## TSC Category
Manufacturing and Operations

## TSC
Production Line Set-Up

### TSC Description
Design mechanism units, systems and drives for industrial manufacturing applications

<table>
<thead>
<tr>
<th>TSC Proficiency Description</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
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<th>Level 6</th>
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<tr>
<td>Design electric drives and electromechanical systems in a range of industrial applications at the workplace</td>
<td>Design mechanism units of machines for a range of industrial applications</td>
<td>Design mechanical and electrical systems for standalone automated industrial machines</td>
<td>Design equipment and products of high precision, accuracy and reliability</td>
<td>Evaluate plant-wide production machinery and automation systems for effectiveness and reliability</td>
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### Knowledge
- Types and usage of electric drives, electromechanical system devices and electrical circuit diagrams
- Types of hardware and software for design drawing
- Interpretation of control requirements and ISO circuit diagram symbols
- Industry standards used in operating electric drives and electromechanical systems
- Design principles of electrical circuit operations of electric drives and electromechanical system components
- Procedures for checking, verifying and amending completed electrical control circuit
- Industrial health and safety risks involved in designing electric drives and electromechanical systems
- Organisational procedures for

- Essential stages of the design process
- Fundamentals of machine mechanisms
- Association between assembly drawings, detailed drawings and bills of material (BOM)
- Surface roughness obtainable from manufacturing processes
- Limits and fits
- Hole basis and shaft basis of tolerance
- Applications of geometric dimensioning and tolerancing (GD&T) to engineering drawings
- Tolerance stacking analysis
- Machine elements selection in machine design
- Part and assembly modelling
- Principles of alternating and direct electrical currents (AC/DC)
- Types of electrical controls used in industrial machines
- Electrical safety and protection
- Electrical loading calculations
- Types of electrical sub-systems, electrical drawings, enclosures and wiring accessories
- Tolerance stacking analysis
- Concept of electrical interference
- Electrical connection techniques and grounding principles
- Electrical system functional tests procedures
- Mechanical power transmissions, hydraulic and pneumatic systems
- Concept of computer-based and programmable logic control (PLC)
- Concepts of exact constraints and over-constraints
- Principles of elastic averaging and Herzian stress
- Types of materials for precision machine structures
- Characteristics of rotary and linear bearings, couplings, linear drives, gears and gear transmissions
- Principles of guideway design to achieve precision linear motion
- Types of guideway systems and their characteristics
- Concepts of degrees of freedom for planar linkage mechanisms
- Kinematic design procedures of linkage mechanisms
- Performance characteristics of flexure-based mechanisms
- Homogeneous transformation matrix (HTM) model of a machine
- Principles of precision engineering
- Methods and tools for evaluating machinery and automation systems
- Evaluation criteria for machinery and automation systems
- Types and impact of recommendations on engineering processes
- Organisational and legislative requirements
<table>
<thead>
<tr>
<th>Abilities</th>
<th>SKILLS FRAMEWORK FOR PRECISION ENGINEERING TECHNICAL SKILLS AND COMPETENCIES (TSC) REFERENCE DOCUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Identify control sequences based on control requirements and electrical diagrams</td>
<td>• Produce statements of function and design requirements for devices, in accordance with machine specifications</td>
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<tr>
<td>• Identify and select required electric drive components and electromechanical system devices based on control requirements</td>
<td>• Identify machine mechanisms, according to design specifications</td>
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<td>• Design electric drives and electromechanical systems in accordance with control requirements</td>
<td>• Identify geometric features of engineering drawings</td>
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<td>• Check completed circuit diagrams to ensure control requirements are met</td>
<td>• Interpret types of dimensioning, datum references, dimension limits, surface sign and finish applied on components</td>
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<td>• Connect electrical drives, electromechanical system and test equipment, in accordance with specifications of completed circuit diagram and approved written work instructions</td>
<td>• Interpret the basis and class of fit applied on components</td>
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<td>• Test electric drives and electromechanical systems, in accordance with established organisational procedures</td>
<td>• Size out appropriate machine elements to accomplish desired designs</td>
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<td>• Visualise practical phenomena of vibration and solve related problems</td>
<td>• Produce the parametric models of parts and assemblies in accordance with the assignment specifications</td>
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<td>• Produce electrical design drafts of machines' electrical systems, in accordance with design processes</td>
<td>• Analyse the strengths and weaknesses of the designs against design criteria</td>
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<td>• Recommend improvements to engineering designs that may improve machine performance</td>
<td>• Develop machine design specification drawings</td>
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<tr>
<td>• Evaluate final reports on the selected components used to meet the machine system requirements</td>
<td>• Evaluate machine design specification drawings</td>
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- **Combination rules of errors**
- **Perform analyses to determine precision machines’ requirement performance**
- **Perform performance specification analyses on sensors and actuators, automation control systems, electrical systems and human-machine interface (HMI) systems**
- **Design system integration for selected components, in accordance with precision machine requirements**
- **Report on the selected components used to meet machine system requirements**
- **Evaluate system designs for integration of selected components, in accordance with precision machine requirements**
- **Evaluate final reports on the selected components used to meet the machine system requirements**
- **Develop machine design specification drawings**
| • Maintain documentation of testing results and records | • Account for vibration analysis in designs | • Conduct costs-of-quality analyses related to products to identify areas for improvement |
| Shut down electric drives and electromechanical systems, in accordance with established organisational procedures | • Produce the engineering drawings from the models of parts and assemblies, with appropriate presentations, in accordance with the assignment specifications |
| Disconnect electric drives, electromechanical system devices and test equipment | | |
| Label, isolate and report clearly any faulty components or devices identified during work activities | | |