

Theoretical determination of reflectance of materials

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Abstract : The spectral emittance of a material at ambient temperature can be derived from its spectral reflectance and spectral transmittance. In order to compute easily both the spectral specular reflectance and spectral diffuse reflectance of the material from its optical constants, a computer code is developed. The details of the code are discussed here.

Keywords : Emittance, reflectance, transmittance, absorptance.

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Formation of simple bio-molecules during collapse of an interstellar cloud – a preliminary analysis

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Abstract : More than 120 molecules have been observed in molecular clouds, more than half of which are organic. Some of them, especially those which contain C and N are important because they could be the pre-cursors of more complex bio-molecules. We explore the possibilities of formation of these molecules during interstellar cloud collapse and star formation. During collapse, the density and temperature of the gas increase, thereby increasing the reaction rates of the constituent atoms and molecules. Presence of grains and metallic catalysts may increase the reaction rate further. We therefore discuss in details the effects of grains in forming H₂ molecules in the cloud. We show how the mass fraction of simple molecules such as HCN, H₂O, NH₃ etc. varies with radial distance of a collapsing cloud.

Keywords : Molecular clouds, star formation, bio-molecules.

PACS Nos. : 98.38.Dq, 97.10.Bt, 87.15.Rn

Photon tunneling and light coupling to planar slab waveguides

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Abstract : We show that the guided modes from one slab waveguide in the optical integrated circuits (OIC) can be coupled and diffused to another slab waveguides due to photon tunneling while it is forbidden in normal classical treatment. Using this idea, we can estimate and evaluate the crosstalk level in another optical channel and design the suitable and optimal distance between two waveguides for small and determinable coupling rate. The Helmholtz wave equation has been used to calculate the crosstalk level and transit time during coupling.

Keywords : Light coupling, photon tunneling, crosstalk level, optical intergrated circuits.

PACS Nos. : 42.50.Dv, 42.82.Et

Latitudinal variations of strength of ionospheric response and its correlation with intensity of magnetic storms

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Abstract : A study has been made to investigate the latitudinal variations of the 'strength of the ionospheric response' to positive and negative weak as well as major magnetic storms by considering low (Ramey), mid (Sagamore Hill) and high (Goose Bay) latitude stations during the years 1980-81. The nature of the correlation that exists between the strength of the response and intensity of positive and negative magnetic storms at various latitudes has also been checked. In the case of weak and major positive storms, the lowest strengths of response are shown respectively by the mid and high latitude stations, while the highest strength of response, for both categories of storms, is shown by the low latitude station. For weak and major negative storms, the lowest strengths of response are again shown respectively by the mid and high latitude stations; in contrast, the highest strengths are exhibited respectively by the high and mid latitude stations. The strength of the response during major positive storms, in general increases with decreasing latitude. A positive correlation was found to exist between the strength of the response and the intensity of storms during weak and major positive storms for the low latitude station, Ramey. A similar trend was also seen for low and mid latitude stations during major negative storms. However, in the case of weak negative storms, a negative correlation was found to exist between the strength of the response and the intensity of storms for all the three latitudes, contrary to the previous studies for low latitudes during negative storms. Also, a negative correlation is observed between the intensity and time delay for maximum ionospheric response, in the case of positive weak storms for low latitude and negative weak storms for high latitude.

Keywords : Magnetic storms, ionospheric response, latitudinal variations.

PACS Nos. : 94.30.Lr, 94.20.-y

Spectroscopic studies of some aliphatic alcohols

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Abstract : Spectra of a number of aliphatic alcohols (pure as well as diluted with hexane and CCl_4) have been studied in the 500–14000 cm^{-1} region. In addition to the fundamental and overtone bands of CH and OH stretch vibrations, a large number of combination bands involving different frequencies have been observed. Vibrational constants for the CH and for free as well as associated OH stretch vibrations have been determined. It is found that where as the peaks due to CH stretch remain almost unchanged in magnitude on dilution, the peaks due to OH vibration show a blue shift. The blue shift decreases in the higher overtones in the case of CCl_4 diluted sample but remains nearly constant in the case of hexane diluted sample. This has been explained as due to the formation of $\text{OH}\cdots\text{Cl}$ bond. The combination bands were explained in terms of local-normal and normal-normal combinations.

Keywords : Associated and free OH peak, blue shift, intermolecular hydrogen bonding, local-normal and normal-normal combinations.

PACS Nos. : 78.30.Jw, 33.20.Ea, 33.20.Tp, 42.65.Ky

Energy and amplification of whistler mode wave

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Abstract : Parallel resonance energy and wave growth/damping of the electrons in the magnetosphere at various frequencies for different L -values have been computed for whistler mode wave in the presence of thermal velocity and parallel electric field. The resonance energy of the electron decreases with wave frequency as well as with L -value. The wave growth/damping depends on the nature of the dc electric field present in the Earth's magnetosphere.

