RK UNIVERSITY

SYLLABUS

Course Title	**SPECTROSCOPY**
Course Code	MGC101
Course Credit	Lecture : 04
	Tutorial : 00
	Practical : 00
	Total : 04

Detailed Syllabus:

Sr. No.	Name of chapter & Details	Session Allotted
	SECTION-I	
1	**Infrared Spectroscopy:** Principle, Theory, Instrumentation, sample handling, applications of IR spectroscopy: Normal modes of vibration, complicating factors: overtone and combined bands, Fermi resonance, coupling, vibration-rotation bands, factors affecting IR group frequency, Michelson Interferometers, Spectral analysis.	**10**
2	**Nuclear Magnetic Spectroscopy:** **^{1}H NMR Spectroscopy** Principles, Theory and Instrumentations, elementary ideas of NMR integration, chemical shifts, factor affecting chemical shifts, coupling (first order analysis), different spin system, mechanism of spin coupling Eg. AB, ABX, factors affecting vicinal and germinal couplings, long range coupling, spin decoupling, shift reagents, solvent shifts, nuclear overhauser effect, 2D NMR (COSY, NOSEY, HECTOR), spectral analysis and applications.	**10**
3	**^{13}C NMR Spectroscopy:** Principles, broad band decoupling, chemical shift features of hydrocarbons, effects of substituent on chemical shifts, olefinic, acetylenic, aromatic, and carbonyl carbons, DEPT.	**05**
4	**Multinuclear NMR Spectroscopy:** Applications of multinuclear NMR – Examples from ^{19}F, ^{15}N, ^{77}Se, ^{119}Sn, ^{199}Hg, and ^{31}P NMR of paramagnetic molecules – Lanthanide shift.	**05**
	SECTION-II	
5	**Mass Spectroscopy:** Principle, Theory, Instrumentation, Sample handling, Applications of Mass Spectroscopy. Mode of ionization, mode of fragmentation, fragmentation associated with functional group, different types of ions, isotopic peaks, MALDI-TOF.	**10**

6	**UV-VIS Spectroscopy:** Principle, Theory, Instrumentation, Sample handling, Applications of UV Spectroscopy. Double beam UV spectrometer, absorption and emission spectra, solvent cut-off, factors affecting UV-vis spectra, Woodward-Fieser rules for dienes, enones and aromatic compounds.	**10**
7	**Problems Based on Spectral Data Interpretation:** Structure elucidation through various spectroscopic data such as FTIR, NMR, UV and MS. On the basis of structure, spectroscopic data analysis.	**10**

Instructional Method and Pedagogy:

1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
3. Surprise tests/Quizzes/Tutorials will be conducted.
4. Problem solving through analysis of spectra.

Students Learning Outcomes:

At the end of the course the students will be able to:

- **Differentiate** the advance methods of spectroscopy.
- **Interpret** the spectroscopic data and spectra.
- **Identify** the application of various spectroscopic techniques.

Reference Books:

1. Spectrometric Identification of organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley, 2008.
2. Spectroscopy of Organic Compounds, P. S. Kalsi, 5th edition, New age international publishers, 2012.
3. Principles of instrumental analysis, Douglas A. Skoog, F. James Holler and Stanley R. Crouch, Thomson publishers, 6th Edition, 2007.
4. Organic Spectroscopy (NMR, IR, Mass and UV), S. K. Dewan. CBS publishers, 2010.
5. Spectroscopy Methods in Organic Chemistry, D. H. Williams, I. Fleming, Tata McGraw-Hill, 2005.
6. Introduction to spectroscopy, Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, Wadsworth Publishing Co. Inc., 2015.

RK UNIVERSITY	**SYLLABUS**
Course Title	**ORGANIC CHEMISTRY-I**
Course Code	MGC102
Course Credit	Lecture : 04
	Tutorial : 00
	Practical : 03
	Total : 07

Detailed Syllabus:

