

Writing anything except Roll Number on question paper will be deemed as an act of indulging in unfair means and action shall be taken as per rules.

M.SC. (CHEMISTRY) Semester-I (WINTER-2019)
MSCH111 INORGANIC CHEMISTRY

Time – Three Hours

Maximum Marks – 80

Note:

1. All questions are compulsory in Part A. Each question carries 2 marks.
2. Attempt FIVE questions in all from Part B, selecting ONE question either (i) or (ii) from each question.. Each question carries 6 marks.
3. Attempt 3 questions in all from Part C. Each question carries 10 marks.

PART – A

1.
 - i Give the shapes of H₂O and NH₃ molecule?
 - ii What is formation constant?
 - iii The complex compounds in which ligand can be replaced by another ligand are called?
 - iv Draw the structure of POCl₃ molecule.
 - v What is thermodynamic stability?
 - vi Define kinetic stability.
 - vii Give the formula of tris oxalato-chromate (III) ion.
 - viii What is steric effect?
 - ix Give the structure of the activated complex.
 - x What is trans-effect series?

PART – B

2.
 - i Write notes on Bent's rule and energetic of hybridization.
OR
 - ii Explain VSEPR theory.
3.
 - i Explain Sigma (σ) bonding in octahedral complexes according to MOT.
OR
 - ii Explain Pi (π) bonding in octahedral complexes according to MOT.
4.
 - i Explain Dey and Mukherjee's method.
OR
 - ii Discuss Asmus method.
5.
 - i Explain S_N1 CB mechanism.
OR
 - ii Discuss S_N2 CB mechanism.
6.
 - i Explain electron transfer with the formation of single bridge intermediate.
OR
 - ii Discuss electron transfer through multi bridge intermediate.

PART – C

7. Explain geometry of SnCl_2 , C_2H_4 and CO molecule.
8. Discuss crystal field splitting of d-orbitals of the central metal cation in octahedral complexes.
9. Write notes on:
 - i Chelate effect and its thermodynamic origin
 - ii Factors affecting the stability of metal complexes
10. Explain the effect on the rate of aquation or acid hydrolysis.
11. Write application and theoretical application of the trans-effect.

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M.SC. (CHEMISTRY) SEMESTER-I (WINTER-2019)
MSCH112 ORGANIC CHEMISTRY-I

Time – Three Hours

Maximum Marks – 80

Note:

- All questions are compulsory in Part A. The answers of these questions are limited upto 30 words each. Each question carries 2 marks.
- Attempt FIVE questions in all from Part B, selecting ONE question either (i) or (ii) from each question. Answer of each question shall be limited upto 250 words. Each question carries 6 marks.
- Attempt 3 questions in all from Part C. Answer of each question shall be limited upto 500 words. Each question carries 10 marks.

PART – A

- Define cross conjugation.
 - Draw the structure of Isotetralins.
 - What is Racemic mixture (conglomerate).
 - What is sulphoxides?
 - What is the condition for geometrical isomerism?
 - Draw the staggered and eclipsed conformation of propane diagram.
 - What is molecularity?
 - What are the secondary kinetic isotopes effects?
 - What is sigmatropic rearrangement?
 - Show the thermal ring opening in $(4n+2) \pi$ electron system.

PART – B

- Explain the Huckel molecular orbital theory for system having $(3+4n)$ carbon atoms in the ring.
OR
 - Explain the stability of alkanes.
- Discuss the Fischer projection.
OR
 - Discuss the stereochemistry of spiranes.
- Explain the term “center of symmetry” with suitable examples.
OR
 - Explain stereochemistry of nitrogen compounds with suitable examples.
- Explain potential energy diagrams.
OR
 - Write a short note on hard and soft acids and bases.
- Explain the types of pericyclic reactions.
OR
 - Explain stereochemistry of cope rearrangements.

PART – C

- Discuss molecular orbital theory.
- Discuss briefly R, S nomenclature.
- Explain stereochemistry of allenes.
- Explain the structure and stability of carbanions.
- Explain claisen rearrangement with suitable examples.