Keywords : Parallel resonance energy, wave-particle interaction, whistler-mode wave, wave growth/damping.

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Thermodynamics of 2- and 3-cyanopyridine from vibrational spectra

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Abstract : The various thermodynamic functions, namely, the heat capacity, the enthalpy, the entropy and free energy of 2- and 3-cyanopyridine have been computed in the temperature range 200–1500 K by using the standard expressions at 1 atmospheric pressure under the rigid rotator harmonic oscillator approximation.

Keywords : Vibrational spectra, thermodynamic functions.

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Dielectric relaxation studies of binary mixtures of acetone and N-methylformamide in the benzene solutions using microwave absorption data

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Abstract : Dielectric relaxation times (τ) and the dipole moments (m) of the binary mixtures of different molar concentrations of acetone (CH_3COCH_3) in the binary mixtures of acetone and N-methylformamide (NMF) in benzene solutions have been calculated by using standard standing wave microwave techniques and Gopala Krishna's single frequency (9.88 GHz) concentration variational method at different temperatures (25°C, 30°C, 35°C, 40°C). The dielectric relaxation process have been found to be an activated process. The energy parameters (DH_e , DF_e , DS_e) for the dielectric relaxation process of binary mixtures containing 50% mole-fraction of acetone have been calculated at the respective given temperatures and the comparison has been made with the corresponding energy parameters (DH_h , DF_h , DS_h) for the viscous flow. On the basis of the observations, it is found that the dielectric relaxation process can be treated as the rate process like the viscous flow process. Solute-solute and solute-solvent molecular associations have been predicted.

Keywords : Dielectric relaxation binary mixtures (acetone + NMF), microwave absorption.

PACS Nos. : 77.22.Gm, 31.70.Dk

Infrared-radiofrequency double resonance spectrometer : an unique machine to probe excited vibrational states

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Abstract : The construction of an Infrared-Radiofrequency Double Resonance (IR-RF DR) spectrometer to study 'pure' nuclear quadrupole hyperfine spectra in the ground and excited vibrational state of a molecule in the gas phase is presented. An indigenously built CO₂ laser was used as the Infrared radiation source. The spectrometer has been used to observe 'pure' nuclear quadrupole hyperfine spectra of methyl iodide (CH₃I), a symmetric top molecule with a single quadrupole nucleus.

Keywords : Molecular spectroscopy, quadrupole hyperfine spectra, excited state.

PACS Nos. : 33.20.Bx. 33.15.Pw

Electromagnetic waves in a partially ionized dusty plasma

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Abstract : The propagation of low-frequency electromagnetic waves in a partially ionized, self-gravitating magnetized dusty plasma has been theoretically studied. The electromagnetic waves having the wavelength of the order of a few AU and the frequency of the order of the order of 10^{-12} s^{-1} are found to be unstable due to the effect of the self-gravitational force acting on the dust grains. On the other hand, the electromagnetic waves having relatively high-frequency ($\sim 10^{-5} \text{ s}^{-1}$) are found to be damped due to the effect of the collisions of the plasma particles (namely, the electrons, the ions and the dust grains) with the background neutrals. The effects of the obliqueness of the wave propagation, the background neutral number density, the dust grain mass density, *etc.* are also observed to significantly modify the dispersion properties of such obliquely propagating electromagnetic waves. The present investigation may be of relevance to the formation of stars in galaxies via the fragmentation of partially ionized dusty plasma systems.

Keywords : Dusty plasma, electromagnetic waves, dispersion properties, gravitational instability.

PACS Nos. : 52.35.Bj, 52.27.Lw, 52.25.Xz, 97.10.Bt

Elemental analysis of anti-diabetic medicinal plants using energy dispersive X-ray fluorescence technique

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Abstract : A quantitative energy dispersive X-ray fluorescence method, based on molybdenum target, applicable to plant samples, is described in this work. The results obtained from the elemental analysis of leaves of eleven different plants commonly used for curing diabetes mellitus in eastern India are also presented. The elements K, Ca, Fe, Cr, Mn, Cu, Zn, Rb, Sr and Pb are identified and quantified simultaneously in these leaf samples. Concentration of these elements shows variation in their proportions. Among these elements, potassium and calcium have been estimated in percentage level whereas other elements are quantified in ppm level.

Keywords : Diabetes mellitus, energy dispersive X-ray fluorescence, medicinal plants, trace elements.

PACS Nos. : 87.15.Mi, 82.80.Ej, 78.70.En

Experimental study of eight element circular array of circular patch antenna

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Abstract : Experimental analysis of eight element circular array of circular patch antenna is proposed for X-band of microwave frequency range. Radiation characteristics are measured and plotted. The far-zone field expressions for the array geometry are derived using vector wave function technique and pattern multiplication approach. The total field patterns are compared with the computed plots. Other important antenna parameters like Voltage Standing wave ratio and gain are also measured and plotted. The results are useful for phased array antenna systems in mobile communication.

