




**Ahmedabad  
University**

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| <div><div>Ahmedabad<br/>University</div></div> |  |                              |                                       |                      |
| Course   | CHE504 Catalysis and Catalytic Processes | Semester                     | Monsoon Semester 2024                 |                      |
| Faculty Name(s)  | Aditi Singhal                            | Contact                      | aditi.singhal@ahduni.edu.in           |                      |
| School   | SEAS                                     | Credits                      | 3                                     |                      |
| GER Category:  |  | Teaching Pedagogy Enable:YES | P/NP Course: Can not be taken as P/NP |                      |
| Schedule   | Section 1                                | 09:30 am to 11:00 am         | Wed                                   | 01-08-24 to 26-11-24 |
|  |  | 11:00 am to 12:30 pm         | Sat                                   | 01-08-24 to 26-11-24 |
|  |  |                              |                                       |                      |
| Prerequisite   | Not Applicable                           |                              |                                       |                      |
| Antirequisite  | Not Applicable                           |                              |                                       |                      |
| Corequisite  | Not Applicable                           |                              |                                       |                      |

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| Course Description        | <p>Study of catalysts and catalytic process is highly interdisciplinary in nature combining the concepts and applications from domains such as Chemistry, Chemical Engineering and Material Science. This course covers the fundamentals of catalysis and has been designed to cater the need of students coming from these diverse areas. This course includes basic modes of catalytic action, classification and key concepts, Industrial applications of catalysts, desired characteristics, synthesis and characterization techniques as well as kinetics of catalytic reactions.</p> <p>Course Content includes:</p> <ol style="list-style-type: none"> <li>1. Classification and introduction to catalysis</li> <li>2. Surface chemistry</li> <li>3. Materials perspective</li> <li>4. Analytical aspects</li> <li>5. Reactivity and Kinetics of catalytic reactions</li> <li>6. Mechanistic aspects</li> <li>7. Hands on laboratory based experiments on catalysis</li> </ol> |
| Course Objectives         | <ul style="list-style-type: none"> <li>• To get students acquainted with the basics of catalysis with an industrial perspective.</li> <li>• To introduce importance of materials and their application in real world problem.</li> <li>• To make students familiar with advance material synthesis and characterization tools.</li> <li>• To understand published research in area of catalysis.</li> <li>• To help students develop creative thinking</li> </ul>   |
| Learning Outcomes         | <p>By the end of this course, students will be able to</p> <ul style="list-style-type: none"> <li>• Understand the importance of catalysis in various industries such as oil, drug.</li> <li>• Familiarize themselves about performing experiment with the catalysts</li> <li>• Understand the recent advancements in fine chemical synthesis</li> <li>• Analyze the experimental data coming out from a catalytic experiment.</li> <li>• Comprehend the data obtained from laboratory-based experiments</li> </ul>   |
| Pedagogy                  | ENABLE  |
| Expectation From Students | Students are expected to attend all the lectures regularly. Participation in online classroom discussions and other related activities is must.   |

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| Assessment/Evaluation        | <ul style="list-style-type: none"> <li>• End Semester Examination:             <ul style="list-style-type: none"> <li>◦ Written - 30%</li> </ul> </li> <li>• Other Components:             <ul style="list-style-type: none"> <li>◦ Quiz - 10%</li> <li>◦ Lab Experiments - 35%</li> <li>◦ Presentation - 15%</li> <li>◦ Lab Attendance - 10%</li> </ul> </li> </ul>   |
| Attendance Policy            | As per Ahmedabad University Policy.  |
| Project / Assignment Details | Relevant group projects based on the different concepts of catalysis such as their synthesis through various techniques, characterization, study of their electrochemical properties, geopolymer synthesis and applications will be conducted and assignments related to the course will be given to each group (3-4 members) of students. It will improve their understanding and knowledge pertaining to catalysis and its applications in various industries. In order to understand the participation of each student in the group, peer evaluations will also be conducted for each activity. |
| Course Material              | Reference Book <ul style="list-style-type: none"> <li>• Catalytic Chemistry, B.C. Gates, Wiley, ISBN: 978-0-471-51761-0, Year: 1992,</li> <li>• Catalytic Chemistry, B.C. Gates, Wiley, ISBN: 978-0-471-51761-0, Year: 1992,</li> </ul>  |
| Additional Information       | B.Tech. Chemical Engineering Semester VI/VII – Elective course   |

