

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

DEPARTMENT OF CHEMISTRY

Curricula & Syllabi for B. Tech. Courses

Subject Code	Subject	L-T-P-H	Credit point
CYC 01	Engineering Chemistry	2-1-0-3	3
CYS 51	CHEMISTRY LABORATORY	0-0-2-2	1
CYC 331	Chemistry - II	3-0-0-3	3
CYS 381	Chemistry – II Laboratory	0-0-3-3	1.5

Department of Chemistry							
Course Code	Title of the course	Program Core (PCR) / Electives (PEL)	Total Number of contact hours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CYC 01	ENGINEERING CHEMISTRY	PCR	2	1	0	3	3
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
None		CT+EA					
Course Outcomes	<ul style="list-style-type: none"> • CO1: Introduced to chemical thermodynamics, kinetics, electrochemistry, absorption and catalytic processes for engineering applications • CO2: To learn fundamentals of polymer chemistry and petroleum engineering. • CO3: Introduced to basic spectroscopic techniques for structure determination and characterization. • CO4: To study few inorganic and bioinorganic compounds of industrial importance. 						
Topics Covered	<p>ORGANIC CHEMISTRY</p> <ol style="list-style-type: none"> Fundamentals of organic reaction mechanisms; Few important reactions and their mechanism along with their applications; Robinson annulation, Hydroboration reaction, Organometallic reagents (Gilman reagents), Metathesis using Grubb's catalyst and Wittig reaction. (3) Fundamental concept on stereochemistry and application: Conformation and configuration of organic compounds, Diastereo-selective, enantio-selective, regio-selective, stereo-specific and stereo-selective reactions. (3) Polymer chemistry and polymer engineering: Fundamental concept on polymer chemistry; synthesis and application of important polymers, Rubber and plastic materials. Conducting polymer. (2) Petroleum Engineering and oil refinery: origin of mineral oils, separation principle and techniques of distillation of crude oil, Uses of different fractions, octane number, cetane number, Knocking, anti-knock compounds, and Bio-Fuel. (2) Structure elucidation of organic compounds by modern spectroscopic methods; Application of UV-Visible and FT-IR spectroscopy. (3) <p>INORGANIC CHEMISTRY</p> <ol style="list-style-type: none"> Coordination Chemistry: Crystal Field Theory of octahedral and tetrahedral complexes, colour and magnetic properties, Jahn-Teller distortion, pseudo Jahn-Teller distortion, Isomerism and stereochemistry.(5) Bioinorganic Chemistry: Heme and non-heme O₂ transport protein (Haemoglobin, Myoglobin), Chlorophyll and photosynthesis. (3) Inorganic Materials: Introduction towards industrially important inorganic materials like cementing material, refractory material, fertiliser, inorganic polymer. (2) Organometallic Chemistry: π-acid ligands, stabilization of metal low oxidation state and 18 electron rules, metal carbonyls and nitrosyls, metal-alkene complexes. (4) <p>PHYSICAL CHEMISTRY</p> <ol style="list-style-type: none"> Thermodynamics: 2nd law of thermodynamics, entropy, free energy, 						

