Course Description

Course Title/Number: **Chemistry (BS-CH 101)**

Semester: 1st **Section: E (ECE/EE)** **Year: 2022-23**

Name of the Faculty: Dr. Susanta Kumar Saha/ Dr. Rabindranath Singha
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Class Schedule:

Class Schedule				
Lecture		Bridge Course	Tutorial	Practical
Tuesday (10:50AM To11:40 AM)	Wednesday (11:40 AM To12:30 PM)	Thursday (12:30 PM To13:20 PM)	Tuesday (15:00 PM to 15:50 PM)	Monday (13:20 PM to 16:40 PM)

Hours for meeting students:

Recess time or by appointment.

i) **Course Objective**

To impart knowledge on basic chemistry this will help students to establish their career in multidisciplinary area.

ii) **Course Outcomes**

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

The student will demonstrate:

CO 1: List major chemical reactions that are used in the synthesis of molecules.
CO 2: Rationalize bulk properties and processes using thermodynamic considerations and periodic properties such as ionization potential, oxidation states and electronegativity.
CO 3: Classify the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.

CO 4: Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.

Once the student has successfully complete this course, he/she must be able to answer the following questions or perform/demonstrate the following:

1. (a) For a reaction both ΔH and ΔS are positive. Under what conditions will the reaction be spontaneous? (b) What will be the conjugate acids for the following Bronsted bases? NH_3, HCO_3^-, CH_3COO^-, $H_2PO_2^-$.
2. (a) Assign oxidation no. of the followings : 'P' in H_3PO_2, 'Cr' in $K_2Cr_2O_7$, 'S' in H_2SO_5, 'C' in HCOOH. (b) How crystal field theory explains the colours of transition metal complexes?
3. (a) pH of a solution of a strong acid is 5. What will be the pH of the solution obtained after diluting the given solution 100 times? (b) Write the Nernst equation for the cell reaction in the Daniel cell. How will the E_{cell} effected when the concentration of Zn^{2+} is increased? (c) Draw and explain the energy level diagrams for conductor, semiconductor and insulator. (d) Explain enantiomers and diastereoisomers with examples.
4. What is molecular orbital? Calculate the bond order of the following species and indicate their magnetic properties - O_2, O_2^+, O_2^-, O_2^2.
5. Teacher asked two students to write the electronic configuration of d^4 system using CFT in octahedral crystal field. Student I: $t_{2g}^3\ e_g^1$, Student II: $t_{2g}^4\ e_g^0$.
   (a) Suggest which student gives correct configuration. Justify your answer.
   (b) Draw figure to show splitting of degenerate 'd' orbital's in an octahedral crystal field.
6. (a) Give molecular orbital energy level diagram of CO. Write its electronic configuration, magnetic behaviour and bond order. (b) Discuss different types of hydrogen bonding with example.
7. What is semiconductors? Classify the semiconductors and give examples.
8. What is spectrochemical series of crystal field theory? Explain the difference between a weak field ligand and strong field ligand
9. Derive the Nernst equation.
10. Derive the entropy change during reversible expansion of an ideal gas.
11. State and explain the first law of thermodynamics. What is entropy? What is the physical significance of it.
12. What is EMF of a cell? How EMF of a cell is related to free energy (mathematical relation)?
13. (a) What is Lewis acid? Give example. (b) What is solubility product? What will be the solubility product of the salt A_xB_y. (c) Explain principle and applications of Florescence spectroscopy.(d) Draw figure to show the splitting of d orbitals in an octahedral crystal field.$[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Explain.
14. (a) What is the wavelength range of Ultra-violet radiation?
    (b) Write short note on i) Chromophore ii) Auxochrome.
15. Define and derive Lambert-Beer's law.
16. What is "Finger print region in IR spectra? What are the applications of IR spectroscopy?
17. What is NMR spectroscopy? What is MRI?
18. What is chemical shift in NMR spectroscopy?

19. Explain the following reactions with a suitable example. (i) Wolff-Kishner reduction, (ii) Cannizzaro reaction, iii) Friedel Crafts' reaction, iv) Tollens' test and Fehlings' test, v) SN1 and SN2 reaction mechanism, vi) Nucleophilic addition.
20. (a) Phenol on treatment with Br_2 in CS_2 at low temperature gives two isomeric mono bromophenols 'X' and 'Y'. But phenol on treatment with bromine water gives a white precipitate 'Z'. Identify the products 'X', 'Y' and 'Z' with chemical reactions.
    (b) What do you mean by enantiomer and diastereomer? Differentiate them with examples.
    (c) Give one example of each of Friedel Crafts' alkylation and acylation reaction.
    (d) Predict the major product(s) of the following reactions and explain their formation:
    i) $H_3C - CH = CH_2 \xrightarrow[HBr]{(Ph-CO-O)2} \rightarrow$
    ii) $H_3C - CH = CH_2 \xrightarrow{HBr} \rightarrow$
    (e) Write down the criteria for aromaticity.
21. (a) Explain the terms band gap, valence band and conduction band with diagram. Classify the semiconductors with examples.
    (b) Estimate the critical constants of a gas (T_c, P_c and V_c) whose van der Waals constants are, a = 0.751 atm.lit^2.mol^{-1}, b = 0.0226 lit.mol^{-1}. (R = 0.082 lit.atom.mol^{-1}.K^{-1}.)

