



UNIVERSITY OF THE PUNJAB

M.A./M.Sc. Part – II Supply – 2020 & Annual – 2021

Roll No.

Subject: Chemistry

Paper: I-A Physical Chemistry (Special)

Time: 3 Hrs. Marks: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q.1. What are nuclear processes? Discuss nuclear fission and nuclear fusion in detail. 25
- Q.2. What is radioactive decay? Give its types of radioactive decay with examples. Discuss the kinetics of radioactive decay in detail. 25
- Q.3. Discuss Langmuir Hinshelwood mechanism of catalytic reaction of two gases on solid surface. 25
- Q.4. Explain osmosis and osmotic pressure. How would you determine the molecular weight of macromolecules by Osmometry? 25
- Q.5. What are emulsions? Give classification of emulsions. Discuss the methods of preparation of emulsions. 25
- Q.6. What is SOL? Give classification of SOL. Discuss the methods purification of SOL in detail. 25
- Q.7. Write short notes on any TWO of the following: 25
- (i) Enzyme inhibition
 - (ii) Electro-osmosis
 - (iii) Gels



UNIVERSITY OF THE PUNJAB

M.A./M.Sc. Part – II Supply 2020 & Annual – 2021

Subject: Chemistry Paper: II-A / I-2-N Physical Chemistry (Additional)

Roll No.
Time: 3 Hrs. Marks: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

1. a) Write a note on quantum efficiency and its determination (13)
b) Discuss in details the photosensitized reactions (12)
2. a) What is molar mass average? Discuss the significance of molar mass distribution. (12)
b) Discuss the various analysis of polymer in brief. (13)
3. a) Derive expression for the rotational energy of diatomic molecule using quantum mechanical method. (15)
b) Discuss different types of vibrational modes in polyatomic molecules. (10)
4. a) What is principle of electronic transitions? Give different types of electronic transitions. (12)
b) What is Raman spectroscopy? Discuss pure Raman spectra of linear molecules. (13)
5. a) Write a note on application of IR spectroscopy. (13)
b) What is nature of light radiations? Classify different types of spectroscopy on the basis of spectral region. (12)
6. Explain the following thermodynamic functions for ideal solutions: (25)
a) Chemical Potential
b) Gibbs free energy change for mixing
c) volume change of mixing
d) enthalpy change of mixing
7. Write notes on any TWO of the followings: (12.5 +12.5)
a) Photosensitized reactions
b) Separation of solid solutions
c) Kinetic of co-polymerization

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UNIVERSITY OF THE PUNJAB

M.A./M.Sc. Part – II Supply 2020 & Annual – 2021

Subject: Chemistry Paper: I-B Inorganic Chemistry (Special)

Roll No.

Time: 3 Hrs. Marks: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q. No.1**
- a) How 3c-4e bond model can be used to predicted the shapes of molecules? 12
 - b) Discuss the role of Organic Reagents in spectrophotometric analysis. 13
-
- Q. No.2**
- a) Explain the Directed Valence Theory with suitable examples. 10
 - b) What are Silicones? How are they prepared? Discuss their applications. 15
-
- Q. No.3**
- a) Discuss the chemistry of 8-Hydroxyquinolin and ortho-phenanthroline. 12
 - b) What are the Periodic anomalies of the non metals and post transition metals. 13
-
- Q. No.4**
- a) How Born Haber cycle is used to calculate the lattice energy of rock salt. 08
 - b) Derive Born Lande Equation to calculate lattice energy? 07
 - c) What are Chelates? Discuss their stability and uses. 10
-
- Q. No.5**
- a) What are borazine? How are they prepared? Discuss their applications.. 15
 - b) Compare the principle and instrumentation of ICP and AAS?
-
- Q. No.6**
- a) Derive Kapustinskii equations and explain their importance in thermodynamics. 10
 - b) What are the types of EDTA titrations? Explain them in detail. 15
-
- Q. No.7** Write note on any TWO of the followings:
- i. Role of d-orbital in sigma bonding
 - ii. Chemistry of Nitron and DMG
 - iii. Inorganic Polymers
- 2x12.5
=25



NOTE: Attempt any FOUR questions. All questions carry equal marks.

