

**Department of Mining, Petroleum and Metallurgical Engineering**

**Cairo University  
Faculty of Engineering**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Specifications** | | | | | | | | | | | | | | | | | |
| **Program(s) on which this course is given:** | | | | | | | Materials and Metallurgical Engineering | | | | | | | | | | |
| **Department offering the program:** | | | | | | | Department of Mining, Petroleum and Metallurgical Engineering | | | | | | | | | | |
| **Department offering the course:** | | | | | | | Department of Mining, Petroleum and Metallurgical Engineering | | | | | | | | | | |
| **Academic Level:** | | | | | | | Fifth year | | | | | | | | | | |
| **Date** | | | | | | | 2014 | | | | | | | | | | |
| **Semester (based on final exam timing)** | | | | | | | Fall Spring | | | | | | | | | | |
| **A- Basic Information** | | | | | | | | | | | | | | | | | |
| **1. Title:** | Plastic Metal Forming of Metals | | | | | | | | | **Code:** | | | **MET 402** | | | | |
| **2. Units/Credit hours per week:** | | Lectures | | | 4 | | | Tutorial | | | 2 | Practical | | - | | Total | 6 |
| **B- Professional Information** | | | | | | | | | | | | | | | | | |
| **1. Course description:** | | | | **Learn the theory of the basic metal forming processes and their type of products and the possible defects for each metal forming process: rolling, forging, extrusion, wire and rod drawing, Conduct simple mechanical analysis calculations on work piece and calculate the necessary loads, and conduct simple rolling load, torque, power calculations and roll-pass designs using the stress equations he learns from the course of "Theory of Elasticity and Plasticity", correlate the various metal working parameters (stress, temperature, and strain rate) to basic metallurgical and mechanical properties, using the knowledge he gains from the course of "Physical Metallurgy: Mechanical Properties of Material", Learn the theory of the basic metal forming processes and their type of products and the possible defects for each metal forming process.**  **Study of the main parts of rolling stand. The study of the distribution of the rolling stress and the effect of different parameters on the rolling operation. Design of modern rolling plants using strip crown control.**  **.** | | | | | | | | | | | | | |
| **2. Intended Learning Outcomes of Course (ILOs):** | | | | **a) Knowledge and Understanding** | | | | | | | | | | | | | |
| 1. Fundamentals of metal forming including plastic deformation and calculation of loads. | | | | | | | | | | | | | |
| 2. Current engineering technologies and contemporary topics related to metal forming. | | | | | | | | | | | | | |
| **b) Intellectual Skills** | | | | | | | | | | | | | |
| 3. Select and identify the appropriate material and forming method compatible with the required design and properties of a component. | | | | | | | | | | | | | |
| 4. Combine, exchange, and assess different ideas, views, and knowledge from a range of sources in topics related to metal forming including manufacturing, development and selection. | | | | | | | | | | | | | |
| **c) Professional and Practical Skills** | | | | | | | | | | | | | |
| 5. Professionally merge the engineering knowledge, understanding, and feedback to improve design, products and/or services. | | | | | | | | | | | | | |
| **d) General and Transferable Skills** | | | | | | | | | | | | | |
| 6. Communicate effectively. | | | | | | | | | | | | | |
| 7. Search for information and engage in life-long self learning discipline. | | | | | | | | | | | | | |
| **3. Contents** | | | | | | | | | | | | | | | | | |
| **Topic** | | | | | | **Total hours** | | | **Lectures hours** | | | | | | **Tutorial/ Practical hours** | | |
| **1. Introduction: Classification of forming processes, Review on some concepts related to metal forming: true stress-strain curve, yielding criteria.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **2.Mechanics of metalworking: slab method, uniform deformation energy method.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **3.Friction and lubrication in metal working, the effect of friction on load calculations, sliding vs sticking friction.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **4.Flow stress determination in metal working, effect of temperature and strain rate on flow stress.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **5.Metallurgical effects in metal working: (static and dynamic) recovery and recrystallization, hot and cold working.