

Studies of magnetization and related properties for hard type-II superconductors

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Abstract : Magnetization and the related properties of type-II superconductor are studied in the framework of Critical State Model. We categorized the solvable sample geometries into three possible solvable classes and addressed some unsolved non-trivial problems in each of these three classes. Applications of these problems for realistic experimental situations are discussed. The theoretical results obtained have a good resemblance with the experimental results. A brief discussion of the earlier literature is also presented.

Keywords : Hard type-II superconductors, critical state model demagnetization factor, magnetization, anisotropy, ac susceptibility, higher harmonics.

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Sensitivity and selectivity of chemically modified nanosized SnO₂ based CO sensors

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Abstract : Among the various metal oxide additives, Bi₂O₃ is outstanding in promoting the sensing properties of SnO₂ element to CO gas in dry air. The structural characterizations of chemically modified nano-sized SnO₂ were performed by using XRD with different calcination temperatures. XRD pattern for 10 wt.% Bi₂O₃ doped SnO₂ calcined at 600°C, indicates complete phase formation and crystallite size was found to be 65 nm. The sensor has been characterized by d.c. electrical measurements for different gases such as CO, LPG, H₂S, and H₂ in dry air. The element of 10 wt.% Bi₂O₃ doped SnO₂ shows maximum sensitivity and selectivity for CO sensor at an operating temperature 225°C. Further improvement in the sensitivity was achieved by adding 1 wt.% Pd in 10 wt.% Bi₂O₃ : SnO₂ at an operating temperature 200°C for CO sensors. Sensitivity for 10 wt.% Bi₂O₃ doped SnO₂ with gas concentrations shows to increase linearly with gas concentration up to 600 ppm. It is observed that the gas has tendency to saturate at gas concentrations above 600 ppm.

Keywords : CO sensor, chemically modified SnO₂, Bi₂O₃, sensitivity, selectivity

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Studies on the temperature dependence of lattice energies of alkali chlorides, bromides and iodides

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Abstract : Lattice energies of LiCl, NaCl, KCl, RbCl, LiBr, NaBr, KBr, RbBr, CsBr, NaI, KI, RbI and CsI at different temperatures have been evaluated making use of the data of elastic constants of the single crystals and employing Kudriavtsev's theory. In all these alkali halides, the lattice energies are found to decrease with increase in temperature. At any given temperature, the lattice energy of LiCl > NaCl > KCl > RbCl, LiBr > NaBr > KBr > RbBr > CsBr, NaI > KI > RbI > CsI and RbF > RbCl > RbBr > RbI indicating that as the size of the alkali metal ion or halide ion increases, the lattice energy of the alkali halide crystal decreases. The results are discussed in the light of mutual interaction of the ions and increase in amplitude of lattice vibrations with temperatures.

Keywords : Lattice energy, ionic crystals, Kudriavtsev's theory, elastic constants.

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Dynamical behavior of photoinduced birefringence in DSR1-PMMA by using pulsed laser

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Abstract : Photoinduced birefringence in PMMA-DSR1 system has been investigated using Nd³⁺-YAG pulsed laser with wavelength of 532 nm which is in the near resonance with absorption line of trans isomer of azobenzene molecules. The effects of parameters such as pumping intensity, pulse repetition rate in the induced birefringence have been studied, using a probe He-Ne laser.

Keywords : Photoinduced birefringence, Nd³⁺-YAG pulsed laser, pumping intensity

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Study of NMR spin-lattice relaxation time and mutual viscosity in some substituted anilines

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Abstract : Experimental measurements of NMR spin-lattice relaxation time (T_1) of o-anisidine, p-anisidine, o-nitroaniline, o-chloroaniline, m-chloroaniline and p-chloroaniline have been reported. The values of NMR spin-lattice relaxation time (T_1) calculated using Bloembergen, Purcell and Pounds, (BPP) theory [Phys. Rev. 73 679 (1948)] are found to be 1/2 to 1/10 times of the experimental values. The author have used various equations of dielectric relaxation time (τ) for calculating T_1 to narrow down this gap. Experimental values of the mutual viscosity (η_{12}) of o-chloroaniline, m-chloroaniline and p-chloroaniline have been also reported. The small difference between the values of η_{12} and η_1 suggests that the basic model of the dielectric relaxation process does not suffer any major changes even when η_{12} is used instead of η_1 . It has been concluded that the Murty equation gives better representation of the dielectric relaxation phenomenon.

Keywords : Spin-lattice relaxation time, dielectric relaxation time, mutual viscosity.

PACS Nos. : 76.60.Es, 77.22.Gm, 66.20.+d.

Higher harmonics electrostatic ion – cyclotron instability with perpendicular AC electric field

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Abstract : Electrostatic ion – cyclotron long wave length instability has been studied for higher harmonics with perpendicular AC electric field. Harmonics – dependent current – driven oblique propagating electrostatic ion – cyclotron instability (EICI) has been studied with density gradient in the region of ionosphere.

Keywords : Higher harmonics, electrostatic ion – cyclotron instability

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Covariation of f_0F_2 and three solar indices

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Abstract : Covariation of critical frequency (f_0F_2) of F_2 -layer of the terrestrial ionosphere with three important solar parameters, namely relative sunspot number, 2800 MHz solar flux and solar flare number has been investigated and the following results have been obtained; (i) Strong correlation exists between the critical frequency and each of the three solar parameters. (ii) Critical frequency of F_2 -layer increases nonlinearly with solar parameters reaching a maximum at sunspot maximum. (iii) Empirical equations connecting critical frequency of F_2 -layer with solar parameters have been derived by applying least-square method of curve-fitting which gives values of critical frequency of F_2 -layer very close to the experimentally obtained values of the same.

