

**Department of Industrial & Manufacturing Engineering**  
**PhD Course List**

S.NO	Course Code	Course Title	Course Content
01	IM-601	Advanced Supply Chain Management	
02	IM-602	Advanced Principles in Supply Chain & Logistics Management	Innovation and its models; Supply Chain Integration; Bullwhip Effect; Strategic Alternatives; Supply Chain Drivers; Achieving Strategic Fit; Manufacturing Supply Chain; Supplier Relationship; Customer Relationship Management; Collaborative Framework; Decision Making Points in Production, Warehouse, Logistics & Retailers; Research Analysis; Demand Management; Understanding the Needs for Customer & Market; Supply Planning; Sales Management; Global Supply Chain; Logistics & Inventory Management; Reverse Logistics; Controlling Priorities; Cold Supply Chain; Information Technology in Supply Chain; Performance Measurement; Capability & Performance Analysis; Logistics Efficiency vs. Responsiveness
03	IM-603	Product Development in Extended Enterprise	Development Processes and Organizations; Product Planning types and its processes; Identifying Customer Needs; Product Specifications; Concept Generation and its structured approaches; Concept Selection and its methodologies; Concept Testing; Product Architecture implications and establishment, Delayed Differentiation; Industrial Design timings and its impact; Design for Manufacturing; Prototyping basics and its principles; Robust Design; Patents and Intellectual Property; Elements of Product Development Economics.
04	IM-604	Business Process Simulation	Introduction to Simulation; Process; Process Modeling tools; Simulation of Business Processes; Simulation Project Methodology, Stoppages – Setups & Breakdowns, Resources – Labor, Transport – conveyors, paths, tracks; Process Mapping in Simulation; Single, Batch and Assembly Activities; Rules & Control logic; Variability; Distributions; Shifts & Actions; Attributes; Variables & Functions; Graphical & Display Features; Testing & Experimentation. Discrete Event Simulation Software training.
05	IM-605	Additive Manufacturing	Fundamentals of Additive Manufacturing (AM) processes, Stereo lithography, Selective Laser Sintering, Fused Deposition Modelling, 3D Printing, Jetting, Materials for AM processes (Polymers, Ceramics, Metals, Composites), AM Benchmarking, AM for Tooling (Rapid Tooling), CAD modeling and slicing for AM, Production Economics of AM, Application Case Studies, Trends and Future of Additive Manufacturing.
06	IM-606	Advanced Polymer Engineering	Introduction to polymeric materials ( $D_p$ and $M_w$ ). Glass transition and crystallinity. Deformation and strengthening mechanisms. Visco elasticity, Yield and Fracture properties. Polymer additives and

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			blends. Fiber reinforced composites, Long and short fibers, prediction of properties of composites. Processing of polymers and composites.
07	IM-607	Advanced Computer Aided Design	<p>Graphics Concepts: Coordinate transformations, shading and smoothing.</p> <p>Geometric Modeling Systems: Representation of analytical and synthetic curves, manipulation of curves. Representation of Surfaces: Analytic surfaces, Construction of common surfaces</p> <p>Manipulation of surfaces (segmentation, trimming, blending, offsetting), modeling in Commercial CAD/CAM software.</p> <p>Curve and Surface Fitting: Global interpolation, local interpolation, global approximation, local approximation. Standards and CAD/CAM Data Exchange: Data types and exchange methods (direct, indirect), Neutral data exchange format (IGES, STEP); Numerical Control: CNC machines, Basic concepts of CNC programming; Matlab: Programming of different CAD based algorithms for visualizing the curves and surfaces.</p>
08	IM-608	Supply Chain Performance Evaluation	<p>Supply Chain Fundamentals; Supply Chain Conceptual Framework &amp; Processes; Metrics; KPIs; Goals and Benchmarking; Traditional Performance Measures; World-Class Performance Measurement System;</p> <p>Management Sys. Vs. Measurement Sys.; Balanced Scorecard; Prism;</p> <p>SCOR; Application to real situation and cases; As-Is Models and To-Be Models; Continuous Improvement Philosophies.</p> <p>Supply Chain Design; Global Supply Chains Risk Management; Management and Coordination; Information Sharing; Metrics and Incentives; scoring and assessment criteria.</p>
09	IM-609	Thermal Spray Coatings	Principles of Thermal Spraying, Materials Used for Spraying, Pre-Spray Treatment, Thermal Spraying Techniques, Post-Spray Treatment, Physics and Chemistry of Thermal Spraying, Coating Build-Up, Methods of Coatings' Characterization, Properties of Coatings, Process Diagnostics and Monitoring and Control, Process Integration, Industrial Applications of Thermal Spraying Technology.
10	IM-610	Technological Processes Evaluation & Diagnosis	The concept of system; System diagnosis. Definitions; Identifying the characteristic features of technological processes motion; Data required for