Sr. No.	Name of chapter & Details	Session Allotted
	SECTION-I	
1	**Reaction Path Way and Effect of Structure on Reactivity:** Heterolytic and homolytic fission, Different types of arrow notation, Electrophiles and Nucleophiles,	**10**
2	**Various Types of Organic Reaction:** **Nucleophilic C-C bond formation:** Aldol condensation, Horner-wordwoth-Emmons reaction, Mukaiyama reaction, Wittig reaction **Electrocyclic C-C Bond Formation:** Nazarov cyclization reaction, Prins reaction, Vilsmeier-Haack reaction, Noyari reaction, Stille coupling	**10**
3	**Miscellaneous Reaction:** Barbier-Wieland reaction, Birch reaction, Bouveault reaction, Chichi Babin reaction, Clemenson reaction, Elbs-persulphate reaction, Freytag reaction, Grubb's reaction, Hoffman-Loffler reaction, Hydroboration reaction, Knoevenagel condensation reaction, Michael addition reaction	**10**
	SECTION-II	
4	**Reagents**: Sodium cyanoborohydride, 9- BBN, Dess martin per iodination, Ceric ammonium nitrate, Lithium diisopropylamine (LDA), Dicyclohexylcarbodiimide (DCC), Trimethylsilyl iodide, Peterson's synthesis, Lithium dimethylcuprate (LDC), Woodward and Prevost hydroxylation, Wilkinson's catalyst, Phase transfer catalyst	**15**
5	**Rearrangements:** Benzil-benzilic acid rearrangements, Pinacole-pinacolone rearrangements, Wagner-Meerwein rearrangements, Demjnov rearrangements, Favorskii rearrangements, Arndt-Eistert rearrangements, Neber rearrangements, Baeyer-	**15**

	Viliger rearrangements, Beckmann rearrangements, Curtious rearrangements, Schmidt rearrangements, Fries rearrangements	

List of Practicals (3 Hours Per Week):

Type I: Laboratory apparatus standardization related practical

1. Calibration of thermometer by using standard organic and inorganic compounds.
2. Calibration of regularly use glass wares.

Type II: Organic Spotting, derivatisation and crystallization related practical (Single compound)

1. Substituted Benzoic acid,
2. Benzaldehyde,
3. Napthaldehyde,
4. Glycine,
5. Ethyl acetate,
6. Nitrobenzene,
7. Glucose,
8. Substituted Amines,
9. Different Functional group containing compounds/Hetero aryl/Aryls, etc.

Type III: Preparation of various intermediate and chemicals related practical

1. Preparation of Aspirin from salicylic acid
2. Preparation of Aniline to Acetanilide.
3. Preparation of Acetanilide to *p*-nitro acetanilide.
4. Preparation of *p*-nitro acetanilide to p-nitro aniline.
5. Preparation of Nitrobenzene to dinitrobenzene.
6. Preparation of Benzaldehyde to Dibenzaldehyde by Claisen-Schmidt reaction.
7. Preparation of Resorcinol to 4-methyl-7-hydroxy Coumarine.
8. Preparation of Aniline to p-bromoaniline.
9. Preparation of Resorcinol to res-acetophenone.
10. Preparation of Hydroquinone to hydroquinone diacetate.

Instructional Method and Pedagogy:

1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
3. Surprise tests/Quizzes/Tutorials will be conducted.
4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
5. Minimum ten experiments shall be there in the laboratory related to course contents.

Students Learning Outcomes:

At the end of the course the students will be able to:

- **Synthesize** different types of new organic compounds.
- **Purify or isolate** the organic compound from the side product.
- **Generate** a different way for preparation of molecules and various derivatives.

Reference Books:

1. Advanced Organic Chemistry, Part A and B, Carey & R. J. Sanburg, 3rd Edition, 1990.
2. Fundamentals of Organic Reaction Mechanisms, Wamser & Harris, John Wiley, 1990.
3. Organic reaction mechanism, R. K. Bansal, New age international publishers, 4th Edition, 2010.
4. Organic reaction mechanism, A. C. Knipe, John Willey and Sons, 2nd Edition, 1997.
5. Organic Chemistry, Jonathan Claiden, Oxford University Press, 2nd Edition, 2012.

