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| **Unit Title** | Solid Mechanics and Dynamics |
| **Level** | 5 |
| **Reference No.*****(showing level)*** | EEC\_5\_978 |
| **Credit Value** | 30 |
| **Student Study Hours** | Contact hours: 98Student-managed learning hours: 204 |
| **Pre-requisite learning** | Mechanical PrinciplesEngineering Mathematics and ModellingMechanical Principles |
| **Co-requisites** | None |
| **Excluded combinations** | None |
| **Unit co-ordinator** | Yuching Bao |
| **Faculty/Department** | ESBE / Engineering & Design |
| **Short Description** | Application of fundamental principles of mechanics and dynamics to more advanced systems, building on knowledge gained through Mechanical Principles (L4). Material properties (metals, polymers, ceramic and composites) and behaviour both in static and dynamic systems |
| **Aims** | **Material Properties*** Understand how materials properties and behaviour are determined by manufacturing methods

**Behaviour**Static systems* Materials under different stress systems and environments
* Body mechanics, both rigid and deformable
* Types of joints and behaviour

Dynamic systems* Linkages, mechanisms and machines
* Systems in translation, rotation about fixed axis and general plane motion
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| **Learning Outcomes** | **Knowledge and Understanding**The expected learning outcomes are that the student should be able to: 1. Explain the relationship between manufacturing, materials composition and microstructures, and their effect on the performance of materials in service
2. Apply the fundamental principles of mechanics to a wide range of engineering systems, such as rigid bodies in translation, rotation about fixed axis, general planar motion
3. Analyse planar mechanisms, transmission systems and machines by a rigorous use of scientific and mathematical techniques

**Transferable Skills*** Development of numerical and analytical skills to solve a variety of problems in a mechanical engineering context
* Development of computing and quantitative skills for the analysis and presentation of complex data
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| **Employability** |  |
| **Teaching and learning pattern** |  |
| **Indicative content** | **Material properties*** Ductility, toughness, brittleness, tests methods and service performance
* Effect of temperature, strain-rate and stress concentration on fracture behaviour
* Composite materials: Stress and strain transformations in composite materials. Design using composite materials
* Metals: Effect of alloying, manufacturing and heat treatment on structure and properties of steels and light metals.

**Behaviour**Static Systems* Fatigue: The S-N curve, non-zero mean stress, residual stress, multi-axial fatigue. Cumulative damage, fatigue stress concentration factors, fatigue testing and the statistical interpretation of data. Low cycle fatigue and strain cycling.
* Time-dependent Deformation of materials: Creep stress relaxation and creep rupture. Strain-time curves. Accelerated test methods.
* Corrosion: Galvanic corrosion localized corrosion such as crevice, pitting and stress corrosion. Method of corrosion protection and their application in product design.
* Axisymmetric systems: Stress analysis of thin walled cylinders and spheres, thick walled and compound cylinders.
* Types of joint: Bolted connections and welded joints. Joint design. Welding process technology.
* Rigid Body Statics: Euler's equations. Friction. Applications: power screws.

Dynamic Systems* Kinematics of Particles: rectilinear and polar coordinates. Variable acceleration. Applications: pulley systems (1 and 2 DOFs).
* Linkages, Mechanisms and Machines: Degrees of freedom. Relative velocity and velocity/acceleration diagrams for simple mechanisms.
* Power Transmission: Gear systems, belt drives, clutches, bearings, seals, flywheels, power losses, fundamentals of lubrication and wear, simple velocity ratios and torques, use of design charts, eg., for choice of belt size. Hoists, winches.
* Shaft Design: Design of shafts for power transmission, combined bending and torsion, consideration of keyway fixing, safety factor, hollow and rigid shafts, materials.
* Rigid Body Kinetics: Rectilinear and Rotary motion. Applications: cars, flywheels.
* Vibration: Introduction to the fundamental concepts of vibration; degrees of freedom, stiffness, equations of motion, free vibration, natural frequencies in rectilinear, torsional and transverse modes.
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| **Assessment*****Elements & weightings*** | Coursework 40%Exam 60% |
| **Indicative Sources*****(Reading lists)*** | TBC |