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			<p>technological processes diagnosis, and gathering it; Measurement techniques in manufacturing processes i.e surface roughness etc. The infrastructure for manufacturing processes diagnosis.</p> <p>Analysis of Variance: One way classification; Tests for the equality of several variances; Single degree of freedom comparisons; Multiple range test; Comparing treatment with a control; Comparing a set of treatments in blocks; Randomized complete block design; Random effects model.</p> <p>Factorial Experiments: Two-factor experiments; Three-factor analysis. 2K Factorial Experiments: Fractional factorial experiments; Analysis of fractional factorial experiments.</p> <p>Use of Computer Aided Engineering software (MATLAB, Minitab) &amp; Mathematical Modeling.</p>
11	IM-611	Electro Spinning of Micro and Nano Fibers	<p>Introduction and historical background of electro-spinning process. Techniques and apparatus used in electro-spinning of nano-fibrous. Factors affecting electro-spinning process. Development of large scale nano-fiber electro-spinning system. Mathematical models for the electro-spinning process.</p>
12	IM-615	Quality Tools in Human Resource	<p>Talent Acquisition: Recruitment: Job Analysis, Job Design; Job Description: Establishing Behavioral Competencies, Establishing Technical Competencies; Job Profiling; Job Evaluation.</p> <p>Selection: Setting acceptance criteria for HR; Psychological Testing; Intelligence Testing</p> <p>Talent Management: Performance Management – Balanced Scorecard: Strategic Goals, Departmental Sub Goals, Individual Objectives (Lagging &amp; Leading), Monitoring Action Plans, Performance Appraisal/Evaluation, Coaching, Counseling &amp; Mentoring.</p> <p>Learning &amp; Development: Learning: Training Needs Analysis, Training – In House, Training External; Development.</p> <p>Talent Retention: Compensation &amp; Benefits; Policies &amp; Procedures; Motivation: Climate Survey; Career Planning; Succession Planning.</p> <p>HR Strategic Planning and Budgeting.</p>

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13	IM-616	Science of Organizational Behavior	<p>Introduction to Organizational Behavior: Historical Background: The Hawthorne Studies; Determine Valid Evidence: Starting with Theory, Using Research Designs, Studies' Validity.</p> <p>Organizational Culture: Diagnosis; Culture Design: Contemporary Design, Uniformity of Culture, Maintaining Culture, Changing Organizational Culture; Diversity and Ethics: The Nature of Ethics – ‘where they came from?’, Stakeholders and Ethics, Decision-making from Ethical Perspective, Utilitarian Rule, Moral Rights Rule, Justice Rule, Diversity Concerns, Sources of Diversity, Capabilities and Disabilities; Building Human Capital: Competence and Capital, Intangibility and Portability, Risk, Process of Building Human Capital.</p> <p>Dynamics of Organizational Behavior: Communication &amp; Decision Making: Non-verbal, Interpersonal and Interactive Communication, Decision Making Process and Styles, Participative Decision Making; Stress and Conflict: Emergence and causes of Stress, Intra Individual Conflict, Interactive Conflict, Effects of Stress and Conflict, Coping Strategies, Negotiation; Power and Politics: Empowerment, Political Implications of Power; Groups and Teams: Nature and Dynamics of Groups, Dysfunctions of Groups, Work Teams. Behavioral Performance Management: Social Cognitive Theory; O.B. Mod. Model: Identification of Behavior, Measurement and Functional Analysis of the Behavior, Intervention Strategy; Perception and Employee Attitude; Motivational Needs; Processes and Applications of Various Leadership Theories; Effective Leadership Process; Challenges: The Knowing-Doing Gap; Research Identification.</p>
14	IM-617	Advance Optimization Technique Using MATLAB	<p>Software and Background; Background of optimization, software used for optimization, MATLAB applications, different workbenches in MATLAB, Systems of Linear Algebraic Equations, Interpolation and Curve Fitting, Roots of Equations, Two-Point Boundary Value Problems, Numerical Differentiation and integration, optimization functions in MATLAB.</p> <p>Single variable optimizations techniques; Bisection method, Newton method, Secant method, golden search method, Polynomial interpolation,</p>

