Public Service Commission
Muzaffarabad Azad Kashmir Date 15-12-2015

Paper Physics

Attempt any Five Questions Assistant Professor (BS 18) Time Allowed: 3 hrs Marks = 100

Q#1a) What are constraints? Classify them. Discuss the type of difficulties offered by constraints, while seeking the solution of mechanical problems. What will be the remedial procedure for solving these problems in case of holonomic and non-holonomic constraints? 14

b) A simple method to model the cooling or heating of an object placed in a constant ambient temperature is to say that the time rate of change in temperature is proportional to the difference between the temperature A of the surrounding medium (the ambient temperature) and the temperature T of the object: 6

$$\frac{dT}{dt} = k\,(A - T\,(t)) \text{ for } k > 0$$

For initial conditions $T(0) = T_0$ solve the above equation analytically to obtain the solution $T = A + (T_0 - A)e^{-kt}$

Q#2a) Show that the expression [Ae^{ikx} + Be^{-ikx}], [C coskx+ D sin kx]. [Fcos(kx+α)], [G sin(kx+β)], are equivalent ways of writing the same function of x, and determine the constants C, D, F, G, α, and β in terms of A and B. (Remember in quantum mechanics, with V=0, the exponentials give rise to travelling waves, and are most convenient in discussing the free particles, whereas sines and cosines corresponds to standing waves.) Assume the function is real. 6

b) During the last decade of the twentieth century and since, there has been increasing interest in the application of quantum physics to the processing of information – in computers for example. Discuss in detail applications of quantum mechanics like, QUANTUM cryptography and Quantum teleportation. 14

Q#3a) Show that the kinetic energy of a three dimensional gas of N free electrons at 0 K is 10

$$U_0 = \frac{3}{5} N \varepsilon_F$$

b) The equation of motion of the plane s is given as

$$M\frac{d^2u_s}{dt^2} = C(u_{s+1}+u_{s-1}-2u_s)$$

Where M is the mass of an atom and C is force constant between nearest neighbor planes. Show that for the long wavelengths the above equation of motion reduces to the continuum elastic wave equation, 10

$$\frac{\partial^2 u}{\partial t^2} = V^2\frac{\partial^2 u}{\partial x^2}$$

Where v is the velocity of sound.

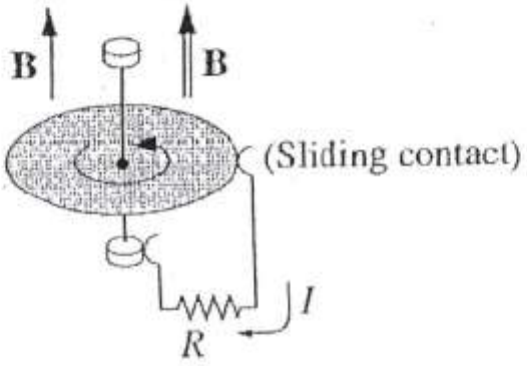
Q#4. Discuss Neutron Sources (spontaneous fission, photo neutron (¥,n) sources). 14

b) A μ^{-1} meson has a charge of -4.8×10^{-10} sC and a mass 207 times that of a resting electron. If a proton should capture a μ^{-1} to form a "mesic" atom, calculate 6
(a) the radius of the first Bohr orbit and
(b) the ionization potential.

Q#5a Drive following formula for energy stored in magnetic field, and also compared it with its counterpart in electrostatics. 12

$$W=\frac{1}{2\mu_0}\int_{all\ space} B^2\ d\tau$$

b) A metal Disk of radius 'a' rotates with angular velocity 'ω' about a vertical axis, through a uniform filed **B**, pointing up. A circuit is made by connecting one end of a resistor to the axle and the other end to a sliding contact, which touches the outer edge of the disk (see Figure below). Find Current in the resistor. 8



Q#6a) *Discuses integrated Circuits while focusing on types, kinds and process (especially wafer preparation, epitaxial growth, isolation diffusion, Base diffusion, emitter diffusion, pre-ohmic etching and Metallization, checking and dicing, Mounting and Packing) involved in ICs fabrications.* 12

b) *A faint star is just visible if 2000 photons/sec enters the eye. What energy per second (in watts) this represents interms of sodium light is given below (λ = 5890 Å). (h = 6.63 ×10^{-34} joule-sec and c = 3 × 10^{8} m/sec).* 4

c) Solar radiation falls on the earth at a rate 1340 watt/m^2 on a surface normal to the incoming rays. Assuming that sunlight consists exclusively of 5500 Angstrom photons, find the volume of photons per meter^2 per second that are reaching the earth. 4

Q#7a) As we know that the splitting of spectral lines when an atom is placed in an external magnetic field was looked for by Faraday, predicted on the basis of classical theory by Lorentz, and first 12

observed by Zeeman. In quantum mechanics, a shift in the frequency and wavelength of a spectral line implies a shift in the energy level of one or both of the states involved in the transition. Discuss in detail the effect that occurs for spectral lines resulting from a transition between singlet states (traditionally called the normal Zeeman Effect, along with that which occurs when the total spin of either the initial or final states, or both, is nonzero (traditionally called the anomalous Zeeman effect).

b) *The magnetic field of the Sun and stars can be determined by measuring the Zeeman-effect splitting of spectral lines. Suppose that the sodium D_1 line emitted in a particular region of the solar disk is observed to be split into the four-component Zeeman effect . What is the strength of the solar magnetic field B in that region if the wavelength difference between the shortest and the longest wavelengths is 0.022 nm? (The wavelength of the D_1 line is 589.8 nm.)* 8

Q#8) Give reasons A radioactive isotope has a half-life of 16 days. You wish to have 30 g at the end of 30 days. How much radioisotope should you start with?

b) Why bridges are usually supported with ropes in the form of parabola.

c) What are the reasons for production of cosmogenic radionuclide's, especially radiocarbon in atmosphere.

d) Justify the statement "Whenever fission of heavy atom occurs, probability of fission fragments with intermediate masses in periodic table is more as compared to the probability of lighter fission fragments". (4,4,4,4,4,)

e) Give at least two reasons in support of claim that electron cannot reside within nucleus of an atom