Keywords : Microstrip antenna, VSWR, radiation properties.

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Lazy dynamics of unfolding and ligand interaction – signatures in hemoglobin and its glycated form

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Abstract : The dynamics of unfolding of hemoglobin (Hb) and its glycated form (GHb) have been studied. The temporal profile of the wavelength maxima in the Q band of Soret region (408–420 nm) showed a characteristic periodic dynamics. Typically, an irregular periodic behavior, a staircase like profile or a combination of the two was observed. The time scale associated with unfolding was of the order of seconds. Multiple possible liganded states of heme and heme dependent incremental alterations in the quaternary structure are proposed to cause such sluggish periodic behavior. The mechanism of protein unfolding, unlike the folding process is an important cellular event in protein transport, but has got lesser attention in literature. Further exploration in the dynamical features of unfolding, as described in the present work, can lead to deeper understanding of the regulation of unfolding and it can also provide an indirect insight of the reversible steps in the folding process.

Keywords : Protein unfolding, glycation, hemoglobin, dynamics.

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Magnetovac solutions of the static Einstein-Maxwell equations

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Abstract : Magnetostatic solutions of Einstein-Maxwell field equations for a mass possessing a magnetic dipole moment are constructed by the method developed by Gutsunaev and Manko [*Gen. Rel. Grav.* **20** 327 (1988); *Phys. Lett. A***132** 85 (1988)]. The generated solutions are well behaved at spatial infinity. However, in absence of magnetic field, the solutions do not reduce to the Schwarzschild metric.

Keywords : General relativity, Einstein-Maxwell equation, magnetovac solutions.

PACS Nos. : 04.20.Jb, 04.20.Cv

Laboratory studies on the effect of external electric fields and discharges on charge transfer during ice-hail collision

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Abstract : Laboratory experiments have been carried out in a walk-in cold room to investigate the effect of uniform and radial electric fields and electrical discharges on charge transfer during collision between ice crystal and graupel (soft-hail). It has been found from these experiments that the average size of crystal decreases with the increasing electric field. However, when discharges are applied to the cloud the ice crystal size is larger. It is also seen that the charge transfer value is always high for low electric field and less for high electric field. The charge transfer values after a discharge has taken place in the cloud are higher. It is also observed that the ratio of ice crystal to water droplet is an important parameter for thunderstorm electrification. If the ratio is high then charge transfer values are less and if the ratio (<1) is small, charge transfer values are more.

Keywords : Thunderstorm electrification, charge transfer, electric field, electric discharge.

PACS Nos. : 92.60.Pw, 92.60.Nv

Magnetic field generation by ion acoustic waves in an inhomogeneous plasma with temperature gradient

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Abstract : An ion acoustic wave propagating perpendicular to the temperature gradient in plasma produces an oscillatory magnetic field via the $\tilde{N}n \times \tilde{N}T$ mechanism. For a 1 Kev plasma of density $\sim 10^{21} \text{ cm}^{-3}$, having temperature scale length $L_T \sim 35 \text{ mm}$, ion acoustic density perturbation $\sim 3\%$ and wave frequency $= 10^{11} \text{ rad sec}^{-1}$. One obtains oscillatory magnetic field $B \sim 30 \text{ KG}$. This magnetic field is large to influence plasma phenomena.

Keywords : Ion acoustic wave, inhomogeneous plasma, temperature gradient, magnetic field.

PACS Nos. : 52.38.Hb, 52.20.Hv, 78.20.Ci

Structural diversity in Cumin seeds (*Cuminum cyminum* L.) using SEM and AFM

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Abstract : Seeds of *Cuminum cyminum* L. were collected from two states of India, Gujarat and West Bengal. The ecological conditions of the two states are quite different and the quantity of the crop production is also different. The microstructural analysis of the two strains (each 30 in number) was done by Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM) after the same period of time following harvesting. Both the high resolution microscopy techniques reveal specific differences at different levels between the two varieties of the seed. Seed structures which have been analysed under high resolution microscope clearly show the difference in development of furrows and ridges. The papillose hairs are quite dissimilar in length and structure as evident from the SEM images. The topographic and phase images of AFM are significantly different in the two varieties of seeds.

Key words : Cumin seed, microstructure, SEM, AFM.

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Radiosonde studies of microwave attenuation and water vapour — a review

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Abstract : Microwave absorption due to water vapour has been studied. This paper deals with the modelling of meteorological parameters as well as the attenuation coefficient due to water vapour at the weak water vapour resonance line. The corresponding microwave brightness temperature has been related with water vapour content at Kolkata. The result has then been compared to those obtained at New Delhi.

Responses in finding water vapour distribution with frequency in terms of water vapour weighting function have been discussed along with those obtained at Antarctica. A special effort has been extended in finding the effect of water vapour in oxygen absorption band which appears to be a major factor to the communication engineers.

Keywords : Microwave absorption, water vapour, radiosonde.

PACS Nos. : 84.40.-x, 92.60.-e
