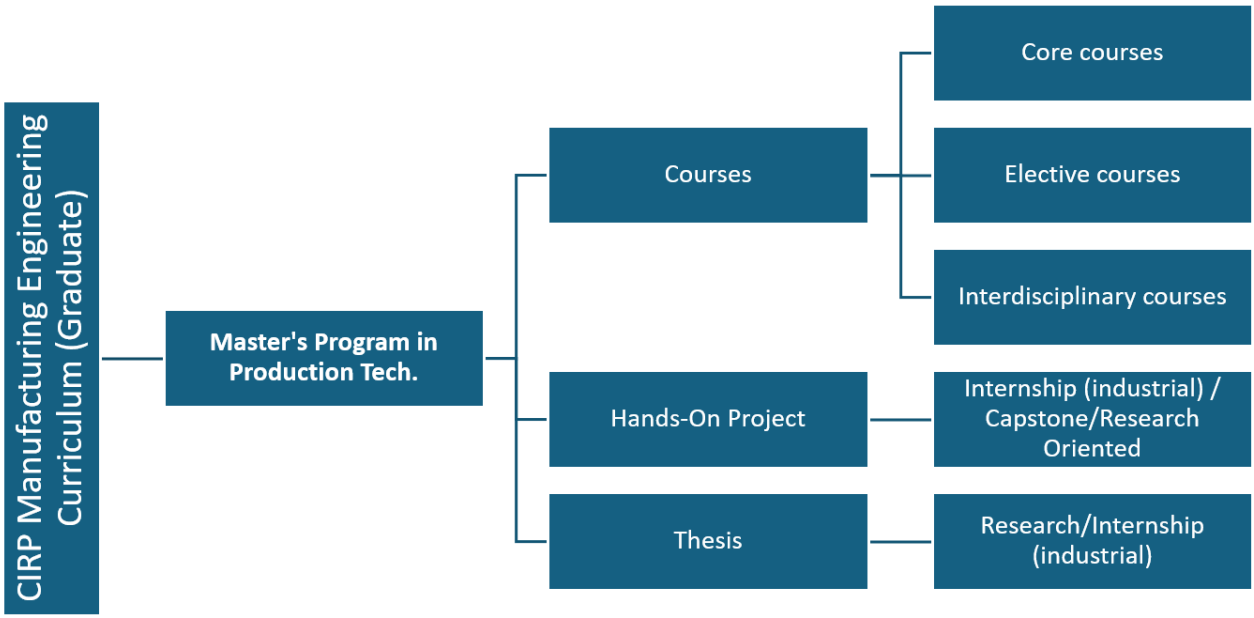
Manufacturing Engineering Curriculum (Postgraduate)

The curriculum is classified into three streams, i.e.
1. Master's Program in Production Technologies (Production Tech.)
2. Master's Program in Production Management (Production Mgt.)
3. Master's Program in Production Systems (Production Sys.)

Course Structure



Master's Program in Production Technologies (Production Tech.)

Objective:

Provide learners with comprehensive knowledge and skills in advanced manufacturing processes and technologies, manufacturing process simulation, sustainable manufacturing and the integration of Industry 4.0 technologies into production technologies, grounded in a strong scientific and technological basis alongside data analytics and AI.

Course modules

	Recommended Modules	
PTC01	**Advanced Manufacturing Technologies and Processes I** Advanced mechanical, non-mechanical and energy beam machining technologies and processes (turning, milling, grinding, drilling, electro-discharge machining, electrochemical machining, laser, plasma, water-jet, ion beam machining): mechanics, material removal mechanism, machines, process development and applications.	10
PTC02	**Advanced Manufacturing Technologies and Processes II** Advanced forming and forging technologies and processes (extrusion, rolling, stamping, shearing, rotary forming, superplastic forming): mechanical science, machines, process development and applications.	10
PTC03	**Additive Manufacturing** History, underlying principles, definition; process classification; advantages and market overview of additive manufacturing; extrusion processes; ink-jet based processes; fusion processes; vat photopolymerization.	10
PTC04	**Manufacturing Process Simulation** Advanced finite element, boundary element, molecular dynamics simulation, multiscale and multi-physics modelling methods for throughput, forces, tool wear, surface quality in machining processes.	10
PTC05	**Sustainability in Manufacturing** An introduction to the environmental impacts of a range of manufacturing systems; potential approaches, and their technological limitations, to the decarbonization of a range of manufacturing systems; the use of life cycle analysis in assessing the environmental impacts of materials processing routes.	10
PTC06	**Data Analytics and AI for Product and Production systems** An introduction to basic statistics, types of data, data visualisation techniques, data modelling. data pre-processing methods including data imputation. forecasting methods, clustering and classification methods, machine learning and deep learning methods for product and production systems.	10
PTE01*	**Nanotechnology in Manufacturing** An introduction to the three manufacturing paradigms, micro, nano and quantum mechanics, main concepts of engineering materials in the nanoscale, and size-dependence of material properties between the atomistic and bulk scales (nanoscale physics), nanoelectronics, nanophotonics and their manufacturing challenges, nanoscale material processing technologies and characterization instruments.	10

