Chapter 5

Software Development
Section 5.1

Flow Chart

As indicated earlier, the system designed in the present study is used to study the behaviour of solute-water interactions in certain systems through the measurement of ultrasonic velocity and density. The parameters, namely, adiabatic compressibility, specific acoustic impedance, apparent molal volume, apparent molal adiabatic compressibility, molar compressibility, Rao number, Van der waal's constant and relaxation strength, which are useful for physico-chemical investigation are computed using the relevant formulae explained in section 4.3.

The flow charts for the computation of individual parameters are presented in Figure 5.1.1. The detailed program developed in BASIC language is presented in the following section.
Fig. 5.1.1a Flow Chart for the computation of acoustic parameters
Fig. 5.1.1b  Flow Chart for the computation of acoustic parameters
Fig. 5.1.1c Flow Chart for the computation of acoustic parameters
START

SELECT A PARAMETER 1,2,3,4,5,6,7,8

SELECT OPTION

OPTION 7

VAN DER WAAL'S CONSTANT, b

ENTER VELOCITY, u
MOLAR VOLUME, V
MOL. WT., M
GAS CONST., GC
TEMP. T

COMPUTE
\[ b = V \times \left( \frac{1}{1 - \frac{GC \times T}{M \times u^2}} \right) \times \left( \sqrt{1 + \frac{M \times u^2}{3 \times GC \times T}} - 1 \right) \]

DISPLAY, b

OPTION 8

RELAXATION STRENGTH, RS

ENTER VELOCITY, u

COMPUTE
\[ RS = \left( 1 - \left( \frac{U^2}{U_{u}^2} \right) \right) \]

DISPLAY, RS

Fig. 5.1.1d Flow Chart for the computation of acoustic parameters
Section 5.2
Detailed Program

REM ** INTELLIGENT INSTRUMENTATION SYSTEM FOR **
REM ** THE COMPUTATION OF DIFFERENT PARAMETERS **
REM
*********************************************************
REM ** INITILISATION OF VARIABLES **
REM
REM ** MAIN PROGRAM **
MAIN:  CLS
AGAIN:  GOSUB MENU
IF OPT = 1 THEN
  GOSUB AC
ELSEIF OPT = 2 THEN
  GOSUB SAI
ELSEIF OPT = 3 THEN
  GOSUB AMV
ELSEIF OPT = 4 THEN
  GOSUB AMAC
ELSEIF OPT = 5 THEN
  GOSUB MAC
ELSEIF OPT = 6 THEN
  GOSUB RAONO
ELSEIF OPT = 7 THEN
  GOSUB VC
ELSEIF OPT = 8 THEN
  GOSUB RS
ELSEIF OPT = 9 THEN
  GOTO ENDP
GOTO AGAIN
ELSE GOTO AGAIN
END IF
GOTO AGAIN
ENDP:
END

MENU:  REM *** PROGRAM FOR MAIN MENU ***
SCREEN 0:  CLS
LOCATE  2,  20:  PRINT "COMPUTATION OF ACOUSTIC PARAMETERS"
LOCATE  7,  25:  PRINT "1. ADIABATIC COMPRESSIBILITY"
LOCATE  8,  25:  PRINT "2. SPECIFIC ACOUSTIC IMPEDANCE"
LOCATE  9,  25:  PRINT "3. APPARENT MOLAL VOLUME"
LOCATE 10, 25:  PRINT "4. APPARENT MOLAL ADIABATIC COMPRESSIBILITY"
LOCATE 11, 25:  PRINT "5. MOLAR ADIABATIC COMPRESSIBILITY"
LOCATE 12, 25: PRINT "6. RAO NUMBER"
LOCATE 13, 25: PRINT "7. VANDERWALL'S CONSTANT"
LOCATE 14, 25: PRINT "8. RELAXATION STRENGTH"
LOCATE 15, 25: PRINT "9. EXIT"
LOCATE 20, 35: INPUT "SELECT ? = "; OPT
RETURN

AC: REM ** PROGRAM FOR COMPUTATION OF ADIABATIC COMPRESSIBILITY **
CLS
LOCATE 2, 20: PRINT "COMPUTATION OF ADIABATIC COMPRESSIBILITY"
PRINT
PRINT
INPUT "Enter the Velocity (U) = "; U
INPUT "Enter the Density (D) = "; D
BETA = 1 / ((U * U) * D)
PRINT
PRINT "Adiabatic Compressibility = "; BETA
PRINT
INPUT "Press ENTER to continue... "; xxx
RETURN