## Session Plan

| NO. | TOPIC TITLE                                  | TOPIC & SUBTOPIC DETAILS   | READINGS,CASES,ETC.  | ACTIVITIES                                 | IMPORTANT DATES |
|-----|--|--|--|--|-----------------|
| 0   |  |  |  |  |                 |
| 1   | Classification and Introduction to catalysis | Basic modes of catalytic action, Classification and key concepts.                      | Principles and Practice of Heterogeneous Catalysis, J.H. Thomas, W.J. Thomas, VCH, 1996. | Online Lectures & discussion, presentation |                 |
| 2   |  | Auto catalysis, Bio catalysis, Electro catalysis and Photo catalysis, Enzyme catalysis |  |  |                 |
| 3   |  | History of catalysis, Catalysts - Industrial perspective                               |  |  |                 |
| 4   | Surface chemistry                            | Desired characteristics of catalysts   | Principles and Practice of Heterogeneous Catalysis, J.H. Thomas, W.J. Thomas, VCH, 1996. | Online Lectures & discussion, presentation |                 |
| 5   |  | Nature of the active site  |  |  |                 |
| 6   |  | metal support interaction  |  |  |                 |
| 7   |  | lattice oxygen   |  |  |                 |
| 8   |  | Effect of Supports, Dopants on catalysis   |  |  |                 |
| 9   |  | Effect of Supports, Dopants on catalysis   |  |  |                 |
| 10  |  | Adsorption mechanisms  |  |  |                 |
| 11  |  | Adsorption mechanisms  |  |  |                 |

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|----|---|---|---|--|--|
| 12 |   | Models  |   |  |  |
| 13 | Materials Perspective                         | Synthesis methodologies                                   | Catalytic Chemistry, B.C. Gates, Wiley, 1992.   | Online Lectures & discussion, presentation |  |
| 14 |   | Synthesis methodologies                                   |   |  |  |
| 15 | Analytical aspects                            | Physico-chemical characterization by different techniques | Heterogeneous Catalysis in Industrial Practice, S.N. Satterfield, 2nd Ed., McGraw Hill, 1991. |  |  |
| 16 |   | Physico-chemical characterization by different techniques |   |  |  |
| 17 |   | Physico-chemical characterization by different techniques |   |  |  |
| 18 |   | Physico-chemical characterization by different techniques |   |  |  |
| 19 | Reactivity and kinetics of catalytic reaction | Catalysis by oxides, doped metal oxides                   | Principles and Practice of Heterogeneous Catalysis, J.H. Thomas, W.J. Thomas, VCH, 1996.      | Lectures & discussion, presentation        |  |
| 20 |   | Catalysis by noble metals                                 |   |  |  |
| 21 |   | Effect of diffusional resistance on activity              |   |  |  |
| 22 |   | Strategies and designs for laboratory studies             |   |  |  |
| 23 |   | Development of basic forms of rate equations              |   |  |  |
| 24 | Mechanistic aspects                           | Langmuir-Hinshelwood model                                | Principles and Practice of Heterogeneous Catalysis, J.H. Thomas, W.J. Thomas, VCH, 1996.      | Lectures & discussion, presentation        |  |

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|----|--------------|-----------------------------|--|--|--|
| 25 |              | Power law model             |  |  |  |
| 26 |              | Eley-rideal mechanism       |  |  |  |
| 27 |              | Mars-van-Kravelan mechanism |  |  |  |
| 28 |              | Reflections and             |  |  |  |
| 29 |              | Reflections and             |  |  |  |
| 30 | End-Sem Exam | End sem exam                |  |  |  |

