1st Semester Regular/Back Examination 2017-18
APPLIED CHEMISTRY
Branches: AEIE, AERO, AUTO, BIOMED, BIOTECH, CIVIL, CSE, ECE, EEE, EIE, ELECTRICAL, ETC, FAT, IT, MECH, METTA, MINERAL, MINING, PE, PLASTIC, PT
Time: 3 Hours
Max Marks: 100
Q. CODE: B816
Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.
(Mass: ^1H = 1.0078u; ^2H = 2.0141u; ^{17}F = 18.9984u; ^{35}Cl = 34.9689u; ^{37}Cl = 36.9659u; ^{79}Br = 79.81 u)

Q.1 Answer the following questions: **[2 x 10]**
a) Write the one-dimensional time-independent Schrödinger equation.
b) Find the value of $\hat{A} f(x)$ when $\hat{A}$ is d/dx and $f(x) = 4x^2y$.
c) Define the any one postulate of quantum mechanics.
d) Write the selection rule for rotational spectrum and define the term used therein.
e) Calculate the energy (in ergs) per photon for radiations of λ = 400nm.
f) Which of the following molecules exhibit rotational spectrum:
   CO, H_2, HBr, H_2O
g) Calculate the number of components, phases and degrees of freedom for a system:
   $H_2 + O_2 \rightarrow H_2O$.
h) Define red and blue shifts in UV-Visible spectra.
i) Define CNG and its composition.
j) Write the chemical name and its formula of the compound produced generally on corrosion of iron in normal atmosphere.

Q.2 Answer all the questions : **[2 x 10]**
a) With an example prove that Square operator is not a linear operator.
b) Define the salient features of the Schrödinger equation.
c) Calculate the uncertainty in velocity of a cricket ball with mass 100 gm, if uncertainty in position is 1cm.
d) Two energy levels in a rotational spectrum are separated by 400 nm. What is the energy difference between these levels? Express in Joules, ergs and eV.
e) How the net calorific value of a solid fuel is calculated?
f) Define EAN rule. Give two examples where this rule is not satisfied?
g) Calculate the weight of air required for complete combustion of 5 gm of CO.
h) Why galvanized utensils are generally not used for cooking?
i) Write the name and formula of a palladium catalyst used in alkene somerisation.
j) Write the structure of ferrocene.

Q.3 a) Which type of molecules exhibit infra-red spectra? Calculate the vibrational energy and force constant of $^1H^{17}F$ if its vibrational frequency is 3.0×10^{14} Hz. **[8]**

b) Discuss five different ligands where ETA(η) is used for organometallic compounds? **[7]**

Q.4 a) Discuss the phase diagram of a four phase one component system. **[9]**

b) Prove that the eigenvalues of a Hermitian operator are real. **[6]**

Q.5 a) A gas has the following composition by volume: H = 25%; CH_4 = 5%; CO = 25%, CO_2 = 5%; O_2 = 5% and N_2 = 35%. If 40% excess air is used for its complete combustion, find the weight and volume of air actually supplied for this process. **[10]**

b) Discuss the hydroformylation reactions which are catalysed by organometallic catalysts. **[5]**

Q.6 a) The force constant of $^{79}Br_2$ is 300 Nm^{-1}. Determine its vibrational energy (in Joules and eV), zero-point energy and vibrational frequency. **[10]**

b) Discuss the salient features of phase diagram of a Bi-Cd system. **[5]**

Q.7 **a)** The $^1H^{17}F$ (rigid type) has bond length 0.16nm. Determine its rotational constant in Joules, eV and cm^{-1}. **[9]**

b) A cell of 10 mm path length contains ferric chloride solution of 0.002M. An electromagnetic radiation of $\square$= 400 nm is passed through it and the absorbance is 0.60. Determine its molar absorption coefficient and transmittance. **[6]**

Q.8 **a)** Define electrochemical corrosion. Discuss its mechanism under various corrosive environments. **[10]**

b) The rotational constant B for $^1H^{35}Cl$ is 12.00 cm^{-1}. Calculate B for $^2H^{35}Cl$ and $^1H^{37}Cl$. **[5]**

Q.9 **a)** What is cracking? Discuss the mechanism of thermal cracking. **[5]**

b) Define the basis of use of μ notation in organometallic compounds. Give two examples. **[5]**

c) Define Lambert-Beer law and write the equations used for this law. Discuss its limitations. **[5]**