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|                                 |   |                      |  |                         |
| *<br>Course Name                | Chinese   |                      |  |                         |
|                                 | English Simulation Theory and System Analysis of Metal Forming Process  |                      |  |                         |
| *<br>Credits                    | 3   | *<br>Teaching Hours  | 48 1 =16                                   |                         |
| *<br>Semester                   | Spring  | *<br>Cross-semester? | No   | Spanning over Semesters |
| *<br>Course Type                | Program Elective Course   | *<br>Course Type     | For full-time students                     |                         |
| *<br>Course Category            | Specialized Course  | Targeting Students   | Doctoral Level                             |                         |
| *<br>Instruction Language       | Chinese   | Teaching Method      | In class teaching                          |                         |
| *<br>Grade                      | Letter grading  | Exam Method          | Essay                                      |                         |
| *<br>School                     | 050 School of Material Science and Engineering  |                      |  |                         |
| Subject                         | Material Science and Engineering  |                      |  |                         |
| Person in charge                | Name  | ID                   | School                                     | E-mail                  |
|                                 | CHEN Jun  |                      | School of Material Science and Engineering | jun_chen@sjtu.edu.cn    |
|                                 |   |                      |  |                         |
| *<br>( )<br>Course Description  | ( )   |                      |  |                         |
|                                 | 1   |                      | 2  |                         |
|                                 |   | 3                    |  |                         |
|                                 | 4   |                      | 5  |                         |
| *<br>English Course Description | <p>Course introduction: In this course, we will introduce plasticity models, deformation theory based variational principle, flow theory based variational principle, small deformation based elasto-plastic FEM, large deformation based elasto-plastic FEM, rigid plastic FEM, the key technologies for the implementation of numerical simulation, engineering applications of numerical simulations by elasto-plastic FEM and rigid-plastic FEM. This course is an important fundamental course for numerical simulation of metal forming processes.</p> <p>Course objectives: (1) Understand different methods for metal forming process numerical simulation and relevant fundamentals of mathematics and mechanics; (2) Grasp the fundamental theories of elasto-plastic FEM and rigid-plastic FEM; (3) Understand the plasticity models and the methods to determine their parameters; (4) Get to know the state-of-the-art about metal forming process numerical simulation and the future trends; (5) Build the capability to use commercial software tools for metal forming process numerical simulation.</p> |                      |  |                         |

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| <p>*<br/>( )<br/>Syllabus</p>         | <table border="0"> <tr><td>1</td><td></td><td>3</td><td></td><td></td><td>+</td><td></td></tr> <tr><td>2</td><td></td><td></td><td>3</td><td></td><td></td><td>+</td></tr> <tr><td>3</td><td>3</td><td></td><td></td><td></td><td>+</td><td></td></tr> <tr><td>4</td><td>6</td><td></td><td></td><td></td><td>+</td><td></td></tr> <tr><td>5</td><td>3</td><td></td><td></td><td></td><td>+</td><td></td></tr> <tr><td>6</td><td></td><td>6</td><td></td><td></td><td></td><td>+</td></tr> <tr><td>7</td><td></td><td>3</td><td></td><td></td><td></td><td>+</td></tr> <tr><td>8</td><td></td><td></td><td>6</td><td></td><td></td><td></td><td>+</td></tr> <tr><td>9</td><td></td><td></td><td></td><td>6</td><td></td><td></td><td></td><td>+</td></tr> <tr><td>10</td><td></td><td></td><td>3</td><td></td><td></td><td></td><td></td><td>+</td></tr> <tr><td>11</td><td></td><td></td><td>3</td><td></td><td></td><td></td><td></td><td>+</td></tr> <tr><td>12</td><td></td><td></td><td></td><td>3</td><td></td><td></td><td></td><td></td><td>+</td></tr> </table>   | 1 |   | 3 |   |   | + |   | 2 |  |  | 3 |  |  | + | 3 | 3 |  |  |  | + |  | 4 | 6 |  |  |  | + |  | 5 | 3 |  |  |  | + |  | 6 |  | 6 |  |  |  | + | 7 |  | 3 |  |  |  | + | 8 |  |  | 6 |  |  |  | + | 9 |  |  |  | 6 |  |  |  | + | 10 |  |  | 3 |  |  |  |  | + | 11 |  |  | 3 |  |  |  |  | + | 12 |  |  |  | 3 |  |  |  |  | + |
