocity of sound under the same condition is 340 ms^{-1}. Find the Mach number of the shock wave. **(04 Marks)**

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15PHY12/22

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Time: 3 hrs. Max. Marks: 80

Note: **1.** ***Answer FIVE full questions, choosing one full question from each module.***
2. Physical Constants : Velocity of light, $c = 3 \times 10^8$ ms^{-1},
Planck's constant, $h = 6.625 \times 10^{-34}$ J.S,
Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg,
Avogadro number, $N_A = 6.02 \times 10^{26}$/Kmol,
Boltzmann constant, $k = 1.38 \times 10^{-23}$ J/K,
Charge of an electron, $e = 1.602 \times 10^{-19}$ C

Module-1

1 a. State Planck's radiation law. Show how Planck's law could be reduced to Wien's law and Rayleigh-Jeans law. **(07 Marks)**

b. State Heisenberg's uncertainty principle and show that electron does not exist inside the nucleus by this principle. **(05 Marks)**

c. Find deBroglie wavelength of a particle of mass 0.58 MeV/c^2 has a kinetic energy 90 eV, where c is velocity of light. **(04 Marks)**

OR

2 a. Using Schrodinger's time independent wave equation obtain eigen values and eigen function for a particle in a one dimensional potential well of infinite height. **(07 Marks)**

b. Define phase velocity and group velocity. Show that group velocity is equal to particle velocity. **(05 Marks)**

c. The inherent uncertainty in the measurement of time spent by Iridium – 191 nuclei in the excited state is found to be 1.4×10^{-10} s. Estimate the uncertainty that results in its energy in eV in the excited state. **(04 Marks)**

Module-2

3 a. Explain Meissner effect. Write any three differences between Type-I and Type-II superconductors. **(07 Marks)**

b. Explain the failure of classical free electron theory. **(05 Marks)**

c. For intrinsic Gallium Arsenide, the electric conductivity at room temperature is 10^{-6} ohm^{-1} m^{-1}. The electron and hole mobilities are respectively 0.85 m^2/V.S and 0.04 m^2/V.S. Calculate the intrinsic carrier concentration at room temperature. **(04 Marks)**

OR

4 a. State law of mass action. Obtain an expression for electrical conductivity of semiconductors. **(07 Marks)**

b. Explain the BCS theory of super conductivity. **(05 Marks)**

c. Calculate the probability of finding an electron at an energy level 0.02 eV above Fermi level at 200 K. **(04 Marks)**

Module-3

5 a. Describe construction and working of carbon dioxide laser with suitable diagrams. **(07 Marks)**

b. Obtain an expression for the numerical aperture of an optical fiber. **(05 Marks)**

c. Find the ratio of population of two energy levels in a medium at thermal equilibrium, if the wavelength of light emitted at 291 K is 6928 Å. **(04 Marks)**

OR

6 a. Describe the recording and reconstruction process in holography with the help of suitable diagrams. **(07 Marks)**

b. Discuss point to point optical fiber communication system. **(05 Marks)**

c. Calculate the numerical aperture and angle of acceptance for an optical fiber having refractive indices 1.563 and 1.498 for core and cladding respectively. **(04 Marks)**

Module-4

7 a. Describe briefly the seven crystal systems. **(07 Marks)**

b. Describe with a neat diagram the crystal structure of diamond. **(05 Marks)**

c. Draw the crystal planes (102) (111) (011) and (002) in a cubic crystal. **(04 Marks)**

OR

8 a. Define atomic packing factor. Calculate the atomic packing factor for sc, bcc and fcc structures. **(07 Marks)**

b. Describe the construction and working of a Bragg's x-ray spectrometer. **(05 Marks)**

c. An x-ray beam of wavelength 0.7 Å undergoes first order Bragg's reflection from the plane (302) of a cubic crystal at glancing angle 35°, calculate the lattice constant. **(04 Marks)**

Module-5

9 a. Explain Ball Milling method of synthesis of nano materials. **(06 Marks)**

b. Describe hand operated Reddy shock tube with diagram. **(05 Marks)**

c. Define shock waves. Mention its applications. **(05 Marks)**

OR

10 a. Explain the working of SEM with the help of a neat diagram. **(07 Marks)**

b. Mention Rankine-Hugonit shock equations and expand the terms. **(05 Marks)**

c. Write any four applications of carbon nano tubes. **(04 Marks)**

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