	<p>Gibbs Helmholtz equation, change of phase. Cryogenics: joule Thomson experiment. (4)</p> <p>ii. Chemical Kinetics: 2nd and 3rd order rate expression, Reversible reaction, Chain reaction, Consecutive reaction, Temp effect on reaction rate. (4)</p> <p>iii. Electrochemistry: Electrochemical cell, Effect of pH, precipitation and complex formation on EMF of oxidation/reduction processes. (2)</p> <p>iv. Absorption: Physical and Chemical absorption, Absorption isotherms. (1)</p> <p>v. Catalysis: Types of catalysis, Rate expression for Catalysed reaction, Acid-base and Enzyme catalysis. (2)</p>
<p>Text Books, and/or reference material</p>	<p><u>Suggested Text Books:</u></p> <p>(i) Physical Chemistry by P. Atkins, Oxford</p> <p>(ii) A guidebook to mechanism in Organic chemistry: Peter Sykes; Pearson Edu.</p> <p>(iii) Inorganic Chemistry Part-I & II, R. L. Dutta, The new book stall</p> <p><u>Suggested Reference Books:</u></p> <p>Organic Chemistry:</p> <p>(i) Basic stereochemistry of organic molecules: S. Sengupta; Oxford University press</p> <p>(ii) Engineering Chemistry: Wiley</p> <p>(iii) Elementary Organic Spectroscopy: William Kemp, ELBS with Macmillan</p> <p>Inorganic Chemistry:</p> <p>(i) Inorganic Chemistry: Principle structure and reactivity, J. E. Huheey, E. A. Keiter and R. L. Keiter, Pearson Education</p> <p>(ii) Bioinorganic Chemistry -- Inorganic Elements in the Chemistry of Life: An Introduction and Guide, 2nd Edition, Wolfgang Kaim, Brigitte Schwederski, Axel Klein.</p> <p>(iii) Inorganic Chemistry Fourth Edition, Shriver & Atkins, Oxford</p> <p>Physical Chemistry:</p> <p>(i) Physical Chemistry by G.W Castellan</p> <p>(ii) Physical Chemistry by P. C. Rakshit</p>

Department of Chemistry							
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			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CYS 51	CHEMISTRY LABORATORY	PCR	0	0	2	2	1
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
None		CT+EA					
Course Outcomes	<ul style="list-style-type: none"> • CO1: To learn basic analytical techniques useful for engineering applications. • CO2: Synthesis and characterization methods of few organic, inorganic and polymer compounds of industrial importance. • CO3: Learn chromatographic separation methods. • CO4: Applications of spectroscopic measurements. 						
Topics Covered	<ul style="list-style-type: none"> vi. Experiments based on pH metry: Determination of dissociation constant of weak acids by pH meter. vii. Experiments based on conductivity measurement: Determination of amount of HCl by conductometric titration with NaOH. viii. Estimation of metal ion: Estimation of Fe²⁺ by permangnometry ix. Estimation of metal ion: Determination of total hardness of water by EDTA titration. x. Synthesis and characterization of inorganic complexes: e. g. Mn(acac)₃, Fe(acac)₃, cis-bis(glycinato)copper(II) monohydrate and their characterization by m. p. , FTIR etc. xi. Synthesis and characterization of organic compounds: e.g. Dibenzylideneacetone. xii. Synthesis of polymer: polymethylmethacrylate xiii. Verification of Beer-Lamberts law and determination of amount of iron present in a supplied solution. xiv. Chromatography: Separation of two amino acids by paper chromatography xv. Determination of saponification value of fat/ vegetable oil 						
Text Books, and/or reference material	<p><u>Suggested Text Books:</u></p> <ol style="list-style-type: none"> 1. Vogel's Quantitative Chemical Analysis (6th Edition) Prentice Hall 2. Advanced Physical Chemistry Experiments: By Gurtu & Gurtu 3. Comprehensive Practical Organic Chemistry: Qualitative Analysis By V. K. Ahluwalia and S. Dhingra <p><u>Suggested Reference Books:</u></p> <ol style="list-style-type: none"> 1. Practical Chemistry By R.C. Bhattacharya 2. Selected experiments in Physical Chemistry By N. G. Mukherjee 						