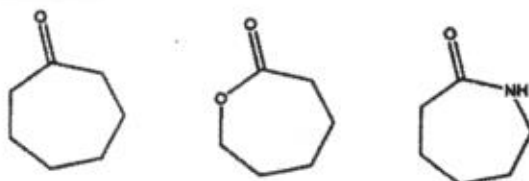
- Q.No.1 a) What are Organometallic compounds? Describe their different methods of preparation. (12)
- b) Discuss the redox reactions with Inner Sphere Mechanism giving suitable examples. (13)
- Q.No.2 a) Discuss the structure and function of metalloporphyrin. (10)
- b) Describe different methods of detection and measurement of radioactivity. (15)
- Q.No.3 a) What are non-aqueous solvents? Discuss various chemical reactions carried out in liquid Ammonia. (12)
- b) Derive the mathematical relationship between disintegration constant and half-life time of a radioactive substance. Also co-relate it with initial amount of radioactive material. (13)
- Q.No.4 a) Describe chemistry of mixed metal oxides. (12)
- b) Differentiate between labile and inert complexes. Classify them on the basis of electronic configuration and size to charge ratio of metal ion involved? (13)
- Q.No.5 a) Discuss the chemistry of ferrocene. (13)
- b) What is cis-platin? Why its trans isomer inactive? Discuss cis-platin mechanism of action in chemotherapy. (12)
- Q.No.6 a) Discuss the chemistry of molten salts. (12)
- b) Discuss the chemistry of $2e^-$ donor system. (13)
- Q.No.7 Write note on any TWO of the followings: 2x12.5=25
- i) Radioactivity
 - ii) SN_1 and SN_2 reactions
 - iii) Classification of organometallic compounds



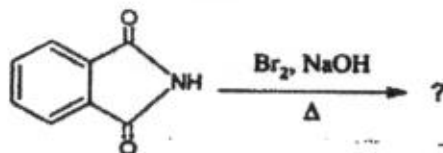
NOTE: Attempt any FIVE questions. All questions carry equal marks.

- Q.1 (i) In pyridinium oxide, the most favorable position towards attack of an electrophile as well as nucleophile is γ -carbon. How would you justify this statement? (5)
- (ii) Outline two methods for the conversion of cyclohexane carboxylic acid into cyclohexane amine. (5)
- (iii) Describe chichibabin reaction and its mechanism? (5)
- (iv) Arrange the following in order of reactivity towards aromatic electrophilic substitution reaction? Explain your answer. (5)
- (a) Benzene (b) Pyrrole (c) Furan (d) Thiophene

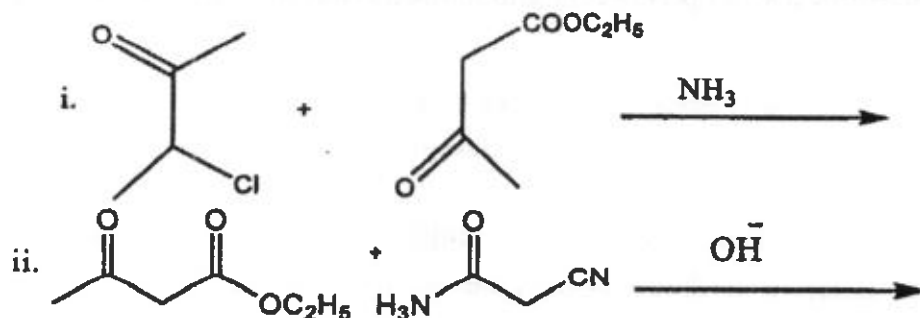
Q. 2 (i) Outline the synthesis of following compounds starting from cyclohexanone. Write complete mechanism for all reactions. (15)



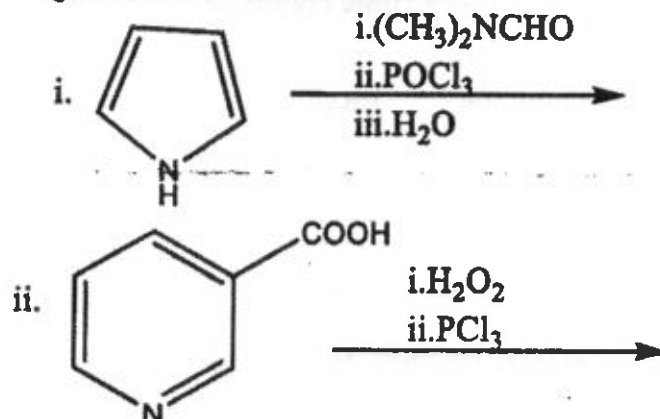
(ii). Complete following reaction with mechanism. (5)