PTE02*	**Innovative Materials in Manufacturing** An introduction to the fundamentals of advanced materials, manufacturing processes, material characterization methods, parameters and instruments.	10
PTE03*	**Semiconductor Manufacturing** A comprehensive introduction to semiconductor manufacturing technologies, processes and systems, from sample preparation, patterning to device packaging, such as optical lithography, X-ray lithography, nanoimprint, self-assembly, laser direct writing, electron-beam, ion beam and next-generation lithography and packaging technologies.	10
PTE04*	**Robotics and Automation in Manufacturing** Industrial robots, robotic programming, advanced control theory, autonomous systems, human-robot interactions in manufacturing.	10
PTE05*	**Precision Engineering** Principles of precision engineering, precision and ultra-precision machining technologies, precision machine design, precision metrology methods and systems.	10
PTE06*	**Digital Twin Engineering** A comprehensive introduction to concept, definition, history, classification, underlying technologies, current applications and limitation of digital twins for manufacturing.	10
IND01	**Innovation and Design/System Thinking** An introduction to systems theory, concepts and approaches; hard and soft systems analysis and systems dynamics; systems and organizational performance and practical application of systems thinking.	10
IND02	**Ethics in Manufacturing** An introduction to key concepts and debates in ethics in manufacturing, including several prominent traditions in ethical theory and their application to ethical questions in a global context.	10
IND03	**Cross-Cultural Management and Communication** Perspectives, definitions, classifications of culture; cultural differences, approach for management at the level of individuals; language and communication in multicultural teams and organisations; the link between culture and ethics in manufacturing organisations; method for communication accommodation and social identity theories.	10
IND04	**Research Methodology and Project Management** An introduction to research methodology, reasoning, research tools, qualitative and quantitative research, technology readiness levels, critical literature review, academic writing, Matlab programming. project management, presentation skills.	10

Note: PTC: Production Technologies Core moule (Compulsory)

PTE*: Production Technologies Elective module (Choose two of them)

IND: Interdisciplinary module

Master's Program in Production Management

Objective:

Provide learners with comprehensive knowledge and skills in advanced production operations management, life cycle engineering, sustainable manufacturing, and the integration of Industry 4.0 technologies into production management, grounded in a strong scientific and technological basis alongside data analytics and AI.

Course modules

	Recommended Modules	
PMC01	**Operation and Production Management** An introduction to history and development of operation management, service operations & service quality, process design, process Improvement & mapping, planning, capacity and inventory managements, ERP, MRP, Kanban, e-connections planning.	10
PMC02	**Quality Engineering and Management** An introduction to quality management system definition, principles and frameworks, quality management systems document hierarchy, risk management, root cause analysis, cost of quality, external assurance.	10
PMC03	**Supply Chain and Logistics Management** An introduction to supply chain management; competing with supply chains; supplier assessment and development; lean transformation, logistics management, RFID, e-business, service supply chain management.	10
PMC04	**Simulation for Production Systems** Classification of production systems, advanced modelling and simulation methods and software for production systems, application case studies.	10
PMC05	**Life Cycle Engineering and Sustainable Production** An introduction to evolution of sustainable design method, life cycle analysis and sustainable service system design method.	10
PMC06	**Data Analytics and AI for Product and Production Systems** An introduction to basic statistics, types of data, data visualisation techniques, data modelling. data pre-processing methods including data imputation. forecasting methods, clustering and classification methods, machine learning and deep learning methods for product and production systems.	10
PME01*	**Reliability Engineering and Maintenance** Analysing the reliability of plant items and systems, decision analysis: identifying reliability problems using Pareto and trend analysis, Weibull analysis: graphical analysis of item life data, the Cumulative Hazard plot, Reliability Block Diagrams (RDBs), truth table and Bayesian techniques, advanced reliability and safety assessment, fault tree analysis, human reliability assessment.	10

