Government of **Western Australia**
School Curriculum and Standards Authority

SAMPLE COURSE OUTLINE

ENGINEERING STUDIES
ATAR YEAR 12

Sample course outline

Engineering Studies ATAR Year 12

Unit 3 and Unit 4

Semester 1

Week	Key teaching points
1–3	Overview of unit and course outline Introduction to Engineering design process, and development of a design folio **Engineering design process** **Investigating** • develop a comprehensive design brief • identify and assess existing solutions or similar products that are identified using a variety of research skills • research and critique materials and components relevant to the design brief **Materials** • define and classify types of materials **Task 1 Part A:** Design project one
4–8	**Investigating** • consider different and appropriate sources of energy **Energy** • relationships between ▪ energy ▪ power ▪ work • different forms of energy ▪ kinetic ▪ thermal ▪ electrical ▪ electromagnetic (light) ▪ potential ▪ chemical ▪ electro-chemical ▪ nuclear • non-renewable sources ▪ fossil fuels: coal, gas and oil ▪ nuclear • renewable sources of energy ▪ solar: thermal, biomass, photovoltaic and wind, including waves ▪ gravity: tidal and hydroelectric ▪ geothermal • analyse the impacts on society and the environment of obtaining and using non-renewable and renewable sources of energy **Task 1 Part B:** Design project one **Engineering design process** **Devising** • produce annotated pictorial drawings of design ideas • produce annotated orthographic drawings of design ideas • analyse and justify the choice of option to be used as the solution **Task 2:** Devise concepts for project one and select the best option for the solution **Specialist engineering fields** **Mechanical** **Materials** All dot points and sub dot points in this section of Unit 3 of the syllabus • apply the processes for steel alloys • analyse stress verses strain graphs for the common materials • use of formulae for stress, strain and Young's Modulus • convert between the stress units • derive values from graphical and tabled data

Week	Key teaching points
	• properties of materials **or** **Mechatronics** **Electrical/electronics** • recognise the circuit symbols for components listed in this section of Unit 3 of the syllabus • describe general characteristics of components • read and sketch simple circuit diagrams that contain the components that relate to microcontroller and interfacing circuits • apply markings ▪ fixed value resistors – 4 band E12 series ▪ capacitors: pF, nF and µF ▪ serial numbers – data sheets o pin outs: voltage regulator, transistor and integrated circuits **Laws and principles** Recognise and use all formula • Ohm's Law • Kirchhoff's Laws • calculate power • cells and batteries • resistor networks • capacitor networks • digital input **Production** • safety ▪ electrical ▪ drilling ▪ soldering • design printed circuit boards ▪ single sided through hole • populate a through hole printed circuit board • soldering technique using correct equipment ▪ identify and correct soldering faults • measure resistance, voltage and current using a digital multimeter **Quantities and Unit prefixes** Use terms listed in this section of Unit 3 of the syllabus **Systems and Control** **Nature of control systems** • systems/control diagrams ▪ loop systems listed in the syllabus **Programming** All dot points and sub dot points listed in this section of Unit 3 of the syllabus • flowcharts • interpret flowcharts and explain functions • draw flowchart given specifications • identify and correct fault(s) in a flowchart • systems/control diagrams • pulse width modulation (PWM)

Week	Key teaching points
9–10	**Fundamental engineering calculations** Use terms and perform calculations listed in this section of Unit 3 of the syllabus **Engineering design process** **Devising** • produce annotated, pictorial drawings of design ideas • produce annotated, orthographic drawings of design ideas • analyse and justify the choice of option to be used as the solution **Task 2 (continued):** Devise concepts for project one and select the best option for the solution Conduct more research, produce and refine sketches and drawings of concepts, and evaluate these to select the best option for the solution **Quantity estimates** Use terms and perform calculations listed in this section of Unit 3 of the syllabus **Engineering design process** **Producing** • present specifications for the selected solution ▪ dimensioned pictorial and orthographic drawings ▪ orthographic drawings and sketches as 3rd angle projections and include lines and dimensioning ▪ materials selection ▪ parts lists ▪ costing of prototype or working model **Task 3:** Produce specifications for the selected solution for project one: working drawings, lists of materials and estimated costing, and develop production plan on a timeline
10–13	**Specialist engineering fields** **Mechanical** **Statics** All dot points and sub dot points of Unit 3 of the syllabus • apply moments formula to determine one unknown where the applied force may need to be resolved into its component forces, to contain no more than two vector resolutions • apply the three conditions for equilibrium and use the formulae to determine one unknown variable • calculate applied forces as vertical and horizontal with no more than one angular force requiring trigonometry to resolve for its horizontal and vertical components • use 'conditions of equilibrium' formulae to determine the reaction forces at a structure's supports (two supports only) • use 'conditions of equilibrium' formulae to solve for one unknown external force or distance variable • use moments formula to determine the reaction forces at a beam's supports • construct shear force and bending moment diagrams for simple supported beams (horizontal and supported at both ends) or simple cantilevers (horizontal and supported at one end) • calculate shear force (SF) values finding the SF to the left and right of specified points • calculate bending moment (BM) values at specified points, including the magnitude and position of the maximum bending moment **or** **Mechatronics** **Interfacing with microcontroller** Include all dot points and sub dot points of Unit 3 of the syllabus • nature of microcontroller • power supply • digital input • analogue input • analogue to digital conversion (ADC) **Producing** • develop and use timeline for construction and testing of solution