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M.SC. (CHEMISTRY) SEMESTER-I (WINTER-2019)

MSCH113 PHYSICAL CHEMISTRY-I

Time – Three Hours

Maximum Marks – 80

Note:

- All questions are compulsory in Part A. The answers of these questions are limited upto 30 words each. Each question carries 2 marks.
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PART – A

- Define pyrolysis reaction.
 - Write any one example of photochemical reaction.
 - Write any two features of fast reactions.
 - What do you understand by probing of transition state?
 - Write any two examples of reactions in which enzymes are used as catalysts.
 - Write any two advantages of homogeneous catalysis.
 - Define liquid crystal polymers.
 - Write names of any two methods which are used to calculate molecular mass of polymers.
 - Define zeta potential.
 - Write Lippmann equation.

PART – B

- Explain the kinetics of any one photo chemical reaction.
OR
 - Discuss steady state kinetics and kinetic salt effect.
- Explain RRKM theory of unimolecular reaction.
OR
 - What do you understand by fast reaction? Explain study of fast reactions by flow method.
- Explain quantification of surface active sites of catalyst with the help of example in detail.
OR
 - Discuss kinetics of enzyme reactions.
- Define polymers. Explain the classification of polymers with one example of each category.
OR
 - Calculate the molecular mass of polymers with the light scattering method.
- Write short note on following:
(a) Born model
(b) Electrified interface equation
OR
 - Explain the Debye-Huckel-Onsager treatment and its extensions.

PART – C

7.
 - i Explain the dynamic chain with the help of hydrogen-bromine reaction.
 - ii What do you understand by thermo-dynamic control of reaction? Explain.
8.
 - i Describe dynamics of barrier less chemical reactions in solutions.
 - ii Explain dynamics of molecular motions.
9.
 - i Explain the kinetics of heterogeneous catalytic reactions.
 - ii What do you understand by structure of absorbed species? Discuss with the help of example.
10. What do you understand by chain configuration of macromolecules? Calculate the average dimensions of various chain structures.
11.
 - i Explain electro-kinetic phenomenon and quantitative treatment of zeta potential.
 - ii What do you mean by ion-solvent interaction? Discuss.

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M.SC. (CHEMISTRY) Semester-I (WINTER-2019)

MSCH114 ANALYTICAL CHEMISTRY-I

Time – Three Hours

Maximum Marks – 80

Note:

1. All questions are compulsory in Part A. The answers of these questions are limited upto 30 words each. Each question carries 2 marks.
2. Attempt FIVE questions in all from Part B, selecting ONE question either (i) or (ii) from each question. Answer of each question shall be limited upto 250 words. Each question carries 6 marks.
3. Attempt 3 questions in all from Part C. Answer of each question shall be limited upto 500 words. Each question carries 10 marks.

PART – A

1.
 - i Differentiate between accuracy and precision.
 - ii Give the formula of correlation coefficient.
 - iii What is a monochromator?
 - iv Give two advantages of HPLC.
 - v Define phosphorescence.
 - vi Give two advantages of ICP-MS.
 - vii What are crown ethers?
 - viii Give the name of solvents used for extraction.
 - ix Why atomization is essential in flame photometry?
 - x Give the names of detectors used in gas chromatography.

PART – B

2.
 - i Explain sensitivity and selectivity of analytical methods.
OR
 - ii Discuss good lab practices giving emphasis on chemistry lab.
3.
 - i Discuss various parts of spectrophotometer.
OR
 - ii Explain principle and theory of AAS.
4.
 - i Discuss differences between fluorescence and phosphorescence with their applications.
OR
 - ii Explain theory and principle of ICPS.
5.
 - i Give the principle, methodology and applications of synergistic extractions.
OR
 - ii Discuss role and selectivity of various solvents used in solvent extractions.
6.
 - i Discuss various detectors used in HPLC.
OR
 - ii Explain principle, layout and advantages of HPTLC.