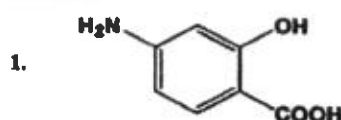
Q.3 (i) Complete the synthesis of following heterocyclic compounds with mechanism. (5x2=10)

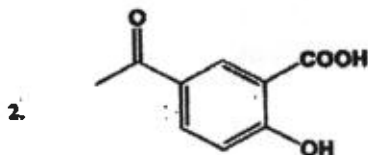


(ii) Complete the following reactions with mechanism. (5x2=10)



Q. 4. (i) Perform the retrosynthetic analysis of the following compound and translate these analyses into forward direction synthesis. (2 x 6 = 12)





(ii) What is difference between cheletropic Addition reaction and cheletropic extrusion reaction. Give one example for each with mechanism. (8)

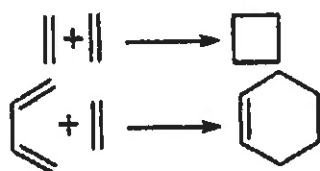
Q. 5 (i) Differentiate between stereospecific reactions and stereoselective reactions.

Give one example for each. (5)

(ii) Discuss the structure and stability of Boranes. (5)

(iii) Write one method for the protection and deprotection of alcohols in chemical reaction. (10)

Q. 6 (i). Which of the following reactions will proceed thermally and which will undergo photochemically? Explain your answer by using frontier molecular orbital (FMO) approach. (10)



(ii) Label and justify A and B in the following (4)



(iii) Give two examples for each of the following reactions. (6)

- Group transfer reaction
- [3, 3] Sigmatropic reaction

Q. 7 Write one method for the protection and deprotection of aldehydes and ketones in chemical reaction. (10)

(i) What is Chemo-selectivity? Give an example. (2)

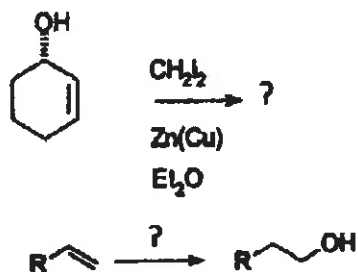
(ii) What are the requirements for solid phase synthesis? Give one example of solid phase synthesis. (8)

Q.8 (i) How would you differentiate between singlet carbene and triplet carbene? (5)

(ii) What are different methods for the generation of nitrene? (10)

(iii) Give synthetic applications of nitrenes. (5)

Q.9 (i) Complete the following reactions? Draw complete mechanisms. (2x5 =10)



(ii) What is phase transfer catalysis? Explain with example. (5)

(iii) Describe the following terms in disconnection approach. Give examples. (5)

- Functional group interconversion
- Synthons
- Synthetic equivalent



NOTE: Attempt any FIVE questions. All questions carry equal marks.