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			<p>MALTAB Programming for these optimizations.</p> <p>Multivariable optimization techniques; Genetic optimizations, Artificial Immune Algorithm, Differential Evolution, Particle Swan Optimization, Hybrid Algorithm. Application problems, Use of MATLAB optimization functions.</p>
15	IM-618	Advance Nontraditional Machining Processes	<p>Introduction to Nontraditional Machining (NTM) processes, Electrochemical processes, Electro-Thermal Processes, Chemical Processes. Hybrid electro-chemical and hybrid thermal Processes. Advanced topics in Electric Discharge Machining (EDM): EDM of composites, effect of process parameters on delamination, recast layer, surface roughness &amp; Material removal rate. Rotary Electric Discharge machining and performance analysis. Electric Discharge Machined surface characteristics and machining damage: Surface Morphology, surface roughness and micro cracks, Use of Atomic Force Microscopy (AFM) for surface analysis.</p>
16	IM-619	Knowledge Modelling and Management	<p>Knowledge Modelling: Knowledge and its lifecycle, Data, information and knowledge, Ontology from a philosophical perspective, Building blocks of a knowledge model, Representing knowledge model, Ontology from a logic based perspective, Levels of abstraction in knowledge modelling, Applications of knowledge modelling</p> <p>Methodology for knowledge modelling: Requirements management, Goal and scope definition, Competency questions, Information gathering and elicitation, Collating the preliminary information</p> <p>Initial Structuring: Listing and analyzing statements, Tracking and monitoring terms, Graphical languages for knowledge modelling, Unified Modelling Language (UML), IDEF5 schematic language.</p> <p>Formalization: OWL classes, OWL individuals, OWL properties: domain and range, OWL properties: inverse properties, OWL properties: characteristics, Class description and definition: the basics, Existential restrictions, Primitive and defined classes, Reasoning in OWL, Universal restrictions, Cardinality restrictions, data type properties.</p> <p>Deployment: Ontology documentation, Ontology visuals, Ontology driven system.</p>

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17	IM-620	Advanced Database Systems	<p>A review of core database concepts: Definitions, Architecture of Database Systems, Relational Database Management Systems, Transaction Management; Object-based and Object-oriented database systems; Query Processing and Optimization;</p> <p>Distributed Databases: Introductory concepts; Functions and Architectures of a DDBMS; Distributed Relational Database Design; Transparencies in a DDBMS; Distributed Transaction Management; Distributed Concurrency Control; Distributed Query Optimization; Online Analytical Processing; Introduction to Data warehouses and Data Mining; Multimedia Databases.</p>
18	IM-621	Ontologies For Business Analysis	<p>Background to ontology modelling: Ontology at a glance, Structure of an ontology, Ontology representation, Ontology from a logic-based perspective</p> <p>Exploring a formal ontology: Class hierarchy, Property hierarchy, Class descriptions, Individuals, Ontology visualization</p> <p>Benefits of ontologies in Business Analysis ontologies in business analysis, Ontologies and interoperability, MDA, MDI, SOA and ontologies, Cost-benefit implications of ontology development</p> <p>Ontology development and deployment Ontology-based business processes and rules, Ontology-driven systems, Ontology-based system development, ontology mapping ontology reuse.</p>
19	IM-622	Web Ontology Language	<p>Introduction</p> <p>What are OWL ontologies, components of OWL ontologies, individuals, properties and classes</p> <p>Building an OWL ontology</p> <p>Named classes, disjoint classes, using create class hierarchy to create classes ,owl properties, inverse properties, OWL object property characteristics, property domain and ranges, describing and defining classes, using a reasoned, automated classification, universal restrictions, automated classification and open world reasoning</p> <p>Creating other OWL constructs in Protégé 4</p> <p>Creating individuals, enumerated classes, annotation properties, multiple sets of necessary and sufficient conditions</p>

