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PhD Course List

S.NO	Course Code	Course Title	Course Content
01	IM-601	Advanced Supply Chain Management	Foundations and Strategic Frameworks: The Paradigm Shift: From functional silos to process integration; Strategic Fit: The alignment between product lifecycle, demand uncertainty, and supply chain design (Efficient vs. Responsive). Network Configuration and Optimization: Facility Location Models: Single and multicommodity location problems using Mixed-Integer Linear Programming (MILP); Inventory and Risk Pooling: Advanced Inventory Models, policies, and Base Stock levels under non-stationary demand; Postponement Strategies: Economic modelling of delayed product differentiation to manage inventory risk. The Value of Information and Global Strategy: Information Sharing: Quantifying the reduction in safety stock via Collaborative Planning, Forecasting, and Replenishment (CPFR); International SCM: Managing and hedging against currency fluctuations and lead-time variability; Strategic Alliances: Incentive alignment in VMI (Vendor Managed Inventory) and Revenue Sharing contracts using Game Theory. Decision Support Systems (DSS) and IT: SCM Software Architecture: The integration of ERP (Enterprise Resource Planning) with specialized APS (Advanced Planning Systems).
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;

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			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 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	Graphics Concepts: Coordinate transformations, shading and smoothing. Geometric Modeling Systems: Representation of analytical and synthetic curves, manipulation of curves. Representation of Surfaces: Analytic surfaces, Construction of common surfaces Manipulation of surfaces (segmentation, trimming, blending, offsetting), modeling in Commercial CAD/CAM software. 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.
08	IM-608	Supply Chain Performance Evaluation	Supply Chain Fundamentals; Supply Chain Conceptual Framework & Processes; Metrics; KPIs;

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			Goals and Benchmarking; Traditional Performance Measures; World-Class Performance Measurement System; Management Sys. Vs. Measurement Sys.; Balanced Scorecard; Prism; SCOR; Application to real situation and cases; As-Is Models and To-Be Models; Continuous Improvement Philosophies. Supply Chain Design; Global Supply Chains Risk Management; Management and Coordination; Information Sharing; Metrics and Incentives; scoring and assessment criteria.
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 technological processes diagnosis, and gathering it; Measurement techniques in manufacturing processes i.e surface roughness etc. The infrastructure for manufacturing processes diagnosis. 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. Factorial Experiments: Two-factor experiments; Three-factor analysis. 2K Factorial Experiments: Fractional factorial experiments; Analysis of fractional factorial experiments. Use of Computer Aided Engineering software (MATLAB, Minitab) & Mathematical Modeling.
11	IM-611	Electro Spinning of Micro and Nano Fibers	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.
12	IM-615	Quality Tools in Human Resource	Talent Acquisition: Recruitment: Job Analysis, Job

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			Design; Job Description: Establishing Behavioral Competencies, Establishing Technical Competencies; Job Profiling; Job Evaluation. Selection: Setting acceptance criteria for HR; Psychological Testing; Intelligence Testing Talent Management: Performance Management – Balanced Scorecard: Strategic Goals, Departmental Sub Goals, Individual Objectives (Lagging & Leading), Monitoring Action Plans, Performance Appraisal/Evaluation, Coaching, Counseling & Mentoring. Learning & Development: Learning: Training Needs Analysis, Training – In House, Training External; Development. Talent Retention: Compensation & Benefits; Policies & Procedures; Motivation: Climate Survey; Career Planning; Succession Planning. HR Strategic Planning and Budgeting.