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CYC 331	CHEMISTRY-II	PCR	3	0	0	3	3
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
Engineering Chemistry CYC01		CT+EA					
Course Outcomes	<ul style="list-style-type: none"> • CO1: To learn advanced analytical techniques useful for chemical engineering. • CO2: To learn the few catalytic process commonly used in industrial applications. • CO3: To learn thermodynamics of solutions and understanding of phase diagrams of single and multicomponent systems. • CO4: To learn fundamentals of fats, oils and carbohydrate chemistry together with basics of large scale organic synthesis. 						
Topics Covered	<p>ORGANIC CHEMISTRY</p> <ul style="list-style-type: none"> vi. Organic C-C bond formation: application of Grignard reagents, ethyl acetoacetate and malonic esters. (3) vii. Principles of large scale organic synthesis having industrial importance. (1) viii. Carbohydrate chemistry: Classification, structure elucidation. Reactions of glucose and fructose; mutarotation, inversion of cane sugar. (4) ix. Fats and oils, soaps and detergents. (3) <p>INORGANIC CHEMISTRY</p> <ul style="list-style-type: none"> v. Application of coordination compound in analytical chemistry: complexometric titration, biological application. (2) vi. Analytical methods used to metal ions estimation: Gravimetric, UV-Vis spectrophotometric, atomic absorption spectrometric, solvent extraction etc. (4) vii. Catalyst: General principles, homogeneous catalysts: hydrogenation of alkenes, hydroformylation, methanol carbonylation, Wacker oxidation of alkenes etc. Heterogeneous catalyst: hydrogenation catalysts, ammonia synthesis, alkene polymerisation (Zigler Natta catalyst). (5) <p>PHYSICAL CHEMISTRY</p> <ul style="list-style-type: none"> xvi. Thermodynamic condition of chemical equilibrium, Chemical potential, Activity, Fugacity, Gibbs-Duhem equation, Duhem-Margules equation. 1st and 2nd order transition. (2) xvii. Transition state theory towards rate of elementary chemical reaction, salt effect on rate of a chemical reaction. Photochemical and photophysical processes, Jablonsky diagram. (3) xviii. Phase rule and its derivation, phase diagram of CO₂, H₂O and Sulphur system, two component system, solid-liquid and binary liquid mixture, 						

	<p>fractional distillation, steam distillation, azotrope, ideal and nonideal solution, Raoult's law and Henry's law, Colligative properties. (5)</p> <p>xix. Conductance and transport number, Buffer solution, Debye-Huckel limiting law, Salt effect and common ion effect on solubility of weak electrolytes. Ion-solvent and ion-ion interaction. Electrochemical cell with transference: liquid junction potential. (5)</p>
<p>Text Books, and/or reference material</p>	<p><u>Suggested Text Books:</u></p> <p>(i) Organic Chemistry: R.T. Morrison and R.N Boyd, Prentice Hall of India Pvt.Ltd. (ii) Physical Chemistry by P. C. Rakshit (iii) Inorganic Chemistry Fourth Edition, Shriver & Atkins, Oxford</p> <p><u>Suggested Reference Books:</u></p> <p>Organic Chemistry: (i) Organic Chemistry by Volhardt.</p> <p>Inorganic Chemistry: (i) Inorganic Chemistry Part-I & II, R. L. Dutta (ii) Fundamentals of Analytical Chemistry By Skoog, West, Holler and Crouch</p> <p>Physical Chemistry: (i) Physical Chemistry by P. Atkins, Oxford (ii) Physical Chemistry by G.W Castellan</p>

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CYS 381	CHEMISTRY II LABORATORY	PCR	0	0	3	3	1
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
None		CT+EA					
Course Outcomes	<ul style="list-style-type: none"> • CO1: To learn advanced chemical analysis useful for chemical engineering. • CO2: Estimation of metal ion concentration using advanced spectroscopic techniques. • CO3: Advanced synthesis and characterization methods for few compounds of industrial importance. 						
Topics Covered	xx. Determination of CMC of a surfactant: conductometrically and surface tension measurement. xxi. Potentiometric titration: estimation of Fe ²⁺ in Mohr's salt. xxii. Determination of solubility product of lead iodide. xxiii. Kinetics of ester hydrolysis. xxiv. Spectroscopic Estimation of metal ion: Estimation of Cu ²⁺ / Cr ³ xxv. Estimation of metal ion: Estimation of Na ⁺ , K ⁺ , Ca ²⁺ by Flame photometry xxvi. Estimation of base content of commercially available antacid and acid content of vitamin C. xvii. Synthesis of Mohr's salt. xviii. Synthesis of paracetamol. xxix. Analysis of pyrolusite ore.						
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