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			<p>Restriction Types</p> <p>Quantifier restrictions, has Value restrictions, cardinality restrictions.</p> <p>Complex Class Descriptions</p> <p>Intersection classes and union classes</p>
	IM-623	Advanced Production Technologies in Industry 4.0	<p>Review of Advanced Production Technologies, practice &amp; recent literature.</p> <p>Internet of Things</p> <p>Lean Production Systems for Industry 4.0</p> <p>Data Analytics in Manufacturing</p> <p>Modern Factory Layout Planning – latest tools used in factory planning and layouts</p> <p>Digital supply chains</p> <p>Advancements in Additive Manufacturing</p> <p>Assembly Robotics and Smart Automation</p> <p>Smart Automation for Future Production Technology</p> <p>Computer-aided Process Planning and Process Design</p>
	IM-624	Advanced Sustainable Manufacturing	<p>Review of recent sustainable manufacturing, practice &amp; recent literature.</p> <p>Metrics for Green Manufacturing</p> <p>Principles of Green Manufacturing</p> <p>Sustainable lean and green audit process.</p> <p>Closed-Loop Production Systems</p> <p>International green manufacturing standards and compliance.</p> <p>Green Manufacturing Through Clean Energy Supply.</p> <p>Enabling Technologies for Assuring Green Manufacturing.</p> <p>Sustainable green manufacturing system design and project management.</p>
	IM-625	Advanced Work Psychology	<p>Brief history of work psychology, job analysis, understanding work and work tasks, employee recruitment, methods for assessing and selecting employees, evaluating employee performance, employee training and development. Motivation, positive employee attitudes and behaviours, worker stress and negative employee attitudes and behaviours. Communication in the workplace, group processes in work organisations, leadership, influence, power, and politics, organizational structure, culture, and development. Evaluation techniques (the test, the interview, the portfolio, behavioural observation, role-play tests, computers as tools,) psychological assessment based on (Who,</p>



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			what, why, how, and where?), Statistical basis of psychology, good test concept (reliability and validity), norms (sampling to develop norms, types of norms, utility analysis, intelligence and measurements, achievement test, cognitive ability, productivity, and motivation measures..
	IM-626	Advanced Ergonomics Tools & Techniques	Ergonomics, musculoskeletal disorders, occupational ergonomics, ergonomics intervention, humans in work system environment, human factors, user-centered design, man-machine-environment systems. Human strength evaluation, biomechanical basis for ergonomics, cumulative trauma disorders (CTS), ergonomics and aging, human adaptation in the workplace, biomechanical modelling of the neck, shoulder and back. Back injury risk assessment tools, cognitive task analysis, subjective scales, wrist and back postures in office work, PLIBEL, the ACGIH TLVW, Rapid entire body assessment (REBA) and Rapid upper limb assessment (RULA), the Washington state sharp approach, and psychophysical approaches.
	IM-627	Advanced Occupational Ergonomics	Occupational ergonomics, anthropometry, biomechanical aspects of body movement, evaluation of manual materials handling and upper extremity intensive work. Job analysis, workstation evaluation and design, tool evaluation and design, manual materials handling, manual materials assist devices, office ergonomics, design and evaluation of a musculoskeletal and work history questionnaire, fall prevention in industry using slip resistance testing. Record-based (“passive”) surveillance for cumulative trauma disorders, active surveillance of work-related musculoskeletal disorders. Ergonomic programs, ergonomics automotive, health care construction, and agricultural industry. Occupational heat stress, vibration, noise exposure. Cumulative trauma disorders of the upper extremities, revised lifting equation, use of ergonomics in rehabilitation, legal aspects of ergonomics, economics of ergonomics, micro ergonomics and macro-ergonomics.
	IM-628	Advanced Researches in Smart Manufacturing	Industrial Revolutions, Smart Integrated System, Components of smart manufacturing, Cyber Security, Data Analytics in Manufacturing, Emerging IoT and Robotics Applications in Smart Manufacturing, Augmented Reality, Additive Manufacturing Technologies and Applications,



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			<p>Advances in Virtual Factory Research and Applications, Digital Traceability Through Production Value Chain, Blockchain in smart manufacturing, Security and privacy issues in smart manufacturing, Value Creation through Internet of Things, Connection of industry 4.0 with Jidoka, Just-in-time, Kanban, Total Productive Maintenance (TPM), Quality Control and other concepts, Important factors for the maturity of Industry 4.0, Industries 4.0 Readiness, Digital Operations Self-Assessment, Connected Enterprise Maturity Model, Framework for Technology Roadmap, Strategy Phase, Product Design Phase, Product Development Phase.</p>
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