Week	Key teaching points
	• construct solutions by selecting and using appropriate tools and machines and by following safe work practices • test the solution for correct function and document using checklists and test data **Task 4:** Production of project one Construct the proposed solution, using prepared production plan, materials and available equipment Record progress in design folio, including any modifications and changes to the design and processes during production
14–15	**Engineering design process** **Evaluating** • evaluate the final solution in terms of: ▪ meeting the requirements of the design brief ▪ safety, function and finish of the product ▪ modifications and changes to the design and processes during production ▪ refinements and changes for future development **Task 5:** Evaluate completed project one Written report on, and photographs of, completed project one **Task 6:** Semester 1 Examination of approximately 2.5 hours using modified examination design brief from the Year 12 syllabus

Semester 2

Week	Key teaching points
1–3	Overview of unit and assessment requirements Reintroduction to Engineering design process and development of a design folio **Engineering design process** **Investigating** • develop a comprehensive design brief • identify and assess existing solutions or similar products that are identified using a variety of research skills • research and critique materials and components relevant to the design brief • consider different and appropriate sources of energy **Task 7:** Design project two Note: project two may be completely separate from project one or it may be the extension of the theme used for project one.
4–7	**Materials** Include all sub dot points of this section of Unit 4 of the syllabus • define physical properties of materials • fitness for purpose ▪ identify and justify the required properties of a material for a specified application **Engineering design process** **Devising** • produce annotated pictorial drawings of design ideas • produce annotated orthographic drawings of design ideas • analyse and justify the choice of option to be used as the solution **Task 8:** Devise concepts for project two and select the best option for the solution

Week	Key teaching points
4–7	**Specialist engineering fields** **Mechanical** **Materials** • define Factor of Safety (FS) as the ratio of ultimate failure stress to safe working stress • use the formula to determine one unknown variable **Statics** • calculate second moment of area for material cross-sections using sub dot point formulas in this section of Unit 4 of the syllabus **Deflection of beams** • calculate one unknown variable using one of the four beam deflection formulae • deflection scenarios, when solving for 'y', are to be calculated in isolation and a maximum of two load scenarios in total may be combined to give the final deflection sum using notes and sub dot point formulas in this section of Unit 4 of the syllabus **Method of sections for simply supported pin-jointed trusses** • use the $\Sigma CWM = \Sigma ACWM$ formula to determine the reaction forces at the supports of horizontal, simply supported pin-jointed trusses, where all external forces are vertical • calculate the forces in no more than three members in a simple pin-jointed truss by using the method of sections. Sectioning lines shall remain straight whilst crossing the maximum three members. The moment arm, not the force, shall be the variable requiring trigonometry in determining any particular moment required. All external forces are to be vertical only **or** **Mechatronics** **Laws and principles** • analogue inputs • diodes • unfamiliar formula • NPN transistor • voltage regulator • data extraction
7–9	**Fundamental engineering calculations** Use terms and perform calculations using sub dot point formulas listed in section of Unit 4 of the syllabus **Volume, Density, Quantity Estimates, Energy, Efficiency and Unfamiliar formula** **Engineering design process** **Devising** • produce annotated pictorial drawings of design ideas • produce annotated orthographic drawings of design ideas • analyse and justify the choice of option to be used as the solution **Task 8 (continued):** Devise concepts for project two and select the best option for the solution • progress through theory, refine drawings and concepts to the best possible solution **Engineering design process** **Producing** • present specifications for the selected solution ▪ dimensioned pictorial and orthographic drawings ▪ orthographic drawings and sketches as 3rd angle projections, and include lines and dimensioning ▪ list and/or descriptions of selected materials with justification of choices ▪ parts lists ▪ costing of prototype or working model **Task 9:** Produce specifications for project two: working drawings, lists of materials and costing, develop production plan on a timeline **Engineering in Society** **Life cycle analysis of engineered products** Include all sub dot points in this section of Unit 4 of the syllabus • the stages of the life cycle • impacts for society, business and the environment that occur during the life cycle of engineered products

Week	Key teaching points
	Task 10: Research and analyse the life cycle of an engineered product Research and report on the stages of the life cycle of an engineered product Comment on the impacts of the product on society, business and the environment over the life cycle of the product
10–13	**Specialist engineering fields** **Mechanical** **Dynamics** Include all formula from the sub dot points of this section of Unit 4 of the syllabus • apply the formula to find one unknown variable in constant acceleration, straight line motion • define potential energy as energy of position or state • define kinetic energy as energy of motion • solve problems involving energy and energy conversion using formula • apply the formula for Work to find one unknown variable • define efficiency (η %) and apply the formula to find one unknown variable • apply Power formula to find one unknown variable **or** **Mechatronics** **Interfacing with microcontroller** Include all dot points and sub dot points of this section of Unit 4 of the syllabus • outputs **Mechanics** **Types of motion** • linear, rotary, oscillating and reciprocating • transformation **Mechanical drive systems** • recognise and describe general characteristics and applications of drive systems **Calculations** Use formula of all dot points and sub dot points of this section of Unit 4 of the syllabus **Quantities** Use formula of all dot points and sub dot points of this section of Unit 4 of the syllabus **Engineering design process** **Producing** • develop and use a timeline for construction and testing of solution • construct solutions by selecting and using appropriate tools and machines, and by following safe work practices • test the solution for correct function and document using checklists and test data **Task 11:** Production of project two • construct the proposed solution, using prepared production plan, materials and available equipment
14	**Engineering design process** **Evaluating** • evaluate the final solution in terms of: ▪ meeting the requirements of the design brief ▪ safety, function and finish of the product ▪ modifications and changes to the design and processes during production ▪ refinements and changes for future development **Task 12:** Evaluate completed project two • written report on, and use photographs of, the completed project two
15	**Task 13:** Semester 2 Examination – of approximately three hours, using examination design brief from the Year 12 syllabus