Keywords : Ionospheric parameters, solar indices.

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Optical absorption and electrical properties of polyvinyl alcohol (PVA)-gelatin blend

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Abstract : The optical absorption, real (ϵ') and imaginary parts (ϵ'') of the dielectric constant, dc conductivity (σ), and I-V characteristics of polyvinyl alcohol (PVA)-gelatin blend were investigated in the temperature range of 290 to 460 K. The identification of the structure and assignments of energy bands were derived in terms of the ligand field theory. The main absorption band at 244 nm, was affected by the gelatin concentration. Two relaxation processes namely τ_a and τ_c were obtained at the glass-rubber transition temperature T_g . The first one is due to the rotation of free C=O and NH₂ groups inside the amorphous part of PVA while the second one is due to the rotation of the conjugate of C=O groups and semi-crystalline structure on PVA. The calculated values of the activation energies provide us the information about the presence of ionic conduction. At 303 K the conduction mechanism is Ohmic because there is no injection carriers from the electrode contact, while Richardson-Schottky (RS) effect is predominant in the second region at $T \approx 333$ K.

Keywords : Polyvinyl alcohol-gelatin blend, optical absorption, electrical properties.

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Role of thermal anisotropy in VLF signal reception on ground

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Abstract : In an experiment conducted at Siple, Antarctica on Jan 23–24, 1988, VLF signals in the frequency range of 1900–2900 Hz were transmitted to the conjugate point Lake Mitsissini, Canada. Surprisingly, receiving station could not record arrival of signals above 2400 Hz though theoretical cut-off in this case has a value of ~ 3.3 kHz corresponding to the line of propagation of 63.7° geomagnetic latitude ($L = 5.1$) as it is well known that upper cut-off always occurs at $f = 0.5 f_H$ [f is the wave frequency and f_H is the electron gyrofrequency]. Sonwalkar et al [J. Geophys. Res. 102 14363 (1997)] analysed these VLF signals and attributed non-reception of such signals to unavailability of sufficient number of energetic electrons. Extending the work of Sonwalkar et al, pitch angle diffusion of electrons along with amplification of interacting VLF signals is studied at $L = 5.1$. Our analysis provides an explanation of non-reception of $f \leq 2.5$ kHz signals in terms of scarcity of suitable thermal anisotropy, $A(E_r)$.

Keywords : Cyclotron resonance, wave growth, thermal anisotropy.

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Molecular interaction studies in the ternary mixture of methanol + benzene + cyclohexane

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Abstract : The values of sound velocity, density and viscosity have been measured at 308 K in the system methanol + benzene + cyclohexane. From these data, acoustical parameters such as adiabatic compressibility, free length, free volume and internal pressure have been estimated using the standard relations. The deviations of the sound velocity from that of experimental values are obtained using Nomoto's relation (NR), ideal mixing relation (IMR), free length theory (FLT), collision factor theory (CFT) and Nutsch-Kuhnies (NK) method. The results are interpreted in terms of molecular interaction between the components of the mixtures. Methanol is found to be a good structure breaker that breaks the cyclohexane-benzene complexes. The excess values obtained confirms the presence of weak interaction in the system.

Keywords : Ultrasonic velocity, acoustic parameters, dipolar and dispersive interactions.

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Stationary axisymmetric one-soliton solutions of Einstein field equations

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Abstract : In the paper, we construct one-soliton solutions of Einstein's equations for an axisymmetric stationary line element. The generated solutions are not, in general, asymptotically flat. However, at the equator the solutions are found to be spatially well-behaved at infinity. When some restrictions are imposed on the constants, the solutions reduce to the solutions of Verdaguer [J. Phys. A15 1261 (1982)], Letelier [J. Math Phys. 26 467 (1985)], Van Stockum [Proc. Royal Soc. (Edinburg) A57 135 (1937)] and Weyl [Ann. Phys. (Leipz) 54 117 (1917)].

Keywords : General relativity, exact solutions, soliton technique, one-soliton solutions.

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Filamentation instability of an electromagnetic waves in an expanding homogeneous plasmas

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Abstract : A high intensity laser beam propagating at an angle to the flow velocity $\vec{U}_0$ of a moving plasma is susceptible to filamentation instability. The nonlinearity arises through the ponderomotive force and the growth rate is sensitive to the angle between $\vec{k}$ and $\vec{U}_0$ and the ratio of the expansion velocity to the sound speed. The motion of the plasma introduces finite real frequency to the low frequency ion-quasimode.

Keywords : Filamentation instability, ponderomotive force, expanding plasma.

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Dielectric behaviour of powdered samples in pellet form at microwave frequencies

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Abstract : The dielectric relaxation behaviour of powdered PVC and its pellets is studied at fixed temperature (35°C) and microwave frequency 9.67 GHz. Dielectric parameters ϵ' , ϵ'' , relaxation time τ and conductivity σ of both types of samples are determined. By using measured data, work on pellets is reported under two conditions. First, these pellet samples are prepared under constant external pressure by varying weight of powdered sample in steps of 0.5 gm. In the second case, weight of powdered sample is kept constant and pellets are prepared by applying different pressures. Based upon measured results, several conclusions are drawn.

Key words : Pellets, dielectric parameters, relaxation time.

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