VI Semester

Open Elective APPLIED CHEMISTRY FOR ENGINEERS			
Course Code	**21CHE653**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

CLO 1	Impart the knowledge of polymers and their processes.
CLO 2	Understand the basic mechanism of actions of surfactants and lubricants.
CLO 3	Master the knowledge about nanomaterials and their properties.
CLO 4	Enlighten the needs and utilization of environmental and green chemistry
CLO 5	Acquire the knowledge of classification of energy resource from conventional fuel and nuclear fuel

Pedagogy (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to convince abstract concepts.
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module1 - POLYMERS - 08 hours

Introduction, types of polymerization. Mechanism of polymerization of ethylene. Molecular weight, numerical problems. Glass transition temperature – Crystallinity, melting point. Viscoelasticity. Elastomers- structure, applications, and curing. Conducting polymers and applications. Solubility of polymers. Fabrication and moulding of polymers. Synthesis, properties and uses of PVC, PMMA. Resins: Synthesis, properties and uses of urea - formaldehyde and phenol - formaldehyde. Composites: types and applications. Metallic and nonmetallic fillers.

Pedagogy	**Chalk and talk/power point presentation:** Introduction, types of polymerization. Mechanism of polymerization of ethylene. Molecular weight, numerical problems. **Videos/Learning material:** Glass transition temperature – Crystallinity, melting point. Viscoelasticity. **Self-study:** Thermoplastics and thermosetting polymers.

Module2 - Surfactants and Lubricants - 08 hours

Methods of preparation, cleaning mechanism. Critical micelle concentration and its determination. Hydrophobic and hydrophilic interactions. Micelles and reverse micelles. Detergents. Lubricants-physical and chemical properties, types and mechanism of lubrication. Additives of lubricants and freezing points of lubricants.

Corrosion: Thermodynamic overview of electrochemical processes. Reversible and irreversible cells. Chemical and electrochemical corrosion and mechanism of corrosion. Factors affecting corrosion. Protection of corrosion and practical problems of corrosion.

Pedagogy	**Chalk and talk/power point presentation**: Methods of preparation, cleaning mechanism. Critical micelle concentration and its determination. Hydrophobic and hydrophilic interactions. Micelles and reverse micelles. Detergents. **Videos/Learning material**: Lubricants-physical and chemical properties, types and mechanism of lubrication. Additives of lubricants and freezing points of lubricants. **Self-study:** Corrosion inhibitors, Anodic protection.

Module3 - Nanomaterials - 08 hours

Nanomaterials: Introduction to nanomaterials. Properties and applications of fullerenes, carbon nanotubes and nanowires. Synthesis-top down and bottom-up approaches. Nanoelectronics. Applications of nanomaterials in catalysis and medicine.

Metals and Alloys: Phase rule and applications of one, two and multi-component systems. Iron-carbon phase diagram. Types of alloys, carbon steel, alloy steel, alloys of Cu, Al, Pb.

Pedagogy	**Chalk and talk/power point presentation**: Introduction to nanomaterials. Properties and applications of fullerenes, carbon nanotubes and nanowires. Synthesis-top down and bottom-up approaches. **Videos/Learning material**: Nanoelectronics. Applications of nanomaterials in catalysis and medicine. Phase rule and applications of one, two and multi-component systems. Iron-carbon phase diagram. Types of alloys, carbon steel, alloy steel, alloys of Cu, Al, Pb. **Self-study:** Water system, effects of incorporation of variable amount of carbon in steel.

Module4- - Environmental and Green Chemistry- 08 hours

Air, water and noise pollution. Optimum levels of pollution. Significance and determination of COD and BOD. Solid waste treatment of collection of NKP. Greenhouse effect/global warming. e-Waste. Radioactive pollution. Applications of green chemistry and green technology. Concept of atomic and molecular economy and its use in green chemistry.

Modern Analytical Techniques: Mass spectrometry. Thermal analysis. Electron microscopy, scanning tunneling microscope and atomic force microscope. Sensors. Lab-on-a-chip.

Pedagogy	**Chalk and talk/power point presentation**: Air, water and noise pollution. Optimum levels of pollution. Significance and determination of COD and BOD. **Videos/Learning material**: Greenhouse effect/global warming. e-Waste. Radioactive pollution. Applications of green chemistry and green technology. **Self-study:** Principles of green chemistry

Module5 -Energy Science - 08 hours

E**nergy Science:** Petroleum refining, liquid fuels, anti-knock agents. Cracking of oils. Limitations of fossil fuels. Alternative and non-conventional sources of energy – solar, wind, geo, hydro-power and biomass. Advantages and disadvantages. Nuclear energy, reactors and nuclear waste disposal. Safety measures for nuclear reactors.

Pedagogy	**Chalk and talk/power point presentation**: Petroleum refining, liquid fuels, anti-knock agents. Cracking of oils. Limitations of fossil fuels. **Videos/Learning material**: Nuclear energy, reactors and nuclear waste disposal. **Self-study:** Comparative study of energy sources like natural, fossil fuel and nuclear fuels.

Course outcome (Course Skill Set)

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

CO 1	Discuss synthesis of polymers and their properties.
CO 2	Explain the concepts of surfactants and lubrication.
CO 3	Explain the concepts of characterization techniques used in Nanoscience and Nanotechnology.
CO 4	Enumerate the greenhouse effect/global warming.
CO 5	Apprehend the need of non-conventional energy sources.

Assessment Details (both CIE and SEE)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Books

1. AK Bandyopadhyay, Nanomaterials , New Age International (P) Ltd., 2nd Edition, 2010.
2. Rao. C. N, Muller. A, Cheetham . A. K, Nanomaterials chemistry, Wiley-VCH, 2007.
3. N. Kumar, Concise concepts of nanoscience and nanomaterials, Scientific publishers, 2018

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=HTIzwP8BKC8
2. https://www.youtube.com/watch?v=GIcVxvl7n84
3. https://www.youtube.com/results?search_query=Characterization+of+Nanomaterials
4. https://www.youtube.com/watch?v=gUEbxTkPIWI&list=PLbMVogVj5nJSl_2XmFjuRmvuAqCOZXUjv

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- https://www.vlab.co.in/broad-area-chemical-sciences
- https://demonstrations.wolfram.com/topics.php
- https://interestingengineering.com/science