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| **Unit Title** | Manufacturing Systems and Materials Technologies |
| **Level** | 6 |
| **Reference No.**  ***(showing level)*** | EEC\_6\_107 |
| **Credit Value** | 30 |
| **Student Study Hours** | Contact hours: 104  Student-managed learning hours: 196 |
| **Pre-requisite learning** | Solid Mechanics and Dynamics |
| **Co-requisites** |  |
| **Excluded combinations** |  |
| **Unit co-ordinator** | Yuching Bao |
| **Faculty/Department** | ESBE / Engineering & Design |
| **Short Description** | The unit provides an understanding of the scope of materials technologies and the integrative role of materials selection in engineering. In addition, it explains technological change and innovation in materials, as well as sustainable and environmentally compatible technologies. It provides an understanding of elasticity, finite elements, plasticity and fracture of different materials and their application to practical engineering problems.  The second art of the unit introduces the concept of manufacturing systems (including integrated manufacturing), their applications as fundamental elements of the contemporary product realisation process, and the issues involved in their management. |
| **Aims** | The aims of the unit are to:   * Enable students to understand the principles and methodology of materials selection and manufacturing process selection. * Provide an understanding of how materials technologies can be designed and controlled to meet the requirements of high-performance products, improve material performance and limit the environmental impact of engineering products * Encourage students to develop creative skills by considering new materials in engineering applications * Provide an understanding of the theories of elasticity and plasticity. * Use finite element analysis in the solution of engineering problems. * Examine the principles and applications of fracture mechanics. * Provide students with the concepts, methods and applications of contemporary manufacturing systems and integrated manufacturing and its related aspects * Equip the students with the knowledge of techniques for the management of manufacturing systems. |
| **Learning Outcomes** | **Knowledge and Understanding**  The expected learning outcomes are that the student should be able to:   1. Understand the principles and methodology of materials and process selection 2. Understand the behaviour and control of high-performance materials 3. Explain the role manufacturing systems in the product realisation process and its application in modern manufacturing and CIM systems 4. Define concepts and applications of manufacturing planning, material handling systems and industrial robots 5. Have an awareness of trends and application of quality control and computer aided inspection techniques 6. Apply concepts and techniques of operations management   Transferable Skills :  The unit provides the opportunity to develop the following key and cognitive skills:   * learning how to learn by exploring a variety of learning   styles and methods during both class sessions and in self-  managed study activities;  - interpretation and analysis of engineering data;  - develop operations management skills  **Practical Skills**   * Apply elasticity and plasticity theory, and fracture toughness data to practical problems * Solve problems using finite elements   **Transferable Skills**   * Development of numerical and analytical skills to solve problems. * Development of computing and quantitative skills for the analysis and presentation of complex data. * Development of creative skills and innovation in engineering * Communication and presentation skills |
| **Employability** |  |
| **Teaching and learning pattern** | Formal lectures, tutorials, seminars and demonstrations supported by handouts tutorial sheets and a dedicated module site on Blackboard for additional materials. Audio visual aids, case studies, group discussion seminars and the use of computer software, hardware and laboratory experiments /demonstrations. |
| **Indicative content** | Materials Properties   * Elasticity theory, constitutive equations, finite element analysis. Finite element models and their solution using software packages. Plasticity theory, stress-strain relationships, applications.   Materials Behaviour  Fracture mechanics, energy balance, stress intensity factors, fracture toughness testing and applications. Mechanisms and control of fatigue, creep and surface degradation in engineering materials.  Materials and Process Selection  Charts, selection with and without shape. Process selection: methodology, characterisation and process charts. Development of new technologies. Emerging technologies.  Manufacturing and operations strategies  Organisation and information processing in manufacturing system; Contemporary and emerging global trends in manufacturing operation; Sustainable and environmentally friendly manufacturing; Applications of computer-integrated manufacturing models. Standards and protocols in manufacturing systems  Manufacturing automation  Overview of production and automation strategies. Decision support tools in manufacturing. Research and developments in materials and cutting tool technology.  Manufacturing process planning  Role of computer-aided process in planning an integrated manufacturing system. Generative and automated process planning.  Quality control and inspection  Principles and methods. Contact and non-contact inspection methods. Application of computer-software for automated inspection. Application of CNC-CMM for quality control.  Material handling storage and retrieval  Concepts, functions and analysis of modern material handling, storage and retrieval systems. Application of inventory control and materials requirements planning.  Robotics applications in manufacturing  Application of industrial robots in manufacturing and the role of industrial robots in integrated manufacturing. Single-machine robot cell applications. Performance and economic justification of robot applications  Operations management  Overview. Development of operations strategy. Production planning, materials and capacity planning. |
| **Assessment**  ***Elements & weightings*** | Closed book exam – 50%  Case study  Coursework assignments / Practical Lab sessions  Coursework – 50% |
| **Indicative Sources**  ***(Reading lists)*** | TBC |