Pokhara University
Faculty of Science and Technology

Course Code: CHM 110
Course Title: Applied Chemistry (2-1-2)
Nature of the Course: Theory and Practical
Level: Bachelor

Full Marks: 100
Pass Marks: 45
Total Lectures: 30 hours
Program: BE

1. Course Description

This Applied Chemistry course is designed to help the engineering students to use different materials without causing any wastage or pollution thus helping the engineers in handling a wide range of materials in the right way.

2. General Objectives

The general objectives of the course are:

- To focus on the general application of chemical principles to analyse and evaluation of engineering problems such as by developing engineering materials
- To make students aware about the proper and safe handling of engineering materials to protect oneself and to the environment.

3. Methods of Instruction

Lecture, Tutorial, Discussion, Readings and Practical works

4. Syllabus in Detail

Specific Objectives	Contents
• Define the application of electrochemistry in battery-production and various types of batteries • Explain corrosion and its control measures	**Unit I: Electrochemistry and Battery Technology (6 hrs)** 1.1 Electrolytic cell and its application 1.2 Introduction to Galvanic cell and examples, electrode potential, EMF of the cell and cell representation. 1.3 Electrochemical series & its application 1.4 Electrochemical theory of corrosion and its preventions. 1.5 Batteries and their importance, Classification of batteries- primary, secondary and reserve batteries with examples. 1.6 Construction, working and applications of: Zn-Cu, Ni-Cd, Lithium-ion and Sodium ion battery.
• Identify different types of environmental pollutants, their causes, health impacts and control measures • Explain safe handling, use and disposal of engineering materials	**Unit II: Environmental Chemistry (5 hrs)** 2.1 Air, Water and Soil Pollution: causes, effects and control measures 2.2 Water Quality Analysis 2.2.1 Alkalinity 2.2.2 Hardness 2.2.3 Free Chlorine

	2.2.4 Dissolved Oxygen 2.2.5 Chemical Oxygen Demand
• Define the characteristics of transition metals which thus can be applied in designing engineering devices and products	**Unit III: Transition Elements and its Applications (4 hrs)** 3.1 Introduction to transition elements and its position in the periodic table 3.2 Characteristics of transition elements: 3.2.1 Electronic Configuration 3.2.2 Atomic radii 3.2.3 Variable oxidation states 3.2.4 Complex formation 3.2.5 Colour and Magnetic Properties 3.2.6 Catalytic property 3.3 Applications of Transition metals in various engineering fields
• Illustrate types of organic reactions, possible reaction path and its governing factors	**Unit IV: Types of Organic Reactions (4 hrs)** 4.1 Substitution reaction: SN1 and SN2 reactions, mechanism, kinetics, stereochemistry, reactivity, factors affecting this type of reaction. 4.2 Elimination reaction: E1 and E2 reactions, mechanism, kinetics, orientation (Saytzeff's rule), reactivity, factors affecting this type of reaction.
• Analyse the properties of various engineering materials • Recognize the rapidly evolving field of material chemistry and its application in the industry	**Unit V: Engineering Materials and its Applications (7 hrs)** 5.1 Explosives: Introduction, preparation, properties and applications of TNT and TNG 5.2 Cement: Types, manufacture of Portland cement setting and hardening mechanism of cement 5.3 Paints: Introduction, properties and constituents 5.4 Sensors -Introduction, basic principle and applications 5.5 Photovoltaic cells-Introduction, basic principle and applications
• Illustrate polymers as substitute materials and define their applications to various engineering fields	**Unit VI: Polymers and its Applications (4 hrs)** 6.1 Polymers 6.1.1 Addition, condensation and copolymerization 6.1.2 Preparation, properties and uses of PVC, Teflon, Silicone Rubber and Neoprene 6.2 Concept of conducting, & non-conducting, biodegradable & non-biodegradable polymers, examples and their applications

5. List of Tutorials

The following tutorial activities of 15 hours per group of maximum 24 students should be conducted to cover all the required contents of this course:

S.N.	Tutorials
1	Problems related to calculation of EMF of cell using Nernst equation.
2	Pollution issues due to air, water and soil pollutants with reference to urban areas
3	Problems related to SN1, SN2, E1 and E2 organic reactions
4	Problems related to engineering materials (manufacture and setting of cement , use and preparation of explosive, use of paints, sensor and photovoltaic cell)
5	Problems related to color, formation of complexes and magnetic properties of transition elements.