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **6.Metallurgical effects in metal working: effect of two phases, development of crystallographic texture, anisotropy. Effect of hydrostatic pressure, super plasticity.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **7.Forging: Process, machinery, open and closed die forging.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **8.Forging: Load calculations, Defects.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **9.Extrusion: Process, machinery, direct and indirect extrusion.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **10.Extrusion: How to estimate needed loads, defects.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **11.Tube, wire and rod drawing: Process, equipment, Tube, wire and rod drawing:** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **12.Rolling Mills and their arrangement.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **13.Distribution of rolling stresses and effect of different parameters on the rolling operation** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **14.Main parts of rolling stands** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **15.controlling strip crown by roll bending, roll crossing roll shifting and cyclic roll shifting.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **16.Design of modern rolling plants using strip crown control.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **17.The different parameters affecting cold rolling load.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **18.Calculation of cold rolling load.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **19.Resistance to deformation during hot rolling.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **20.Calculations of hot rolling loads.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **21.Calculation of energy and HP in cold rolling.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **22.Calculation of energy and HP in hot rolling.** | | | | | | 2 | | | 1 | | | | | | 1 | | |
| **23.Roll pass design.** | | | | | | 4 | | | 2 | | | | | | 2 | | |
| **4. Teaching and Learning Methods** | | | | | | Lectures ( x) | | | Practical Training/ Laboratory ( ) | | | | | | Seminar/Workshop ( ) | | |
| Class Activity (x ) | | | Case Study ( x) | | | | | | Projects ( ) | | |
| E-learning ( ) | | | Assignments /Homework (x) | | | | | | Other: | | |
| **5. Student Assessment Methods** | | | | | | | | | | | | | | | | | |
| * **Assessment Schedule** | | | | | | | | | **Week** | | | | | | | | |
| -Assessment 1; Class test | | | | | | | | | 4 | | | | | | | | |
| -Assessment 2; Project Assignment | | | | | | | | |  | | | | | | | | |
| -Assessment 3; Presentations | | | | | | | | |  | | | | | | | | |
| -Assessment 3; Midterm Exam | | | | | | | | |  | | | | | | | | |
| -Assessment 4; Final Exam | | | | | | | | | End of term | | | | | | | | |
| * **Weighting of Assessments** | | | | | | | | | | | | | | | | | |
| -Mid-Term Examination | | | | | | | | | 15% | | | | | | | | |
| -Final-term Examination | | | | | | | | | 70% | | | | | | | | |
| -Project/ case study | | | | | | | | | 5% | | | | | | | | |
| -Class Test | | | | | | | | | 5% | | | | | | | | |
| -Presentation/ oral exam | | | | | | | | | 5% | | | | | | | | |
| -Total | | | | | | | | | 100% | | | | | | | | |
| **6. List of References** | | | | | | | | | | | | | | | | | |
| 1. Mechanical Metallurgy; G. E. Dieter, Mc. Graw-Hill Book Company, 1988. (Part 4, ch15-20). | | | | | | | | | | | | | | | | | |
| 1. Engineering metallurgy; R. Higgins, part 2: Metallurgical Process Technology, ELBS, 1974. Ch.8,9,10,11. | | | | | | | | | | | | | | | | | |
| 1. Mechanical Working of Metals: Theory and Practice; Pergamon International Library. | | | | | | | | | | | | | | | | | |
| 1. The Rolling of Strip, Sheet, and Plate; E. C. Larke, Chapmann and Hall Ltd., 1963. | | | | | | | | | | | | | | | | | |
| Course notes | | | | | | | | | | | | | | | | | |
| Prepared by the lecturers. | | | | | | | | | | | | | | | | | |
| **7. Facilities Required for Teaching and Learning** | | | | | | | | | | | | | | | | | |
| - Small group of students. | | | | | | | | | | | | | | | | | |
| - Up-to-date references in library. | | | | | | | | | | | | | | | | | |
| **Course Coordinator:** | | | **Dr. Nahed Abd El-Raheem – Dr. Raafat El-Kousy - Dr. Waleed Khalifa** | | | | | | | | | | | | | | |
| **Head of Department:** | | | **Dr. Sayed El-Banna** | | | | | | | | | | | | | | |