PART – C

7.
 - i Classify analytical methods.
 - ii Discuss types of errors.
8. Give principle, theory, layout and applications of flame photometry.
9. Describe principle of electrophoresis with the help of diagram. Enlist its advantages and applications.
10.
 - i Discuss principle and instrumentation of fluorescence.
 - ii Write a note on chemiluminescence.
11. Explain theory and general layout of gas chromatography giving detail of coupled gas chromatography.

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M.SC.(CHEMISTRY) Semester-II (SUMMER-2019)

MSCH211 INORGANIC CHEMISTRY-II

Time – Three Hours

Maximum Marks – 80

Note:

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- Attempt 3 questions in all from Part C. Answer of each question shall be limited upto 500 words. Each question carries 10 marks.

PART – A

- What is π -acid complexes?
 - Calculate the E.A.N of $V(CO)_6$
 - Give the structure of $(CH_3)_6P(BH)_3$
 - What is Nido Boranes?
 - What do you mean by Isolobal relationship?
 - Define Zintl ions.
 - Define Beer-Lambert's law.
 - Why square planes complexes do not exhibit optical isomerism?
 - Calculate magnetic moment of Ce^{3+} ions
 - What is magnetic exchange?

PART – B

- Explain the structure of Metal nitrosyls.
OR
 - Give the each of two preparation of nitrosyl fluoride and nitrosyl chloride.
- Explain structure the properties of $LiBH_4$
OR
 - Draw the structure of B_4H_{10} , B_5H_{11} and $B_{10}H_{14}$
- Discuss preparation and properties of Discarbo-closo-dodecaboranes.
OR
 - Describe low nuclearity carbonyl clusters.
- Explain selection rules of electronic transitions.
OR
 - Explain Orgel diagram of Co^{2+} ions

6. i Describe molecular orbital diagram for tetrahedral complex of ligand metal charge transfer transition.
OR
ii Explain molecular orbital diagram of octahedral complex of metal to ligand charge transfer transition

PART – C

7. Explain vibrational spectra of metal carbonyls for bonding and structural elucidation.
8. Describe preparation, properties and structure of small and large carboranes.
9. Explain structure of Diborane and molecular orbital treatment for 3 centres-2 electron (3c-2e) bond formation in B_2H_6 molecules
10. Explain correlation diagram of d^2 metal ion in octahedral complexes
11. Write note on
(i) Magnetic properties of complexes
(ii) Spin Crossovers

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M.SC.(CHEMISTRY) Semester-II (SUMMER-2019)
MSCH212 ORGANIC CHEMISTRY-II

Time – Three Hours

Maximum Marks – 80

Note:

1. All questions are compulsory in Part A. The answers of these questions are limited upto 30 words each. Each question carries 2 marks.
2. Attempt FIVE questions in all from Part B, selecting ONE question either (i) or (ii) from each question. Answer of each question shall be limited upto 250 words. Each question carries 6 marks.
3. Attempt 3 questions in all from Part C. Answer of each question shall be limited upto 500 words. Each question carries 10 marks.

PART – A

1.
 - i Define leaving group with suitable example.
 - ii What is regioselectivity give suitable example?
 - iii Define IPSO attacks.
 - iv Define electrophiles with suitable example.
 - v What are biomolecular aliphatic electrophilic substitution reactions?
 - vi Define nucleophilic substitution reaction with suitable example.
 - vii Define the term arylation with suitable example.
 - viii Define the term free radical with its stability.
 - ix What are carbonyl compounds give suitable example.
 - x Define electrophilic addition reaction with suitable example.

PART – B

2.
 - i Explain nucleophilic substitution at an allylic carbon with the help of suitable example.
OR
 - ii Explain phase transfer catalysis with suitable example of reaction.
3.
 - i Discuss quantitative treatment of reactivity in substrates and electrophiles
OR
 - ii Explain arenium ions mechanism in aromatic electrophilic substitution.