6. Practical Works (30 hours for a group of maximum 24 students)

S.N.	Practical Works
1	To determine total alkalinity of the given water sample (Two samples)-Acid-Base titration method
2	To determine the total hardness of water sample-Complexometric Titration method
3	To determine the amount of free chlorine in the given water sample- Titration method
4	To estimate DO (dissolved oxygen) in the given water sample-Winkler's method
5	To construct Zn-Cu galvanic cell and to measure EMF of the cell
6	To analyse E. Coli and total coliform bacteria in the water sample- Membrane filtration
7	Physico- chemical analysis of water samples (pH, conductivity, turbidity, total dissolved solid and suspended solid)
8	To determine pH of unknown buffer by preparing standard known buffer (Acidic and basic buffer)

7. Evaluation System and Students' Responsibilities

Evaluation System

In addition to the formal exam(s), the internal evaluation of a student may consist of quizzes, assignments, lab reports, projects, class participation, etc. The tabular presentation of the internal evaluation is as follows.

Internal Evaluation	Weight	Marks	External Evaluation	Marks
Theory		30		
Attendance & Class Participation	10%			
Assignments	20%			
Presentations/Quizzes	10%			
Internal Assessment	60%			
Practical		20		
Attendance & Class Participation	10%			
Lab Report/Project Report	20%		Semester-End examination	50
Practical Exam/Project Work	40%			
Viva	30%			
Total Internal		50		
Full Marks: 50 + 50 = 100				

Student's Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

8. Prescribed Books and References

Text Books

1. Maron, S. H. & Prutton, C. (2017). *Principle of Physical Chemistry*, Oxford & IBH Pub. Co.
2. Lee, J. D. (2008). *Concise inorganic chemistry*, John Wiley & Sons.
3. Morrison, R. T., & Boyd, R. N. (2012). Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.

References

1. Madan, R. D. & Prakash, S(1999). *Modern Inorganic Chemistry*, S. Chand publishing.
2. Bahl, B. S., & Bahl, A. (2017). *A textbook of organic chemistry*, S. Chand Publishing.
3. Jain and Jain (2013). *A Text Book of Engineering Chemistry,* Dhanpat Rai Publications.

Pokhara University
Faculty of Science and Technology

Course Code: PHY 110
Course title: Applied Physics (3-2-2)
Nature of the Course: Theory & Practical
Level: Bachelor

Full Marks: 100
Pass Marks: 45
Total Lectures: 45 hours
Program: BE

1. Course Description

This course covers the fundamental topics of physics and basic principles that are required to study other engineering courses. It develops the ability to identify, formulate and solve engineering physics problems. Moreover, it enables to formulate, conduct, analyze and interpret experiments in engineering physics through tutorials, laboratory work and self-learning activities.

2. General Objectives

The general objectives of this course are:

- To equip the students with the fundamental concept and laws of oscillation, electromagnetism and thermodynamics.
- To acquaint the students with waves, laser, optical fiber, quantum mechanics and enlighten the importance of capacitor and dielectrics.