Q. No. 1.		(4 x 5 = 20)
	a) Arrange the following protons in the decreasing order of their δ values and account for your order? Methyl, ethylene, acetylinic, aryl, aldehyde	
	b) How will you distinguish between <i>p</i> -xylene and mesitylene by PMR spectroscopy?	
	c) What are the main differences between PMR spectroscopy and CMR spectroscopy?	
	d) What are the characteristics of the fragment that provides the base peak in a mass spectrum?	
	e) How will you distinguish between $\text{CH}_3\text{CH}_2\text{Cl}$, $\text{CH}_3\text{CH}_2\text{Br}$, and $\text{CH}_3\text{CH}_2\text{I}$ by mass spectrometry?	
Q. No.2.	What are terpenes? Draw all the steps involved in the biosynthesis of cholesterol.	(20)
Q. No.3. a)	How could you distinguish the PMR and CMR spectra of the following compounds? i. $\text{CH}_3\text{OCH}_2\text{OCH}_3$ ii. CH_3OCH_3 iii. $\text{CH}_3\text{OCH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{OCH}_3$ iv. <i>p</i> -xylene	(2.5 x 4 = 10)
b)	Define coupling constant and what are the different factors influencing the chemical shift and coupling constant values in $^1\text{H-NMR}$ spectrum.	(10)
Q. No.4.	How can you distinguish among the seven isomers of $\text{C}_4\text{H}_{10}\text{O}$ by the number of distinct signals and the areas under them in their PMR spectra?	(20)
Q. No.5. a)	What fragments are expected as a result of McLafferty rearrangement in the following compounds? (10)	
	i) 5-Methyl hexanal, ii) 4-Methyl-2-pentanone, iii) 2-Butylcyclohexanone,	
	iv) Butyl 2,2-dimethylpropanoate, v) 2-Ethylhexanoic acid.	
b)	The mass spectrum of butyraldehyde shows a prominent peak at m/z 44. How will you explain it? (5)	
c)	The mass spectrum of phenetole exhibits a peak at m/z 94. How will you explain it? (5)	
Q. No. 6.	Differentiate between the following with suitable examples. (10 + 10)	
	(a) E1 & E2 elimination reaction with the help of examples.	
	(b) Saytsev & Hoffman rules and the factors favouring each of them.	
Q. No.7.	What are the factors affecting SN1 and SN2 Reactions. Explain with the help of suitable examples. (10 + 10)	
Q. No.8.	Deduce the structure of each of the following compounds on the basis of their molecular formula and PMR data. 4 x 5 = (20)	
	i. $\text{C}_{10}\text{H}_{14}$: δ 1.3 (9H, singlet) and 7.0-7.5 (5H, multiplet)	
	ii. C_6H_{14} : δ 0.9 (12H, doublet) and 1.4 (2H, heptet)	
	iii. $\text{C}_4\text{H}_6\text{Cl}_4$: δ 3.9 (4H, doublet) and 4.6 (2H, triplet)	
	iv. $\text{C}_3\text{H}_7\text{OCl}$: δ 2.0 (2H, quintet), 2.8 (1H, singlet), 3.7 (2H, triplet) and 3.8 (2H, triplet).	
Q. No.9. a)	How will you distinguish among the <i>pri</i> , <i>sec</i> , <i>tert</i> -butyl alcohols by mass spectrometry? (5)	
b)	How will you distinguish between benzene, toluene, <i>m</i> -xylene and mesitylene by PMR spectra? (5)	
c)	Write a short note on Quadruple mass analyser. (5)	
d)	How could PMR and CMR spectra distinguish the following compounds? (5)	



UNIVERSITY OF THE PUNJAB

M.A./M.Sc. Part – II Supply 2020 & Annual – 2021

Roll No.

Subject: Chemistry

Paper: IV (Environmental Chemistry)

Time: 3 Hrs. Marks: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q. 1 (a) Discuss the importance of ENVIRONMENTAL EDUCATION. (10)
- (b) Briefly discuss three types of WASTEWATER TREATMENT (primary, secondary and tertiary). (15)
- Q. 2 (a) What is AIR POLLUTION? Describe the sources and impacts of any five (5) air pollutants. (10)
- (b) Write note on Cd (Cadmium) and Pb (Lead) as environmental pollutants. (10)
- (c) What is BIOMAGNIFICATION? (5)
- Q. 3 (a) Compare and contrast BOD and COD methods. What are their advantages and disadvantages? (15)
- (b) How pH of soil relates to NUTRIENT AVAILABILITY? (10)
- Q. 4 (a) What are NEQs? Discuss any five (5) NEQs related to drinking water. Provide their guideline values. (10)
- (b) Highlight the significance of ENVIRONMENTAL MONITORING? (15)
- Q. 5 (a) What are the sources of soil ALKALINITY and ACIDITY and explain the impact of pH on plants? (15)
- (b) What is GREEN HOUSE EFFECT? How it is related with GLOBAL WARMING? (10)
- Q. 6 (a) Discuss industrial, agricultural and municipal sources of WATER POLLUTION? (15)
- (b) How GC technique helps in organic pollutant monitoring? (10)
- Q. 7 Write a note on any three of the followings; (8+8+9)
- (a) Acid rain
- (b) Nuclear energy
- (c) Photochemical smog
- (d) Aflatoxins
- (e) Arsenic poisoning



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M.A./M.Sc. Part – II Supply 2020 & Annual – 2021

Subject: Chemistry Paper: I-D: Bio-Chemistry (Special)

Roll No.

Time: 3 Hrs. Marks: 100

NOTE: Attempt any FIVE questions. All questions carry equal marks.