4. i Explain SE_1 reaction with mechanism
OR
ii Compare SN_{Ar} and SN_1 reaction
5. i Explain free radical substitution reaction mechanism.
OR
ii Discuss role of NBS in allylic halogenation
6. i Discuss mechanistic and stereo chemical aspect of addition reaction.
OR
ii Explain mechanism of metal hybrids reduction of saturated and unsaturated carbonyl compound.

PART – C

7. Compare in detail SN_1 and SN_2 reaction mechanism with stereo chemical aspect.
8. Explain the following
(a) Diazonium coupling reaction
(b) Vilsmeier reaction
(c) Gattermann koch reaction.
9. Explain the following
(a) Von- Richter reaction
(b) Sommelet- Hauser Reaction
(c) Smiles re-arrangements
10. Discuss the followings
(a) Auto-oxidation
(b) Sandmeyer reaction
(c) Hunsdiecker reaction
11. Discuss the following
(a) Michael reaction
(b) Wittig reaction
(c) Hydroboration of alkene

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M.Sc. (CHEMISTRY) SEMESTER-II (SUMMER-2019)
MSCH213 PHYSICAL CHEMISTRY-II

Time – Three Hours

Maximum Marks – 80

Note:

1. All questions are compulsory in Part A. The answers of these questions are limited upto 30 words each. Each question carries 2 marks.
2. Attempt FIVE questions in all from Part B, selecting ONE question either (i) or (ii) from each question. Answer of each question shall be limited upto 250 words. Each question carries 6 marks.
3. Attempt 3 questions in all from Part C. Answer of each question shall be limited upto 500 words. Each question carries 10 marks.

PART – A

1.
 - i What will happen if the walls of the one dimensional box are suddenly removed?
 - ii What do you mean by Zeeman effect?
 - iii What do you mean by fugacity?
 - iv Define following terms:
 - i) Phase space
 - ii) Ensemble
 - v Define corrosion.
 - vi What is the significance of ψ and ψ^2 ?
 - vii Why is it impossible for a $2^2 P_{5/2}$ to exist?
 - viii Write the expression of Gibbs Duhem equation.
 - ix What do you understand by partition functions?
 - x What do you mean by galvanization?

PART – B

2.
 - i. Mention the postulates of quantum mechanics.
OR
 - ii. Derive equations for the wave function and energy level for a microscopic particle moving in one dimensional box for which potential energy is zero inside the box and is infinite outside the box.
3.
 - i. Write the secular equations for cyclo-butadiene and hence calculate the delocalization energy on the basis of Huckel's approximation.
OR
 - ii. Explain why cyclooctatetraene is unstable but its dianion is stable and planar.
4.
 - i. Define chemical potential. Explain variation of chemical potential with temperature.
OR
 - ii. Explain partial molar free energy in a system of ideal gases.
5.
 - i. Give the expression of following properties in terms of partitions functions:
 - a) Energy
 - b) Specific heat at constant volume
OR
 - ii. Derive the following expression :

$$q_{\text{rot}} = \frac{KT}{\sigma hCB}$$

6. i. Explain types of corrosion.
OR
ii. Explain different methods for protection from corrosion.

PART – C

7. Derive energy term for a particle moving 3-dimensional box.
8. Explain:
- a) Russle-Saunders coupling 2
 - b) Abnormal Zeeman effect 4
 - c) HMO theory 4
9. Explain thermodynamic derivation of law of mass action
10. Explain Maxwell-Boltzmann distribution law using Lagrange's method of undetermined multipliers
11. Explain:
- a) Corrosion Inhibitors 3
 - b) Theory of Corrosion (**ANY ONE**) 5
 - c) Monitoring of Corrosion 2

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M.SC.(CHEMISTRY) Semester-II (SUMMER-2019)
MSCH214 ANALYTICAL CHEMISTRY-II

Time – Three Hours

Maximum Marks – 80

Note:

1. All questions are compulsory in Part A. The answers of these questions are limited upto 30 words each. Each question carries 2 marks.
2. Attempt FIVE questions in all from Part B, selecting ONE question either (i) or (ii) from each question. Answer of each question shall be limited upto 250 words. Each question carries 6 marks.
3. Attempt 3 questions in all from Part C. Answer of each question shall be limited upto 500 words. Each question carries 10 marks.

