M. Sc. Chemistry Examination, 2022

(4th Semester)

Inorganic Chemistry Special

Paper – XVI-I

Time : Two hours Full Marks : 50

Use a separate answer script for each Unit.

UNIT: I-4161

1. Illustrate the mechanism of Suzuki type C-C coupling reaction using a palladium catalyst, and explain each step. Identify the organometallic species involved in the catalytic cycle. 6+1

2. What is hydroformylation reaction? Show the mechanism of hydroformylation of an alkene ($RCH=CH_2$) using a cobalt catalyst. Comment on the ratio of n:iso products. 2+6+2

3. What are N-heterocyclic carbenes? Explain the reason behind their stability. 2+2

4. Describe the structure of $[Ru(C_6Me_6)_2]^{2+}$ and comment on its stability. Highlight the structural differences that takes place on two-electron reduction of the metal center. 2+2

UNIT: I-4162

1. Answer ***any nine*** from the following: 9×1

a) "Polar coordinating solvents are preferable solvents for preparing a coordination polymer" — Justify.

b) What structural beauty of dendrimers makes them suitable for utilization in drug delivery?

c) How has SHAB principle been exploited in the design of coordination polymers?

d) What will be the general structural transformation in metal organic framework if the ligand to metal ratio changes from 1 : 1 to 2 : 1?

e) What are the common physiochemical techniques utilized for the characterization of porous coordination polymers?

f) Name two naturally occurring nanoparticles (i.e. not synthesized artificially).

g) What are the different patterns of TEM studies and how does it help to understand the crystallinity of the samples?

h) Why is gold or platinum coating necessary for non-conducting/biological samples during SEM studies?

i) What are opto-electronic materials and where are they used?

j) Why does the band gap increase when decreasing the size of nanostructures?

2. a) What is third generation porous material? How does it differ from second generation porous material? Name two unique applications of third generation porous material. 1+1+2

b) How do the primary and secondary valencies of metal ions direct the formation of an overall structure in metal organic frameworks? 2+2

3. a) What is the use of FTIR studies for biosynthesized nanoparticles? Discuss the sensing properties of functionalized Au-nanoparticles for heavy metal ions.

b) Why do we need a core-shell system? What are the advantages of core shell system, in comparison to other nanoparticles?

c) Write the full form of analytical tools used for the characterization of materials: (i) DLS (ii) AFM; Mention the utility of these tools in the field of material characterizations.

d) What is the reason for shifting of XRD peak of Au doped ZnO nanocrystals with respect to pure ZnO? 2×4