SAI: REM ** PROGRAM FOR COMPUTATION OF SPECIFIC ACOUSTIC IMPEDENCE **
CLS
LOCATE 2, 20: PRINT "COMPUTATION OF SPECIFIC ACOUSTIC IMPEDENCE"
PRINT
PRINT
INPUT "Enter the Velocity (U) = "; U
INPUT "Enter the Density (D) = "; D
A = U * D
PRINT
PRINT "Acoustic Impedence = "; A
PRINT
INPUT "Press ENTER to continue... "; xxx
RETURN

AMV: REM ** PROGRAM FOR COMPUTATION OF APPARENT MOLAL VOLUME **
CLS
LOCATE 2, 20: PRINT "COMPUTATION OF APPARENT MOLAL VOLUME"
PRINT
PRINT
INPUT "Enter Molecular Weight (MW) ="; MW
INPUT "Enter Temperature (T) ="; T
INPUT "Enter Density of Water at T ="; DW
INPUT "Enter the Density of Liquid (D) ="; D
INPUT "Enter the Molality (m) ="; M
PHIV = (MW / DW) - ((1000 * (D - DW)) / DW * M)
PRINT
PRINT "Apparent Molal Volume = "; PHIV
PRINT
INPUT "Press ENTER to continue..."; xxx
RETURN

AMAC:
REM ** PROGRAM FOR THE COMPUTATION OF APPARENT
MOLAL ADIABATIC COMPRESSIBILITY **
CLS
LOCATE 2, 20: PRINT "COMPUTATION OF APPARENT
MOLAL ADIABATIC COMPRESSIBILITY"
PRINT
PRINT
INPUT "Enter Molecular Weight (MW) ="; MW
INPUT "Enter Temperature (T) ="; T
INPUT "Enter Density of Water at T ="; DW
INPUT "Enter the Density of Liquid (D) ="; D
INPUT "Enter the Molality (m) ="; M
INPUT "Enter Adiabatic Compressibility of Water
at T ="; BW
INPUT "Enter Adiabatic Compressibility of
Liquid at T ="; BL
PHIK = (1000 * (BL * DW - BW * D)) / (M * D * DW) + (BL * MW) / D
PRINT
PRINT "Apparent Molal Adiabatic Compressibility
= "; PHIK
PRINT
INPUT "Press ENTER to continue..."; xxx
RETURN

MAC:
REM ** PROGRAM FOR THE COMPUTATION OF MOLAR
ADIABATIC COMPRESSIBILITY **
CLS
LOCATE 2, 20: PRINT "COMPUTATION OF MOLAR
ADIABATIC COMPRESSIBILITY"
PRINT
PRINT
INPUT "Enter Molar Volume (MV) ="; MV
INPUT "Enter Temperature (T) ="; T
INPUT "Enter Adiabatic Compressibility of Liquid
at T ="; BL
W = MV * BL ^ (-1 / 7)
PRINT
PRINT "Molar Adiabatic Compressibility ="; W
PRINT
INPUT "Press ENTER to continue..."; xxx
RETURN

RAONO: REM ** PROGRAM FOR THE COMPUTATION OF RAO NUMBER **
CLS
LOCATE 2, 20: PRINT "COMPUTATION OF RAO NUMBER"
PRINT
PRINT
INPUT "Enter Molar Volume (MV) ="; MV
INPUT "Enter Temperature (T) ="; T
INPUT "Enter Ultrasonic Velocity (U) ="; U
RNO = MV * U ^ (1 / 3)
PRINT
PRINT "Rao Number ="; RNO
PRINT
INPUT ; "Press ENTER to continue..."; xxx
RETURN

VC: REM ** PROGRAM FOR THE COMPUTATION OF VAN DER WAAL'S CONSTANT **
CLS
LOCATE 2, 20: PRINT "COMPUTATION OF VAN DER WAAL'S CONSTANT"
PRINT
PRINT
INPUT "Enter Molar Volume (MV) ="; MV
INPUT "Enter Temperature (T) ="; T
INPUT "Enter Molecular Weight ="; MW
INPUT "Enter Ultrasonic Velocity (U) ="; U
INPUT "Enter Gas Constant ="; GC
VANC = MV * ((1 - (GC * T / (MW * U * U))) * (SQRT(1 + MW * U * U / 3 * GC * T) - 1))
PRINT
PRINT "Vanderwaal's Constant ="; VANC
PRINT
INPUT "Press ENTER to continue..."; xxx
RETURN

RS: REM ** PROGRAM FOR THE COMPUTATION OF RELAXATION STRENGTH **
CLS
LOCATE 2, 20: PRINT "COMPUTATION OF RELAXATION STRENGTH"
PRINT
PRINT
INPUT "Enter Temperature (T) ="; T
INPUT "Enter Ultrasonic Velocity (U) ="; U
RLS = (1 - (U * U / 1600 * 1600))
PRINT
PRINT "Relaxation Strength ="; RLS
PRINT
INPUT "Press ENTER to continue..."; xxx
RETURN