3. Methods of Instruction

Lecture, Tutorial, Discussion, Readings and Practical works

4. Contents in Detail

Specific Objectives	Contents
Understand mechanical oscillations, solve problems related to different types of oscillation, familiar with the scope in various engineering fields.	**Unit I: Mechanical Oscillation (6 hrs)** 1.1 Free oscillation, Damped oscillation and Forced oscillation (Physical meaning and equations). 1.2 Compound pendulum, Minimum and maximum time period in compound pendulum, Interchangeability of point of suspension and point of oscillation in compound pendulum, Torsion pendulum, Determination of modulus of rigidity of material using torsion pendulum.
Solve and analyze the problems related to waves	**Unit II: Wave Motion (4 hrs)** Introduction of wave, wave velocity and particle velocity, types of waves and their applications, Speed of wave in stretched string, energy, power and intensity of plane progressive wave, standing wave and resonance, sonometer.
Solve the problems related to reverberation in different units of building. Solve the problems	**Unit III: Acoustics (4 hrs.)** 3.1 Classification of sound waves, Acoustics of building, Reverberation of sound, absorption coefficient, Noise

related to ultra sound.	pollution and its control, Sound insulation, Sabine equation. 3.2 Introduction, production and applications of ultrasonic wave. Ultrasonic method in non-destructive testing.
understand the use of lasers in engineering sciences and solve problems related to laser and fiber optics. Apply the concept of optical fibers in communication system and sensors.	**Unit IV: Photonics (6 hrs.)** 4.1 Laser: Introduction of laser, Principles of generation of laser light (induced absorption, spontaneous emission, stimulated emission, population inversion, pumping, metastable state), He–Ne laser, Semiconductor laser, Applications of laser. 4.2 Fiber optics: Introduction, Types of optical fiber, Principle of propagation of light wave through optical fiber (Acceptance angle), Numerical aperture, Applications of optical fiber in communications, Optical fiber sensors.
Evaluate the capacity of capacitors to store energy with and without dielectrics. Solve problems related to electrostatics.	**Unit V: Capacitor and Dielectric (6 hrs.)** 5.1 Capacitor: Introduction, Types of capacitors, Charging and discharging of capacitor. 5.2 Dielectric: Introduction, Dielectric constant, electric flux density, Polarization, Polarization in free space, Gauss law in dielectric, Electronic and Ionic polarization (Clausius-Mossotti equation).
Deal with interaction between electric field and magnetic field on matter. Analyze the relationship between electric field, magnetic field and speed of wave.	**Unit VI: Electromagnetism (6 hrs.)** 6.1 EM Oscillation: LC oscillation, Damped LCR oscillation, Forced electromagnetic oscillation, resonance and quality factor 6.2 EM waves: Maxwell equations in integral form, Conversion of Maxwell's equations in differential form, Continuity equation, Relation between electric field, magnetic field and speed of light, wave equations in free space, verification of light wave as an electromagnetic wave, Wave equation in dielectric medium
Apply principles of quantum mechanics to investigate the observables on known wave functions. Solve the problems related to particle wave using Schrodinger's wave equations.	**Unit VII: Quantum Mechanics (5 hrs.)** Inadequacy of classical mechanics, Importance of quantum mechanics, Matter wave (de-Broglie equation), Wave function and its significance, Energy and momentum operator, Time independent and time dependent Schrodinger wave equations, Application of Schrodinger wave equation for the electron in metal, Normalized wave function describing the motion of an electron inside in an infinite potential well.
Acquainted with the laws of thermodynamics and applications. Solve the problems related to	**Unit VIII: Fundamentals of Thermodynamics and Heat Transfer (8 hrs.)** 8.1 Concepts and definition: applications of

thermodynamics and heat transfer.	thermodynamics, properties and state of substance, thermodynamics properties and types, processes (definition, characteristics and examples): reversible and irreversible process. 8.2 Laws of thermodynamics: first law of thermodynamics, first law for closed system, internal and stored energy, joules law, enthalpy, specific heat, application of first law for closed system, Related problems on closed system, second law of thermodynamics, heat engine (four components of refrigerator and heat pump, COP of refrigerator and heat pumps), Kelvin-Planck and Clausius statement of second law. 8.3 Heat transfer: modes of heat transfer (conduction, convection and radiation), statement and assumption of Fourier's law of thermal conductivity, one dimensional steady state heat conduction through plane wall, basic laws of radiation (Emissive power and emissivity, Stefan-Boltzmann's law), Concept of black bodies.

