

Ollscoil na hÉireann, Gaillimh  
National University of Ireland, Galway

**FIRST SEMESTER EXAMINATIONS 2000**

**SECOND CIVIL ENGINEERING EXAMINATIONS**

**ENGINEERING MATERIALS**

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Time allowed: 2 hours

Answer 2 questions from Part A and 2 questions for Part B

Use separate answer books for each part

**Part A**

*Answer 2 questions*

1. Distinguish between the following, illustrating your answers with diagrams when appropriate
  - (i) Interstitial atoms and substitutional atoms.
  - (ii) Body centered cubic and hexagonal close packed.
  - (iii) Metallic bonds and grain boundaries.
  - (iv) Stress relieving and strain hardening.
2.
  - (a) Write a short note on fracture of metals.
  - (b) Describe the progression of failure in a fibre reinforced composite laminate.
3. Compare and contrast the properties of polymers and metals and describe how the properties influence the various applications of these materials in Civil/Environmental Engineering.

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**Part B**  
*Answer 2 questions*

4. Write notes on the following, making reference to origins, varieties and uses:
- Portland cements;
  - latent hydraulic binders.
5. Discuss the durability of reinforced concrete structures, with particularly reference to the following:
- permeability, and factors which influence it;
  - corrosion of steel: its effects and avoidance;
  - other agencies of attack or mechanisms of deterioration of concrete.
6. (i) Write notes on the following:  
*cold weather/ hot weather concreting; curing - purpose and methods; creep and shrinkage of concrete; measurement of compressive strength; admixtures for concrete.*
- (ii) Design a concrete mix to the following specifications, using the mix design form and handout provided:
- |  |                                   |
|--|-----------------------------------|
| Characteristic strength                                | 40 N/mm <sup>2</sup> at 28 days   |
| Proportion defective                                   | 5%                                |
| Standard deviation                                     | 4 N/mm <sup>2</sup>               |
| Cement type  | Ordinary (Normal) Portland cement |
| Aggregate type   | Coarse - uncrushed                |
|  | Fine - uncrushed                  |
| Proportion of fine aggregate passing 600 $\mu$ m sieve | 50%                               |
| Maximum aggregate size                                 | 20mm                              |
| Slump  | 30-60mm                           |
| Maximum free water/cement ratio                        | 0.50                              |

Repeat with crushed aggregates and comment on the differences.