RKUNIVERSITY	SYLLABUS

Course Title	**ANALYTICAL CHEMISTRY-I**
Course Code	MGC103
Course Credit	Lecture : 04
	Tutorial : 00
	Practical : 03
	Total : 07

Detailed Syllabus:

Sr. No.	Name of chapter & Details	Session Allotted
	SECTION-I	
1	**Basic Concept of Analytical Chemistry:** Introduction, Importance of analytical chemistry, Classification of analytical methods – Classical and instrumental methods 1. Types of analysis - Quantitative analysis and Qualitative analysis. 2. Basic of titrimetric methods of analysis – Precipitation, redox, complexometric and neutralization. Non-aqueous titration – Importance, concept of Arrhenius, Bronsted-Lowry and Lewis acid-base theory for non-aqueous theory, types of solvents, titration of weak acid and weak base, strength of acid, Applications	**10**
2	**Chemical Calculations:** Concentration units, Solutions preparation, Standardization of solutions and reagents, Primary and secondary standards, Buffers solutions, calibrations in laboratory practices.	**10**
3	**Data Analysis:** Types of errors, normal error curve, accuracy and precision, Data processing – significate figures, mean, median, mean deviation, standard deviations, confidence limits, test of significance: t test and F test, rejection of data, , numerical of data analysis.	**10**
	SECTION-II	
4	**Food Analysis:** Moisture, ash, crude, protein, fat, crude fiber, carbohydrate, Ca, K, Na, oil and fat analysis.	**08**

5	**Green Chemistry Approach:** Introduction, importance and twelve principles of green chemistry, current trends of synthesis and techniques of green chemistry.	**09**
6	**Solvent Extraction:** Principle, theory, classification and application.	**13**

List of Practicals (3 hours Per Week):

1. Preparation and standardization of 0.1 N HCl, 0.1 N H_2SO_4 and 0.1 N HNO_3 against standard NaOH solution. To find out the mean and standard deviation.
2. Preparation and standardization of 0.1 N and 0.5 N NaOH against succinic acid. To find out the mean and standard deviation.
3. Preparation and standardization of 0.1 N I_2, or 0.1 M I_2 solution against standard $Na_2S_2O_3$ solution. To find out the mean and standard deviation.
4. Preparation and standardization of 0.1 N $KMnO_4$ solution against standard oxalic acid solution. To find out the mean and standard deviation.
5. Preparation of Indicators and buffer solutions
6. To estimate the Ca^{+2} and Mg^{+2} in the given sample by complexometric titration.
7. To determine the amount of ascorbic acid in a given sample.
8. To determine the % of phthalic anhydride or maleic anhydride in the given sample.
9. To determine the crude fiber in the given sample of ginger powder.
10. To determine amount of benzyl benzoate in given sample.
11. To determine % of calcium gluconate in the given sample by complexometric titration.

Instructional Method and Pedagogy:

1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
3. Surprise tests/Quizzes/Tutorials will be conducted.
4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
5. Minimum ten experiments shall be there in the laboratory related to course contents

Students Learning Outcomes:

At the end of the course the students will be able to:

- **Know** about the importance of classical and instrumental methods.
- **Differentiate** the aqueous and non-aqueous titrations.
- **Able to** prepare a various solutions and reagents used in laboratory**.**
- **Calculate** the deviations and measure the errors associated with measurements that is widely used in pharmaceutical industries.
- **Identify** the ingredients present in the foods
- **Differentiate** conventional and green ways that are used for synthesis of drugs and other chemicals.

  Identify the application of solvent extraction in chemical analysis.

Reference Books:

1. Instrumental method of chemical analysis by B. K. Sharma. 24th edition**,** Goel publishing house Meerut, 2005
2. Vogel's Textbook of quantitative analysis by L. Barrtal ELBS, Pearson Education, 2009.
3. Instrumental method of Chemical Analysis by G. R. Chatwal & S. K. Anand, 5th Edition, Himalaya Publication House, 2012.
4. Analytical Chemistry: Principles by J. H. Kennedy, Cengage Learning India, 2011.
5. Handbook of Food Analysis by S. N. Mahindru, Swan Publishers, New Delhi, 1977.
6. Fundamentals of Analytical Chemistry by D. A Skoog, D. M West, F. J. Holler, S. R. Crouch, 8th Edition, Saunders College, 2001.
7. Green Chemistry: Environmentally Benign Reactions V. K. Ahluwalia, CRC Press, 2008.
8. Statistical Methods in Analytical Chemistry by P. C. Meier, R. E. Zund, 2nd Edition, John Wiley & Sons., 2000.
9. Introduction to chemical analysis by R. D. Braun, McGraw-Hill, International Edition, 1982.
10. Contemporary Chemical analysis by J. F. Rubinson, K. A. Rubinson, 1st edition, Prentice- Hall International Inc. 1998.