PME02*	**Human-Centric Production Systems Organization** Industry 5.0, human-centric approach, a system framework to embrace human difference, prioritise UX and accessibility, harmonise organizational environment, ethics in human-centric production systems organization.	10
PME03*	**Innovation and Technology Management** Effective innovation strategies, the tools and techniques to develop new products and tactics to take them to market; managing intellectual property (IP), management strategies and approaches in multinational corporations, SME, universities and research institutes; digital innovation.	10
PME04	**Strategic Technology Management:** An introduction to a series of strategic frameworks for managing high-technology businesses, and a set of powerful analytical tools which are critical for the development of a technology strategy as an integral part of business strategy.	10
PME05*	**Digital Twin Management and Operations** An introduction to concept, definition, history, classification, underlying technologies, current applications and limitation of digital twin technologies for manufacturing management and operations.	10
PME06*	**Lean Six Sigma:** An introduction to lean thinking, six sigma, and lean six sigma (LSS), comparing and contrasting lean & six sigma, LSS project characterization and selection, lean and six sigma metrics, basic lean tools and techniques	10
IND01	**Innovation and Design/System Thinking** An introduction to systems theory, concepts and approaches; hard and soft systems analysis and systems dynamics; systems and organizational performance and practical application of systems thinking.	10
IND02	**Technology Ethics** An introduction to key concepts and debates in ethics in manufacturing, including several prominent traditions in ethical theory and their application to ethical questions in a global context.	10
IND03	**Cross-Cultural Management and Communication** Perspectives, definitions, classifications of culture; cultural differences, approach for management at the level of individuals; language and communication in multicultural teams and organisations; the link between culture and ethics in manufacturing organisations; method for communication accommodation and social identity theories.	10
IND04	**Research Methodology and Project Management** An introduction to research methodology, reasoning, research tools, qualitative and quantitative research, technology readiness levels, critical literature review, academic writing, Matlab programming. project management, presentation skills.	10
Required total credits		**120**

Note: PMC: Production Management Core moule (Compulsory)
PME*: Production Management Elective module (Choose two of them)
IND: Interdisciplinary module

Master's Program in Production Systems

Objective:

Provide learners with comprehensive knowledge and skills in advanced manufacturing systems, smart manufacturing, sustainable manufacturing and the integration of Industry 4.0 technologies into production, grounded in a strong scientific and technological basis alongside data analytics and AI.

Course modules

	Recommended Modules	
PSC01	**Product and Production Systems Design I** An introduction to and overview of manufacturing systems, definitions and usage of terms including enterprise, systems, sequencing, scheduling, connectivity, plant layout, product quality, Operations Research (OR), efficiency computer-integrated manufacture, product lifecycle management, design methods and supporting software.	10
PSC02	**Product and Production Systems Design II** Smart manufacture and Industry 4.0, operation management, quality control and quality assurance, advanced design methods, case studies for product and production system design.	10
PSC03	**Life Cycle Engineering** A comprehensive introduction to life cycle analysis: history, method, procedures, software and application case.	10
PSC04	**Cyber Physical Production Systems** An introduction to Industry 4.0, history, definition, classification, application, methods, sensors and software to establish CPS for production system.	10
PSC05	**Sustainability for Product and Production Systems** An introduction to the environmental impacts of a range of product and production systems; potential approaches, and their technological limitations, to the decarbonization of a range of product and production systems; the use of life cycle analysis in assessing the environmental impacts of materials processing routes.	10
PSC06	**Data Analytics and AI for Product and Production systems** An introduction to basic statistics, types of data, data visualisation techniques, data modelling. data pre-processing methods including data imputation. forecasting methods, clustering and classification methods, machine learning and deep learning methods for product and production systems.	10
PSE01*	**Generative Design for Manufacturing** Finite element analysis, design methods for 3D printing, assembly and re-manufacturing.	10

PSE02*	**IOT and Digital Manufacturing** An introduction to digital manufacturing system design, computer vision, AR/VR/XR, cloud and edge computing, big data, Internet of Things, cyber physical systems, digital twin, artificial intelligence technologies.	10
PSE03*	**Cybersecurity for Production Systems** Foundational concepts and principles, authentication and access control, operating system security, cryptographic mechanisms and applications, security management, risk assessment, cyber-attacks and threat intelligence, network and Internet security, intrusion detection and incident response, and human aspects for production systems.	10
PSE04*	**Human Systems Integration in Manufacturing** Industry 5.0, human-centric approach, a system framework and approach to integrate human into manufacturing systems, ethics in human integrated production systems organization.	10
PSE05*	**Biologicalisation in Manufacturing** An introduction to concept, three pillars and framework of biologicalisation in manufacturing, bio-inspired materials, surface and functional design approaches.	10
PSE06*	**Digital Twin Engineering** A comprehensive introduction to concept, definition, history, classification, underlying technologies, current applications and limitation of digital twins for manufacturing.	10
IND01	**Innovation and Design/System Thinking** An introduction to systems theory, concepts and approaches; hard and soft systems analysis and systems dynamics; systems and organizational performance and practical application of systems thinking.	10
IND02	**Ethics in Manufacturing** An introduction to key concepts and debates in ethics in manufacturing, including several prominent traditions in ethical theory and their application to ethical questions in a global context.	10
IND03	**Cross-Cultural Management and Communication** Perspectives, definitions, classifications of culture; cultural differences, approach for management at the level of individuals; language and communication in multicultural teams and organisations; the link between culture and ethics in manufacturing organisations; method for communication accommodation and social identity theories.	10
IND04	**Research Methodology and Project Management** An introduction to research methodology, reasoning, research tools, qualitative and quantitative research, technology readiness levels, critical literature review, academic writing, Matlab programming. project management, presentation skills.	10

Required total credits		120

Note: PSC: Production Technologies Core moules (Compulsory)
PSE*: Production Technologies Elective module (Choose two of them)
IND: Interdisciplinary module