Raman Spectroscopy

Session 1: 40 pts

1. CO_2 and H_2O
    a) Sketching of CO_2 and H_2O molecules **2 pts (1 pt for each molecule)**
    b) Identification of the O-H and C=O stretching modes **3 pts (1.5 pt for each bond)**
    c) Analysis of *symmetric* and *antisymmetric* modes of the O-H and C=O vibrations **5 pts (2.5 pts for each bond)**
    d) Identification of natural frequency of oscillation of O-H and C=O bonds **3 pts (1.5 pt for each bond)**
    e) Discussion on the difference in the number of degenerate angular vibration modes between CO_2 and H_2O **2 pts**
2. CH_4
    a) Identification of each mode for CH_4 **3 pts**
    b) Discussion on degeneracy of each mode **2 pts**
    c) Derivation of kinetic and potential energy **4 pts**
    d) Estimate the spring constant of the C-H bond. **4 pts**
3. O-H stretching mode
    a) Identification of the O-H stretching mode in CH_3OH **2 pts**
    b) Comparison with this mode with that in H_2O **2 pts**
    c) Identification of O-H stretching mode in C_2H_5OH and CH_3-CHOH-CH_3 **2 pts**
4. Isopropanol (CH_3-CHOH-CH_3) and acetone (CH_3-CO-CH_3.)
    a) Identification of C-H modes **2 pt**
    b) Identification of C-C **2 pt**
    c) Comparison of frequencies of the C=O mode in acetone and CO_2. **2 pt**

Session 2: 60 pts

1. Acquisition of signal from background and discussion on its effects **3 pts**
2. Acquisition of signals from glass slide and glass vial and discussion on the differences between the two **4 pts**
3. Discussion on the effect of acquisition time and the number of scans on the signal/noise ratio **2 pts**
4. Discussion on the calibration of the spectrograph **4 pts**
5. Acquisition of signals, processing of raw files using Matlab and graph-plotting for Isopropanol, Chloroform, Acetone, Ethanol, SiC and ZnS **30 pts (5 pts for each material)**

6. Identification of the wave numbers corresponding to specific vibrational modes in each *organic material* **8 pts (2 pt for each)**
7. Identification of phases present in ZnS and SiC **4 pts (2 pt for each)**
8. Acquisition of Raman spectrum for the unknown material and subsequent data-analysis **5 pts**