| 1                                     |  | 3 |   |   | + |   |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 2                                     |  |   | 3 |   |   | + |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 3                                     | 3  |   |   |   | + |   |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 4                                     | 6  |   |   |   | + |   |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 5                                     | 3  |   |   |   | + |   |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 6                                     |  | 6 |   |   |   | + |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 7                                     |  | 3 |   |   |   | + |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 8                                     |  |   | 6 |   |   |   | + |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 9                                     |  |   |   | 6 |   |   |   | + |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 10                                    |  |   | 3 |   |   |   |   | + |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 11                                    |  |   | 3 |   |   |   |   | + |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| 12                                    |  |   |   | 3 |   |   |   |   | + |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| <p>*<br/>English<br/>Syllabus</p>     | <p>Chapter 1 Background of metal forming technologies and fundamentals of numerical simulation; 3 teaching hours (TH); In-class teaching and discussion<br/> Chapter 2 Calculus of variations about plastic deformation and flow law; 3 THs; In-class teaching and discussion<br/> Chapter 3 Small deformation theory-based elasto-plastic finite element method; 3 THs; In-class teaching and discussion<br/> Chapter 4 Finite deformation theory-based elasto-plastic finite element method; 6 THs; In-class teaching and discussion<br/> Chapter 5 Rigid visco-plastic finite element method; 3 THs; In-class teaching and discussion<br/> Chapter 6 Flow stress model, yield function, hardening model, forming limit curve and ductile fracture criterion and parameter calibrations; 6 THs; In-class teaching and discussion<br/> Chapter 7 Framework of numerical simulation system and advanced development; 3 THs; In-class teaching and discussion<br/> Chapter 8 Key technologies for rigid visco-plastic FEM implementation; 6 THs; In-class teaching and discussion<br/> Chapter 9 Key technologies for elasto-plastic FEM implementations; 6 THs; In-class teaching and discussion<br/> Chapter 10 Numerical simulation applications of rigid visco-plastic FEM; 3 THs; In-class teaching and discussion<br/> Chapter 11 Numerical simulation applications of elasto-plastic FEM; 3 THs; In-class teaching and discussion<br/> Chapter 12 Cutting edge questions on metal forming technologies and numerical simulation; 3 THs; In-class teaching and discussion</p> |   |   |   |   |   |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| <p>*<br/>Requirements</p>             | <p>10-15</p>   |   |   |   |   |   |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| <p>*<br/>English<br/>Requirements</p> | <p>Grading: In the last week, each student shall make a 10-15 minute presentation related with the course. After the course is finished, each student shall submit a review report or an academic report/article related with the course within 2 months.</p>  |   |   |   |   |   |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| <p>*<br/>Resources</p>                | <p>[1] 1999<br/> [2] 1990<br/> [3] 1989<br/> [4] 1989<br/> [5] 1997<br/> [6] 2005<br/> [7] 1988<br/> [8] S. Kobayashi, S.I. Oh, T. Altan. 1989, Metal Forming and the Finite Element Method, Oxford University Press<br/> [9] J. Hallquist, 2006, LS-Dyna Theory Manual, www.lstc.com</p>  |   |   |   |   |   |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |
| <p>*<br/>English<br/>Resources</p>    | <p>[1] PENG Yinghong, 1999, Numerical Simulation Technologies for Metal Forming Processes, Shanghai Jiao Tong University Press<br/> [2] QIAO Duan and QIAN Rengen, 1990, Nonlinear Finite Element Method and Its Applications in Plastic Forming, Metallurgical Industry Press<br/> [3] LV Liping, 1989, Finite Element Method and Its Applications in Forging Process,</p>  |   |   |   |   |   |   |   |   |  |  |   |  |  |   |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |   |  |  |  |   |  |   |  |   |  |  |  |   |   |  |   |  |  |  |   |   |  |  |   |  |  |  |   |   |  |  |  |   |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |   |  |  |  |  |   |    |  |  |  |   |  |  |  |  |   |

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|      | <p>Northwestern Polytechnical University Press</p> <p>[4] CHEN Ruxin, HU Zhongmin, 1989, Plastic Finite Element Method and Its Applications in Metal Forming Processes, Chongqing University Press</p> <p>[5] ZHONG Zhihua, LI Guangyao, 1997, Computer Simulation and Application of Sheet Metal Forming Process, Beijing University of Technology Press</p> <p>[6] LIN Zhongqin, 2005 Numerical Simulation of Auto Panel Stamping Processes, Mechanical Engineering Press</p> <p>[7] JIANG Youliang, 1988, Nonlinear Finite Element Method, Beijing Institute of Technology Press</p> <p>[8] S. Kobayashi, S.I. Oh, T. Altan. Metal Forming and the Finite Element Method, Oxford University Press, 1989</p> <p>[9] J. Hallquist, LS-Dyna Theory Manual, <a href="http://www.lstc.com">www.lstc.com</a>, 2006</p> |
| Note |   |