iii) Topic/Unit/Chapter Layout

Topic/Unit/Chapter	Lecture Hours	Tutorials
Module-1: Atomic and molecular structure.	10	3
Module-2: Spectroscopic techniques and applications.	8	3
Module-3: Intermolecular forces and potential energy surfaces.	4	2
Module-4: Use of free energy in chemical equilibria.	8	3
Module-5: Periodic properties.	4	2
Module-6: Stereochemistry.	4	2
Module-7: Organic reactions and synthesis of a drug molecule.	4	2

iv) Textbooks

1. Chemistry by Gourkrishna Dasmohapatra.

Reference books

1. Physical Chemistry by P.C. Rakshit
2. Inorganic Chemistry by J. D. Lee
3. Organic Chemistry by Morrison & Boyd

(v) Evaluation Scheme

1) Theory

Evaluation Criteria	Marks
Continuous Assessment	25
Attendance	5
University Exam/External Exam	70
Total	100

* The Internal assessment will be determined through the continuous assessment (CA) which is needed to be submitted 4 times in a semester based on performance of the students assessed as per academic calendar published by the University. The 4 nos of CAs will be based on test/ viva/ quiz/ presentation/seminar/ GD etc out of which 2 nos preferably would be tests..

Assignments will be given in all of the following forms
1. Problem Solving—Numeric and conceptual
2. Term paper – A systematic report on a topic to be submitted under supervision after doing necessary exploration of knowledge on the topic.
3. Mini project – A small project on the topic or problem assigned by the teacher and covered by the course being taught. The duration of the project will be not more than one month.
4. Presentation & Seminar – The student will prepare a PPT on a topic relevant to the course and present with PPT for 10 minutes under supervision of teacher.

Schedule for Continuous Assessment (CA):

CA Description	Schedule
Quiz – 1	As per Institute Academic Calendar
1st Internal Examination	
Term Paper	
Quiz – 2	
Assignment	
2nd Internal Examination	

Course target attainment levels:

Attainment Level	Inference	Marks
Attainment Level 1	50% of the students have attained more than the target level of that CO	1
Attainment Level 2	60% of the students have attained more than the target level of that CO	2

Attainment Level 3	70% of the students have attained more than the target level of that CO	3

Course Target for the university examination = 60% of the students will get "A" Grade

Target has been set on the basis of last year's performance / result by the students, student quality this year and difficulty level of the course.

University Grading System:

Grade	Marks
O	90% and above
E	80 – 89.9%
A	70 – 79.9%
B	60 – 69.9%
C	50 – 59.9%
D	40 – 49.9%
F	Below 40%

(ix) A. Weekly Lesson Plan

Week	Lectures	Assignment/ Class test
1st week	L1- Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. L2- Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. L3- Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings.	
2nd week	L4- Synthesis of a commonly used drug molecule. L5- Representations of 3 dimensional structures, structural isomers and stereoisomer. L6- Configurations and symmetry and chirality, enantiomers, diastereomers.	
3rd week	L7- Optical activity, absolute configurations and conformational analysis. L8- Isomerism in transitional metal compounds. L9- First and second laws of thermodynamics and thermodynamic functions: energy, entropy and free energy.	
4th week	L10- First and second laws of thermodynamics and thermodynamic functions: energy, entropy and free energy. L11- Estimations of entropy and free energies. L12- Free energy and emf.	Assignment Term Paper
5th week	L13- Acid base, oxidation reduction and solubility equilibria. L14 - Water chemistry. L15- Corrosion.	
6th week	L16- Use of free energy considerations in metallurgy through Ellingham diagrams. L17- Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital	Assignment Problem

	energies of atoms in the periodic table, electronic configurations. L18- Atomic and ionic sizes, ionization energies, electron affinity and electronegativity.	Solving
7th week	L19- Polarizability, oxidation states, coordination numbers and geometries. L20- Hard soft acids and bases, molecular geometries. L21- Principles of spectroscopy and selection rules.	
8th week	L22- Electronic spectroscopy. L23- Fluorescence and its applications in medicine. L24- Vibrational and rotational spectroscopy of diatomic molecules & applications.	
9th week	L25- Nuclear magnetic resonance. L26-Magnetic resonance imaging. L27- Surface characterisation techniques.	Assignment mini project
10th week	L28- Diffraction and scattering. L29- Schrodinger equation. L30- Particle in a box solution and their applications for simple sample.	
11th week	L31- Molecular orbitals of diatomic molecules (e.g.H_2). L32- Energy level diagrams of diatomic molecules. L33- Pi-molecular orbitals of butadiene and benzene and aromaticity.	Assignment ppt
12th week	L34- Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. L35- Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. L36- Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.	
13th week	L37- Band structure of solids and the role of doping on band structures. L38- Band structure of solids and the role of doping on band structures. L39- Ionic, dipolar and van der Waals interactions.	Quiz
14th week	L40 - Equations of state of real gases and critical phenomena. L41- Equations of state of real gases and critical phenomena. L42 - Equations of state of real gases and critical phenomena.	