NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF GEOLOGICAL, MINING AND METALLURGICAL ENGINEERING

METALLURGICAL ENGINEERING PROGRAM

GE428 – FOUNDRY

I. GENERAL INFORMATION

CODE	**:**	GE428 Foundry
SEMESTER	**:**	8
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory–Practice–Laboratory)
PREREQUISITES	**:**	ME322 Solidification
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Metallurgical Engineering

II. COURSE DESCRIPTION

The course prepares students in the understanding and application of the methods and techniques for the manufacturing of metal and alloy castings of different forms and sizes. Students understand and analyze the different stages of the casting process since molding design, metal melting, metal solidification, and casting finishing. Students apply the knowledge of physical metallurgy, metallurgical physical-chemistry and solidification to optimize the casting process minimizing energy requirements, as well as the amount of defective parts.

III. COURSE OUTCOMES

At the end of the course, students:

1. Organize, identify, diagnose and solve problems in the manufacturing of castings.
2. Propose the process to obtain defect-free castings.
3. Apply the knowledge of metallurgical physical-chemical and thermodynamics to explain and optimize metals and alloys solidification process.
4. Design molds and select proper sands according to desired casting properties.
5. Interpret drawings, evaluate solutions and select the proper manufacturing method depending on the characteristics and features of the desired casting.
6. Build, design, calculate and optimize the process to obtain quality products that reach nowadays industrial requirements.

IV. LEARNING UNITS

1. INTRODUCTION - MODELS

Introduction / Basic steps in casting processes / Casting methods / Molding types, tolerances, molding functions / Materials / Colors / Core box.

2. MOLDING AND MECHANIZATION EQUIPMENT – MOLDING SAND

Introduction / Molding equipment and machinery / Auxiliary machines used at foundry / Molds / General properties of molding sands / Ingredients: sand, clay, water / Properties of green sands / Ingredient effects. / Additives / Special sands / Casting defects due to defective green sands.

3. CORE SAND – METALS SOLIDIFICATION

Introduction / Core manufacturing, heating and finishing / Core sand, sand – binder / Core sand properties / Homogeneous, heterogeneous and dynamic nucleation / Growing: pure

metals and alloys / Solidification rate / Properties related to solidification mechanisms / Fluency / Hot cracking / Evolution of dissolved gases / Segregation and inoculation.

4. RISERS DESIGN

Introduction / Riser types / Design methods / Alloys: Adams and Taylor methods / CER method / Caine method. / Carbon steel / The Naval Research Laboratory method / Wlodawer method / Foundries / Module method for gray iron / Meehanite method / Copper alloys / Module method / NRL method / Cox method / Jeancolas method.

5. FEEDING SYSTEM DESING

Introduction / Continuity law / Bernoulli equation / Types of feeding systems / Sprue / Effective height of filling / Shock area / Pressure systems and pressure-less systems / Feeding system design for different types of metals

6. GASES IN METALS – CASTING DEFECTS

Introduction / Gases in metals: hydrogen, nitrogen / Complex gases in steel / Complex gases in copper alloys / Gases control. / Analysis of casting main defects.

V. LABORATORY

Session 1: Fineness module, active clay, AFS clay.
Session 2: Clay testing: Durability, swelling, sedimentation.
Session 3: Green sand testing. Hardness, humidity, compression, cut, permeability, strain, deformation, compactness.
Session 4: Steamed and CO_2 containing core sands testing: traction and flexion.
Session 5: Graphite molds, sand molds and metallic molds.
Session 6: Design of risers and feeding system of an aluminum casting.
Visits to foundry companies: MEPSA, COMESA, HIDROSTAL.

VI. METHODOLOGY

The course takes place in theory, practice and laboratory sessions. In theory, faculty presents and analyzes concepts and methods. In practice sessions diverse problems related to mold design, sand selection and metal solidification are analyzed and solved. In laboratory sessions, students design molds and complete a simple casting process. Likewise, study visits to foundry plants to analyze actual casting process in industry. After each laboratory experience, students submit a report describing procedures and summarizing results and conclusions. Student's active participation is promoted.

VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

PF = (EP + EF + PL) / 3

EP: Mid-term Exam EF: Final Exam
PL: Average of four Practical Works.

VIII. BIBLIOGRAPHY

1. JOHN CAMPBELL.
   Castings, Butterworth-Heinemann Ltd, 2008.
2. PETER R. BEELEY.
   Foundry Technology, Newnes-Butterworth, 2005.
3. HEYNE, ROSENTHAL and LOPER.
   Principles of Metal Casting, Mc. Graw Hill Book Company Inc., 2001.