Note: The figures in the parentheses indicate the approximate periods for the respective units.

5. List of Tutorials

The following tutorial activities of 15 hours per group of maximum 24 students should be conducted to cover all the required contents of this course.

S.N.	Tutorials
1	Solving the problems related to different oscillation.
2	Solving and analyzing the problems related to waves.
3	Determination of standard reverberation time for normal human ear and solving problems related to ultra sound.
4	Determination of angle of acceptance for working of optical fiber and finding population of atoms in different energy states.
5	Solving the problems for different combination of capacitors and finding the charging and discharging time constant for capacitor.
6	Solving the problems related to Gauss law of electrostatics.
7	Determination of frequency of damped and undammed LC oscillation and analyzing the relationship between electric field, magnetic field and speed of wave.
9	Solving the problems related to thermodynamics and heat transfer.

6. Practical Works (Any Eight)

S.N.	Practical works
1	To determine the acceleration due to gravity and radius of gyration of bar pendulum.
2	To determine the value of modulus of rigidity of the material given and moment of inertia of circular disc using torsion pendulum.
3	To determine the acceptance angle of an optical fiber using laser source.

4	To determine the frequency of AC mains by using sonometer apparatus.
5	To determine the wavelength of laser light by using diffraction grating
6	To determine the capacitance of given capacitor by charging and discharging through resistor.
7	To plot a graph between current and frequency in an LRC series circuit and to find: i) the resonance frequency ii) the quality factor.
9	To determine the dielectric constant of a given material
10	To determine the Planck's constant and photoelectric work functions of the material.
11	To measure the pressure, specific volume and temperature.
12	To find out the efficiency of a compressor.
13	To measure the rate of heat, transfer by conduction
14	To measure the performance of a Refrigeration/ Heat pump

7. Evaluation system and Students' Responsibilities

Evaluation System

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Internal Evaluation	**Weight**	**Marks**	**External Evaluation**	**Marks**
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Attendance & Class Participation	10%			
Assignments	20%			
Presentations/Quizzes	10%			
Internal Assessment	60%			
Practical		20		
Attendance & Class Participation	10%			
Lab Report/Project Report	20%			
Practical Exam/Project Work	40%			
Viva	30%			
Total Internal		50		
Full Marks: 50 + 50 = 100				

Student's Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

8. Prescribed Books and References

Text Books

1. Halliday, D., Resnick, R., & Walker, J. (2013). *Fundamental of Physics*. John Wiley and Sons. Inc.

2. Howel, J. R. & Buckius, R. O. (1992). *Fundamentals of Engineering Thermodynamics*. McGraw-Hill Publishers
3. Young, H. D. & Freedman. R. A. (2009). *Sears and Zemansky's University Physics*. Pearson Education.

References

1. Arora, C. L. (2020). *B. Sc. Practical Physics*, S. Chand Publishing.
2. David, J. Griffiths (2008). Introduction to Electrodynamics, Prentice Hall of India Private Limited, New Delhi.
3. Malik, H. K., Singh, A. K. (2010). *Engineering Physics*, Tata McGraw Hill Education Private Ltd.
4. Mathur, D.S. (2003). *Mechanics*, S. Chand and Company Ltd.
5. Murugeshan, R. & Sivaprasath, K. (2009). Modern Physics, S. Chand and Company Ltd.
6. Reitz, J., Milford, F.J. & Christy, R.W (19986). *Foundations of Electromagnetic Theory.*, Pearson Education.
7. Subrahmanyam, N., Lal, B. (2005). *A text book of Optics*, S. Chand and Company Ltd.
8. Tiwari, K. K (2001). *Electricity and Magnetism*, S. Chand and Company Ltd.
9. Van Wylen, G. J. and Sonntag, R. E. (1989). *Fundamentals of Classical Thermodynamics*, Wiley Eastern Limited, New Delhi.