1. a) Write down the important reactions involved in gluconeogenesis. (10)
b) Discuss decarboxylation of Urea in detail. (10)
2. a) Describe biosynthesis and Catabolism of Pyrimidines. (12)
b) Discuss the different disorders linked to serum urate levels. (08)
3. a) Describe the role of electron transport chain in ATP synthesis. (10)
b) Discuss the Citric acid Cycle in detail. (10)
4. a) Write down different steps involved in glycolysis and calculate energy yield in each step. (12)
b) Describe the Uronic acid pathway in detail. (08)
5. a) Discuss the digestion and absorption of protein. (10)
b) Write briefly about the female sex hormones. (10)
6. Discuss in detail the chemistry, biosynthesis, regulation and functions of Insulin hormone in the body. (20)
7. a) Describe the metabolism of essential fatty acids and their metabolic disorders. (12)
b) Write about prostaglandins in detail. (08)
8. a) Discuss Creatine and creatinine synthesis and secretion in the body. (12)
b) Make a list of hormones secreted by Posterior Pituitary gland. Discuss briefly about the Antidiuretic hormone (08)
9. Write a note on any two of the following (10+10)
 - a) Uncouplers of oxidative phosphorylation
 - b) HMP shunt
 - c) Oxytocin hormone



NOTE: Attempt any FIVE questions. All questions carry equal marks.

- Q. 1. a. Describe the composition of normal urine? Why it's composition is changed during various pathological conditions? (10)
- b. Elaborate the structure and functions of kidney. Write down the role of kidney in detoxification of drugs. (10)
- Q. 2. What is the role of immune system in the management of COVID-19? How cell mediated and Humoral response coordinate with one another to combat the pathogens. (20)
- Q.3. Discuss antibiotic, anti-viral, anti-malarial and anti-fungal drugs with at least two suitable examples in each case. What is meant by drug resistance? (20)
- Q.4. Write notes on the followings. (20)
- i. Recombinant technology
 - ii. Hemoglobin degradation
 - iii. CSF
 - iv. Radioisotopes
- Q.5. Describe the regulation of gene expression in prokaryotes and eukaryotes. What steps are involved in protein synthesis? (20)
- Q.6. What is fermentation biotechnology? Discuss the industrial production of lactic acid and ethanol through fermentation, (20)
- Q.7. Differentiate between the followings. (20)
- i. HPLC and GC
 - ii. ELISA and RIA
 - iii. Myeloma and Hybridoma
 - v. Buffer and solution
- Q.8. Write down the importance of vitamins in the biological system. Give the biochemical functions, deficiency symptoms and requirements of the vitamin A and D. (20)
- Q. 9. How the proteins can be extracted and partially purified by following different biochemical techniques. What is the significance of K_m in protein purification, (20)



NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q1. a) Discuss the detail note on the sensitivity of detectors used in GC. 10
b) Write a note on Columns and stationary phases and specialized stationary phases used in GC. 10
c) How will you calculate column efficiency and coating efficiency in GC column. 05
- Q2. a) Discuss the solvent delivery systems used in HPLC. 10
b) Write a note on chemically bonded stationary phases for HPLC. 10
c) Discuss the effect of temperature and diffusion on HPLC results. 05
- Q3. a) How membrane electrodes works. What is acidic and alkaline error. 10
b) Explain the working of the Indicator Electrodes of the Kind. 10
c) Write a note on membrane electrodes for ions other than proton. 05
- Q4. a) Write a not on the electrodes of Redox type. 07
b) Discuss a note on the applications of Conductometry in Chemistry. 07
c) Discuss the applications of Polarography for both inorganic and organic compounds. 11
- Q5. a) Write a note on differential pulse polarographic techniques, why they are more sensitive than Conventional techniques. 10
b) Discuss various factors which affect Diffusion Current and half wave potential. 15
- Q6. a) Why anodic stripping voltametry more sensitive than other polarographic techniques. 05
b) Write a note on amperometric titrations with single and twin micro electrodes. 20
- Q7. a) Write general principle and instrumentation of DTA. 10
b) What does enthalpy represent and what type of information it provides. How is it determined. 15



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M.A./M.Sc. Part – II Supply 2020 & Annual – 2021

Roll No.