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13	IM-616	Science of Organizational Behavior	Introduction to Organizational Behavior: Historical Background: The Hawthorne Studies; Determine Valid Evidence: Starting with Theory, Using Research Designs, Studies' Validity. 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. Dynamics of Organizational Behavior: Communication & 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.
14	IM-617	Advance Optimization Technique Using MATLAB	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. Single variable optimizations techniques; Bisection method, Newton method, Secant method, golden search method, Polynomial interpolation,

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			MALTAB Programming for these optimizations. Multivariable optimization techniques; Genetic optimizations, Artificial Immune Algorithm, Differential Evolution, Particle Swan Optimization, Hybrid Algorithm. Application problems, Use of MATLAB optimization functions.
15	IM-618	Advance Nontraditional Machining Processes	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 & 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.
16	IM-619	Knowledge Modelling and Management	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 Methodology for knowledge modelling: Requirements management, Goal and scope definition, Competency questions, Information gathering and elicitation, Collating the preliminary information Initial Structuring: Listing and analyzing statements, Tracking and monitoring terms, Graphical languages for knowledge modelling, Unified Modelling Language (UML), IDEF5 schematic language. 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. Deployment: Ontology documentation, Ontology visuals, Ontology driven system.

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17	IM-620	Advanced Database Systems	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; 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.
18	IM-621	Ontologies For Business Analysis	Background to ontology modelling: Ontology at a glance, Structure of an ontology, Ontology representation, Ontology from a logic-based perspective Exploring a formal ontology: Class hierarchy, Property hierarchy, Class descriptions, Individuals, Ontology visualization Benefits of ontologies in Business Analysis ontologies in business analysis, Ontologies and interoperability, MDA, MDI, SOA and ontologies, Cost-benefit implications of ontology development Ontology development and deployment Ontology-based business processes and rules, Ontology-driven systems, Ontology-based system development, ontology mapping ontology reuse.
19	IM-622	Web Ontology Language	Introduction What are OWL ontologies, components of OWL ontologies, individuals, properties and classes Building an OWL ontology 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 Creating other OWL constructs in Protégé 4 Creating individuals, enumerated classes, annotation properties, multiple sets of necessary and sufficient conditions

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			Restriction Types Quantifier restrictions, has Value restrictions, cardinality restrictions. Complex Class Descriptions Intersection classes and union classes
	IM-623	Advanced Production Technologies in Industry 4.0	Review of Advanced Production Technologies, practice & recent literature. Internet of Things Lean Production Systems for Industry 4.0 Data Analytics in Manufacturing Modern Factory Layout Planning – latest tools used in factory planning and layouts Digital supply chains Advancements in Additive Manufacturing Assembly Robotics and Smart Automation Smart Automation for Future Production Technology Computer-aided Process Planning and Process Design
	IM-624	Advanced Sustainable Manufacturing	Review of recent sustainable manufacturing, practice & recent literature. Metrics for Green Manufacturing Principles of Green Manufacturing Sustainable lean and green audit process. Closed-Loop Production Systems International green manufacturing standards and compliance. Green Manufacturing Through Clean Energy Supply. Enabling Technologies for Assuring Green Manufacturing. Sustainable green manufacturing system design and project management.
	IM-625	Advanced Work Psychology	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,

			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,

			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.
	IM-629	Supply Chain Risk Management	Supply chain management and risk management: Objectives and Functions of a supply chain and configuration, Introduction to risk management; Risk Perception, Risk within dynamic environments, Benefits of risk management, Supply chain risk (SCR); Defining, Identifying and Scoping SCR, Internal vs external risks (SCOR Framework), SCR Management; process, Overview, and planning SCR; Risk management deliverables and administration, Developing a communications plan incorporating Risk tolerance, Risk types and categories; Identification and evaluation toolkit, Service level risks, financial risks, Evaluating and Analyzing SCR, Measuring the impact of risk; Risk and its Modeling and simulations, Risk mitigation matrix and developing strategies, Evaluation and prioritization of risks, Developing Contingency plan, and Mapping risks, SCR Mitigation strategies; developing response strategies, for its Mitigation in, transportation, warehousing, inventory, and sourcing, Controlling supply chain risks; Benefits of monitoring and control, considering Ethical and Legal aspects, Managing a risk charter and its accountabilities.
	IM-630	Heuristic Optimization	Foundation of Heuristic Optimization; Need for Heuristics, Characteristic of Heuristics, Complexity & Performance of Heuristics. Heuristic Classification; Improvement-Only Heuristics Introduction, Neighborhood, Climbing Method. Improvement-Only Heuristics; Multi-Start, Greedy