RKUNIVERSITY	SYLLABUS

Course Title	**PHYSICAL AND INDUSTRIAL CHEMISTRY**	
Course Code	MGC104	
Course Credit	Lecture : 04	
	Tutorial : 00	
	Practical : 03	
	Total : 07	

Detailed Syllabus:

Sr. No.	Name of chapter & Details	Session Allotted
	SECTION-I	
1	**Industrial Unit Processes:** Study of following processes with special emphasis on chemistry & chemical engineering principles of following processes: Halogenations, Alkylation, Oxidation, Hydrogenation & Reduction, Nitration, Sulphonation, Hydrolysis & Esterification.	**16**
2	**Industrial Unit Operations:** Theory and application of, Absorption, Distillation, Liquid Extraction, Drying, Filtration	**14**
	SECTION-II	
3	**The Properties of Solutions and Solvents:** Properties of Ideal Solutions, Application of Raoult's Law to Both constituents of an Ideal Solution, Vapour Pressure Curves, The Freezing Points of Dilute Solutions, Determination of Molecular Weights, The Boiling Points of Solutions. Classification of solvents, Polarity of solvents, Physical properties of solvents, Miscibility of solvents, solvents system designing	**15**
4	**Chemical Kinetics:** Opposing reactions. Principles of details of balancing. Rate constants and equilibrium constants. Consecutive reactions. Parallel reactions. Reactions in flow systems. Theory of unimolecular, bimolecular and trimolecular reactions. Chain reactions, Ionic reactions and salt effect.	**15**

List of Practicals (3 Hours Per Week):

1. To determine the heat of solution of the given acid by solubility method.
2. Determination of hydrolysis constant of aniline hydrochloride by conductivity method.
3. Determination of the critical solution temperature (CST) of the phenol/water system and to study the effect of additive on CST.
4. To determine partial molar volume of sodium chloride in aqueous solution at room temperature.
5. To determine the dissociation constant (k1 and k2) of a dibasic acid pH metrically.
6. To find out the (a) cell constant of given conductivity cell, (b) to determine the critical micelle concentration (CMC) of an ionic surfactant.
7. Find out the amount of Fe^{3+} in the given solution by colorimetry method.
8. Find out the Normality of a strong acid (HCl) by pH meter.
9. To determine the concentration of a given solution of an optically active substance by polarimetric measurements.
10. Synthesis and derivatisation of some industrially applicable intermediates.
    (a) Reduction of Benzil with $NaBH_4$
    (b) Synthesis of Schiff Base (N,N′-Bis(salicylidene)ethylenediamine)

Instructional Method and Pedagogy:

1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
3. Surprise tests/Quizzes/Tutorials will be conducted.
4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
5. Minimum ten experiments shall be there in the laboratory related to course contents.

Students Learning Outcomes:

At the end of the course the students will be able to:

- Able to understand the chemistry & chemical engineering principles involved in different chemical transformations
- Able to understand the properties of solutions & kinetics involved in chemical processes
- Measure the various physical constants
- Able to correlate between various physical constants
- Able to handles the various instruments used for the measurement of physical constant & reaction parameter

Reference Books:

1. P. Atkins, J. De Paula, Elements of Physical Chemistry, Oxford, 2013.
2. K.J. Laidler, Chemical Kinetics, Pearson, 1987.
3. P.L. Soni, O.P. Dharmarha, U.N. Dash, Textbook of Physical Chemistry, Sultan Chand & Sons, 2001.
4. P. C. Rakshit, Physical Chemistry, Sarat Book House, 2014.
5. B.S. Bhal, Arun Bhal, G.D. Tuli, Essentials of Physical Chemistry, S Chand, 2006.
6. B.R. Puri, L.R. Sharma, Principles of Physical Chemistry, Vishal Publishing Co., 2016.
7. Gurdeep Raj, Advanced Physical Chemistry, Krishna Prakashan Media P. Limited., 2016.
8. Fundamentals of Chemical Thermodynamics, M. L. Lakhanpal, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1983.
9. Thermodynamics, P. C. Rakshit, Current Distributors,1985.
10. Unit Process in organic Synthesis, Groggins, Tata McGraw-Hill Education, 2001.
11. Chemistry of Petrochemical Process, Sami Mater, Levis Hatch, Gulf Professional Pub., 2001.
12. Industrial Organic Chemistry, K. Weissermal, H.J. Arpe, John Wiley & Sons., 2008.