

Program: BSc. in IPE (2<sup>nd</sup> Semester)

Date: 15 May, 2024

Time: 10:00 AM to 1.00 PM

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**

ORGANIZATION OF ISLAMIC COOPERATION (OIC)

**DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING**

**Semester Final Examination**

**Summer Semester: 2022-2023**

**Course Number: ME 4225**

**Full Marks: 150**

**Course Title: Materials Engineering**

**Time: 3.0 hours**

There are 06 (Six) questions. Answer 06 (Six) questions. The symbols have their usual meanings. Marks of each Question and the corresponding CO and PO are written in the brackets.

- 1. (a) Analyze the iron making process utilizing the blast furnace, delineating the chemical reactions occurring within distinct zones of the blast furnace. (10)  
(CO-3)  
(PO-2)  
K3,K4/P1
- (b) Examine the steelmaking processes comprehensively, identifying the essential and detrimental elements to produce high-quality steel. (10)  
(CO-3)  
(PO-2)  
K3,K4/P1
- (c) Analyze the injection molding and extrusion processes as they pertain to the fabrication of ceramic and polymer materials. (10)  
(CO-3)  
(PO-2)  
K3,K4/P1
- 2. (a) Under what circumstances is the casting process chosen for metal forming operations? (10)  
(CO-3)  
(PO-2)  
K3,K4/P1
- (b) Outline the factors pertinent to identifying the optimal methods for metal cutting processes. (10)  
(CO-3)  
(PO-2)  
K3,K4/P1
- (c) Enumerate the steps involved in powder technology processes utilized for ceramic materials. (10)  
(CO-3)  
(PO-2)  
K3,K4/P1
- 3. (a) Summarize the factors that impact the selection and application of engineering materials. (05)  
(CO-4)  
(PO-3)  
K3/P1
- (b) Classify ceramic materials into two main categories: (i) based on application and (ii) based on composition. (08)  
(CO-4)  
(PO-3)  
K3/P1
- (c) Explain the properties and applications of the following advanced materials: (i) semiconductors, (ii) biomaterials, and (iii) smart materials. (07)  
(CO-4)  
(PO-3)  
K3/P1

4. (a) Define proof stress. Illustrate stress-strain graphs for the following materials: (i) cast iron, (ii) glass, (iii) mild steel, (iv) poly-ethylene, and (v) rubber. (10)  
(CO-4)  
(PO-3)  
K3/P1
- (b) Interpret the mechanical behavior of materials based on given data: a carbon steel sample with a tensile strength of 400 MPa and 35% elongation, and an aluminum-manganese alloy sample with a tensile strength of 140 MPa and 10% elongation. (09)  
(CO-4)  
(PO-3)  
K3,K4/P1
- (c) Define static strength. Analyze and differentiate the mechanical characteristics of ductile and brittle materials. (10)  
(CO-4)  
(PO-3)  
K3/P1
5. (a) Propose engineering materials known for their resistance to creep and high temperatures. (05)  
(CO-4)  
(PO-3)  
K3,K4/P1
- (b) Calculate the mass of steel lost in 6 hours when a steel coupon with an anode surface area of 1000 cm<sup>2</sup> is exposed to an electrolyte with a measured corrosion current of 1 mA. Determine the corrosion rate in micrograms per square centimeter per day ( $\mu\text{g}/\text{cm}^2/\text{day}$ ) and in mils per year (mpy), assuming density of steel is 7.2 g/cm<sup>3</sup> and a valence of 2. (10)  
(CO-4)  
(PO-3)  
K3,K4/P1
- (c) Analyze the mechanisms of adhesive and abrasive wear in order to facilitate the selection of suitable materials for enhancing wear resistance. (10)  
(CO-4)  
(PO-3)  
K3,K4/P1
6. (a) Differentiate between soft magnetic materials and hard magnetic materials, comparing and contrasting their characteristics. (05)  
(CO-4)  
(PO-3)  
K3/P1
- (b) Discuss the measurement technique for assessing the roughness of a surface. Explain how surface roughness is influenced by the processing technique employed. (08)  
(CO-4)  
(PO-3)  
K3,K4/P1
- (c) Under what conditions are manipulative processes expected to be the optimal choice for metal forming? (07)  
(CO-4)  
(PO-3)  
K3,K4/P1