PART – A

1.
 - i Define DSC.
 - ii Give two differences between DTA and DSC.
 - iii Define isotop dilution analysis.
 - iv What is neutron activation?
 - v Define diffusion current
 - vi Give Ilkovic equation.
 - vii What is conduction sensor?
 - viii Give advantage of biosensor.
 - ix Give the four name of food adulterants.
 - x Define alloys giving two examples.

PART – B

2.
 - i Discuss factors affecting TGA.
OR
 - ii Discuss principle of DTA
3.
 - i Discuss radioactive decay process.
OR
 - ii Discuss principle of neutron activation analysis.
4.
 - i Classify polarographic techniques. Discuss half potential.
OR
 - ii Discuss principle of voltametry
5.
 - i Explain working of Biosensor.
OR
 - ii Classify ion selective electrodes. Discuss gas sensor.
6.
 - i Write a note on chemistry of petroleum products.
OR
 - ii Discuss agrochemicals and cosmetics chemicals.

PART – C

7. Explain principle, methodology and applications of TGA
8. Explain principle, methodology and application of Isotopic dilution method.
9. Discuss principle and instrumentation of polarography.
10. Explain working of thermal sensors. Give their applications
11. Discuss role of chemistry in the field of drugs and minerals.

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M.SC. (CHEMISTRY) Semester-III (WINTER-2019)
MSCH311 ORGANIC SPECTROSCOPY

Time – Three Hours

Maximum Marks – 80

Note:

- All questions are compulsory in Part A. The answers of these questions are limited upto 30 words each. Each question carries 2 marks.
- Attempt FIVE questions in all from Part B, selecting ONE question either (i) or (ii) from each question. Answer of each question shall be limited upto 250 words. Each question carries 6 marks.
- Attempt 3 questions in all from Part C. Answer of each question shall be limited upto 500 words. Each question carries 10 marks.

PART – A

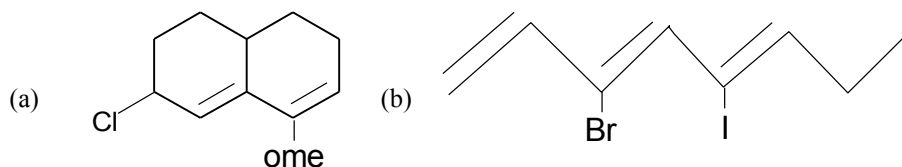
- Define Beer-Lambert law.
 - What are conjugated dienes?
 - Define molecular ion peak.
 - What do you mean by ion abundance?
 - Define vibrational frequency?
 - Discuss hydrogen bond effect on vibrational frequency.
 - Define shielding effect in NMR.
 - Write significance of C-13 NMR.
 - Define coupling constant 'J'.
 - Write general considerations of C-13 NMR.

PART – B

- Discuss different transition states of UV.

OR

 - Calculate λ_{max} for the following:



- Discuss McLafferty rearrangement with suitable examples.

OR

 - Explain nitrogen rule in interpretation of mass spectrometry.
- Discuss different sample techniques used in IR.

OR

 - Describe hydrogen bond effect and solvent effects on vibrations of IR.
- Discuss chemical shifting in NMR with suitable examples.

OR

 - Discuss complex spin-spin interaction between two and three nuclei.
- Discuss Overhauser effect (NOE) in C-13 NMR.

OR

 - Explain two-dimensional NMR spectroscopy.

PART – C

7. Explain Woodward-Fieser rule for carbonyl compounds.
8. Explain the following:
 - i. EI
 - ii. CI
 - iii. FD
 - iv. FAB
9. Explain coupling vibration, overtones and Fermi resonance in IR with suitable example.
10. Discuss interpretation spectra of enols, R-COOH and amide in NMR.
11. Write a brief note on the following:
 - i. COSY
 - ii. NOESY
 - iii. DEPT
 - iv. INEPT

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M.SC. (CHEMISTRY) Semester-III (WINTER-2019)
MSCH312 SOLID STATE, SURFACE CHEMISTRY & CATALYSIS

Time – Three Hours

Maximum Marks – 80

Note:

1. All questions are compulsory in Part A. The answers of these questions are limited upto 30 words each. Each question carries 2 marks.
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3. Attempt 3 questions in all from Part C. Answer of each question shall be limited upto 500 words. Each question carries 10 marks.