Subject: Chemistry Paper: II-E (Analytical Chemistry) (Additional)

Time: 3 Hrs. Marks: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q.1a) Explain the Basic Principle of UV/Visible Spectroscopy with Examples. (08)
- b) Describe different Parts of Instrumentation which play an Important Role in UV/Visible Spectrophotometers. (10)
- c) What do you know about the Electromagnetic Spectrum? (07)
- Q.2a) Describe the Vibrational Spectra in Gaseous Phase and Inert Gas Matrices. (08)
- b) Justify the Importance of FTIR Spectroscopy in Chemical Analysis with Examples. (09)
- c) Explain the Normal Coordinate and Normal Vibrations. (08)
- Q.3a) Describe the Instrumentation for Measuring Phosphorescence. (10)
- b) Write a brief note on Chemiluminescence. (06)
- c) Explain the Tubing System in ICP-Torch of ICPOES. (09)
- Q.4a) Discuss the Analytical Applications of Nitrogen Laser. (09)
- b) Explain the Multi-Level Laser Systems. (07)
- c) Describe the Advantages of Laser Spectroscopy. (09)
- Q.5a) Discuss the Analytical Applications of NMR Spectroscopy. (10)
- b) What is meant by Spin-Spin Coupling? (05)
- c) Describe the Selectivity of Solvents for Analysis through NMR Spectroscopy. (10)
- Q.6a) What is the difference between CI and ESI Ionization Source? Explain with the help of Examples. (07)
- b) Mention the Phenomenon which is being carried out in Time of Flight and Double Focusing Mass Analysers. (09)
- c) How can the Molecular Mass Spectrometry be helpful for the Confirmation of Synthetic Products? (09)
- Q.7 Write comprehensive notes on the following: (9, 8, 8)
- a) Sources of UV/Visible Spectroscopy
- b) Isotope Incorporation
- c) Single and Double Focusing Magnetic Analysers



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M.A./M.Sc. Part – II Supply 2020 & Annual – 2021

Subject: Chemistry Paper: I-F: Applied Chemistry (Special)

Roll No.

Time: 3 Hrs. Marks: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

Q. 01	a) Explain the preparation and industrial application of xylene and propylene?	15
	b) How polyethylene can be prepared and discuss its significance?	10
Q. 02	a) What are the different environmental effects of the paper industry around the vicinity of the industrial unit?	13
	b) Explain process of alkylation and polymerization of petroleum?	12
Q. 03	a) How different fractions of petroleum products are obtained from crude oil? Write down in detail with the help of a labeled flow sheet diagram	07
	b) Write down what type of products can be obtained from the non-volatile remaining portion of the crude oil?	06
	c) What is knocking, why this sound is generated and what are remedial measures normally taken for this problem?	12
Q. 04	a) What is fractional distillation? Discuss different products obtained after fractional distillation?	13
	b) Describe classification, characteristics and uses of polymer in detail.	12
Q. 05	a) Write down various methods for the extraction and refining of vegetable oils. How is refining of crude vegetable oil carried out?	15
	b) What are the different methods used in industry for the extraction of oil from oil containing seeds?	10
Q. 06	a) What are the different possible defects of skin normally observed during inspection of skin in a tannery processes? Briefly discuss with reference to the causes of the defects?	12
	b) Using a flow sheet diagram explain the vegetable tanning process. Give its advantages and disadvantages?	13
Q. 07	Write a short note on the following:-	
	a. Lubricants and paints	05
	b. Distillation of petroleum	05
	c. Hardening of oil	05
	d. Organic fertilizers	05
e. Synthesis of Urea	05	



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M.A./M.Sc. Part – II Supply 2020 & Annual – 2021

Subject: Chemistry Paper: II-F (Applied Chemistry) (Additional)

Roll No.

Time: 3 Hrs. Marks: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q.1** (a) Explain different theories of rusting of iron and its prevention. (13)
(b) Explain the manufacturing of steel by heat treatment. (12)
- Q.2** (a) Explain the principle of electroplating and the different processes involved. (9)
(b) What is the process of electroplating the plastics? (8)
(c) How is chrome plating carried out? (8)
- Q.3** (a) Explain the manufacturing of sugar from sugarcane with the help of flowsheet diagrams. (18)
(b) What is the importance of glucose syrups? (7)
- Q.4** (a) What is the role of chromatographic techniques in industrial quality control? Explain with examples (13)
(b) Describe the role and importance of online analysis and automation in chemical industries. (12)
- Q.5** (a) Explain the process of the destructive distillation of coal. (13)
(b) Write a note on the liquified petroleum gases. (12)
- Q.6** (a) Write a note on the classification of dyes. (13)
(b) How are dyes of different classes prepared? (12)
- Q.7** Write a short note on any TWO of the following (12,13)
(i) Theories of corrosion
(ii) Gas Chromatography
(iii) Manufacturing of Cast Iron