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			Randomized Adaptive Search Procedure (GRASP), and Composite. Improvement-Optional Heuristics; Simulated Annealing, Tabu Algorithm (TA), and Tabu Search. Population-based Heuristics; Genetic Algorithm (GA), and Scatter Search, Harmony Search, and Ant Colony, Bees Algorithm, Differential Evolution (DE) and Particle Swam Optimization (PSO). Applications; Real-life and Software with Challenges, case studies. Hybridization of Heuristics with; Heuristics, Exact Methods, and Integer Linear Programming (ILP). Implementation Issues; Structure, Duplication, Approximation, Constraint Handling, Fuzzy Logic, Parallelization, and Multiple Objectives.
	IM-631	Theories & Philosophies of Research in Management	Knowledge and its sources (perception, reason, memory, and testimony), Justified Beliefs vs. mere Opinions, validity and reliability of data. Ontology, Epistemology and their Connection, Different Ontological Positions. Research and its Impact, Role of Skepticism in Research, Evolution of Management Philosophy, Orientation of Research and Philosophical towards the Corporate World, Research Lens, and Challenges in Strategic Management Research. Natural Scientist Thought Process, Critical Realism (CR), CR contribution to Research, Novelty Contribution to knowledge'. Positive Impact of research on the World, Major Theories across Management Discipline: Resource- and Capability-based View (RBV) Major Theories across Management Discipline: Network Theory, Agency Theory, Transaction Cost Economics, Boundary Spanning
	IM-632	Advanced Supply Chain Data Analytics	Foundations of Supply Chain Analytics; Relationship between Supply Chain Management and Data Analytics, Role of Data in Modern Supply Chains, Review of Linear and Non-Linear Optimization Techniques, Introduction to Supply Chain Software. Data Collection, Cleaning, and Integration; Data Sources in Supply Chain (IoT, ERP, Blockchain), Data Preprocessing and Feature Engineering, Structured and Unstructured Data, Ethical Considerations in Supply Chain Data (Data privacy, security, transparency etc.).

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			Predictive Analytics in Supply Chain; Forecasting Demand and Inventory Needs; Machine Learning Models (Regression, Classification, Time Series), Risk Analytics and Supply Chain Disruption Prediction. Prescriptive Analytics for Decision Support; Optimization Models for Supply Chain Design, Simulation in Supply Chain Scenarios, Multi-Objective Optimization: Balancing Cost, Speed, and Sustainability. Sustainability and Resilience Analytics; Circular Economy in Supply Chain Design, Carbon Footprint Analysis and Reduction Strategies, Resilience Metrics and Data-Driven Strategies. Emerging Technologies in Supply Chain Analytics; Blockchain and Transparency in Supply Chains, AI and Deep Learning for Advanced Decision-Making, Digital Twins and the Future of Virtual Supply Chains. Research and Innovation in Supply Chain Analytics; Case study: Integrating IoT data with ERP systems, big-data analytics of logistics in supply chain and advanced warehouse data analytics.
	IM-633	Advanced Metal Machining	Mechanics of Metal Cutting, Advanced Conventional Machining; High-speed and Ultra-precision machining, Dry, Wet and Cryogenic machining, Energy-efficient machining. Cooling strategies, and MQL, Basics of Surface Engineering, Surface Energy, Measurement of Surface Potential, Coating Materials and Properties, Application of coatings in metal machining, Deposition Techniques for Tool coatings; PVD, CVD, Plasma-Assisted and Hybrid Deposition Methods, Emerging Techniques: ALD and HiPMS. Coating Performance and wear mechanisms; Microstructural characterization: SEM, TEM, XRD. Adhesion, toughness, hardness evaluation, Tribological aspects: friction, lubrication and wear, Failure models, Impact of coating on tool life and surface finish. Performance metrics, Case studies, Cutting Research Trends and Future Directions in Tool Coatings, Modeling of Metal Machining.