PART – A

1.
 - i Define perfect crystals.
 - ii Give two characteristics of line defects.
 - iii Define superconductor.
 - iv Give principle for working of P-N junction.
 - v What is CMC?
 - vi Give two examples of nonionic and zwitter ionic surfactants.
 - vii What do you mean by hardness of water?
 - viii What is detergency?
 - ix Define heterogeneous catalysis.
 - x Give two examples of quaternary ammonium salt.

PART – B

2.
 - i Describe general principles and experimental procedures in solid state chemistry.
OR
 - ii Write a note on colour centre.
3.
 - i Explain band theory of solids.
OR
 - ii Discuss BCS theory of superconductor.
4.
 - i Explain structural features and behaviour of surfactants.
OR
 - ii What are surface active agents? Discuss their classification.
5.
 - i Explain the removal of soil from substrate.
OR
 - ii Discuss mechanism of cleaning process of soaps.
6.
 - i Discuss uses of ultrasound and crown ether.
OR
 - ii Write short notes on:
 - (a) Quaternary ammonium salts
 - (b) Phosphonium salts

PART – C

7. Discuss thermodynamics of Schottky and Frenkel defect formation.
8. Write notes on the following:
 - (a) Photo conduction
 - (b) P-N junction
 - (c) Factors affecting superconductivity
9. Write notes on:
 - (a) Pseudophase model of micelles catalysis
 - (b) Effect of hydrophobic group on surfactant
10. Discuss the effect of water hardness and chemical structure on surfactants.
11. Explain the importance of phase transfer catalysis and other cryptands in phase transfer catalysis.

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M.SC. (CHEMISTRY) Semester-III (WINTER-2019)
MSCH313 ORGANOTRANSITION METAL CHEMISTRY

Time – Three Hours

Maximum Marks – 80

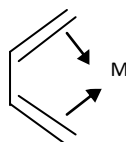
Note:

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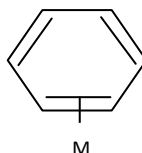
PART – A

- Define hapticity. Give the hapticity of the following ligands:

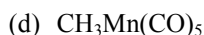
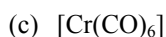
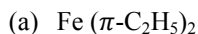
(a)



(b)

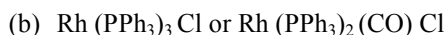
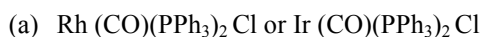


- Give the valence electron count in the following:



- Define insertion and reductive elimination.

- Which of the following compounds undergoes oxidative addition reaction faster?

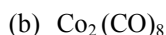
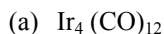


- Give two reactions of ferrocene which shows that it is more reactive than benzene.

- Give two differences between Fischer and Schrock carbenes.

- Compare between homogenous and heterogeneous catalysis.

- Calculate number of metal-metal bonds in the following compounds:



- Give application of organometallic chemistry in the field of agriculture.

- Write IUPAC name and four salient features of Wilkinson's catalyst.

PART – B

- What do you mean by 18-electron rule? Explain with suitable examples and also give its exceptions.

OR

- What do you mean by σ -bonded organometallic compounds? Explain the factors which affect their bonding.

- What do you mean by oxidative addition? Explain its mechanism and salient features.

OR

- Define reductive elimination. Explain its mechanism and important features,

4. i What do you mean by arene complexes? Discuss synthesis and properties of arene complexes.

OR

ii Discuss preparation, structure & bonding of alkyl transition metal.

5. i Discuss the catalytic cycle involves in Wacker process.

OR

ii Explain alkene metathesis in detail.

6. i What do you mean by coupling reactions? Explain the mechanism of Mizoroki-Heck reaction.

OR

ii Discuss cyclic process and advantages of 'Stille Coupling'.

PART – C

7. What are organometallic compounds? How are they classified?

8. What do you mean by fluxional organometallic compound? Give the rate of rearrangement and study technique of fluxional molecules of C. No. 4 and 5.

9. Explain preparation, structure and reaction of ferrocene.

10. Explain the following:

- (a) Turn over number
- (b) Turn over frequency
- (c) Hydroformylation
- (d) Dehydrogenation of alkene

11. Explain following reactions:

- (a) Kumada coupling
- (b) Sonogashira reaction

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M.SC. (CHEMISTRY) Semester-III (WINTER-2019)
MSCH314 ORGANIC SYNTHESIS-I

Time – Three Hours

Maximum Marks – 80

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PART – A

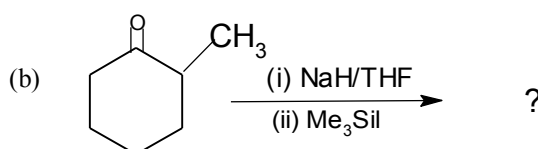
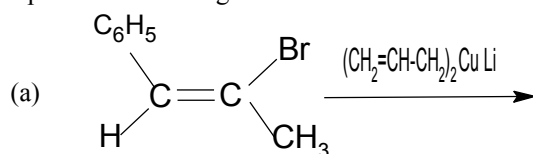
- Write percent ionic character of some carbon-metal bonds.
 - Give full forms of 'HMPA' and 'TMEDA'.
 - What is sharpless method?
 - What is epoxidation?
 - Define Wilkinson catalyst.
 - What is Rosenmund reduction?
 - Write differences between intermolecular rearrangement and intramolecular rearrangement.
 - What is free radical rearrangement?
 - What do you mean by polycyclic aromatic compound?
 - Draw the structure of pyrene and benz(a)anthracene.

PART – B

- Give three methods of preparation of organo-lithium compound.

OR

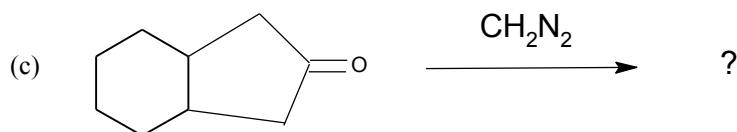
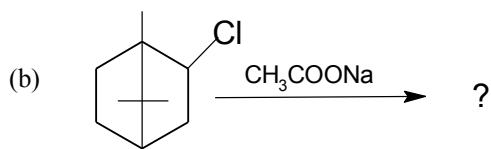
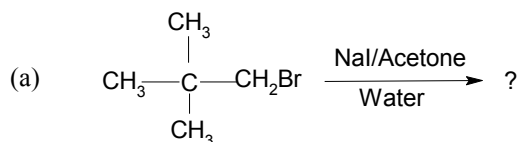
- Complete the following reaction:



- Explain oxidative cleavage of alkenes by Lemieux reagent.

OR

- Write a note on oxidation with iodobenzene diacetate.
 - Explain deoxygenation of epoxides to alkenes.
- OR**
- Explain reductive cleavage of epoxides to alcohols.
 - Write note on memory effect.
- OR**
- Give product in each of the following reactions:



6. i Give synthesis of naphthacene according to linear ortho-fused polynuclear hydrocarbons.
OR
 ii Give synthesis of benz(a)anthracene according to non-linear ortho-fused polynuclear hydrocarbons.

PART – C

7. Explain preparation and properties of organo zinc compound.
8. Write notes on oxidation of activated saturated C-H group.
9. Give reactions for the following conversions:
 (a) Acid chloride to aldehyde
 (b) Cyanide to aldehyde
10. Write reactions of the following:
 (a) Pinacol-pinacolone rearrangement
 (b) Wagner-Meerwein rearrangement
11. Explain spectroscopic properties of polycyclic aromatic hydrocarbons.