Department of Mechanical Engineering

Detailed Syllabus: Ph.D Course Work (Core Subject)

The candidates need to select any one course from the following elective courses.

PHDME 1103A ADVANCED MANUFACTURING PROCESSES
PHDME 1103B OPERATIONS MANAGEMENT
PHDME 1103C ADVANCED MATERIALS TECHNOLOGY

PHDME 1103A ADVANCED MANUFACTURING PROCESSES

Course Objectives: To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design. To cultivate the ability to develop and implement new improved manufacturing processes resulting in creation and distribution of value in engineering applications. To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations.

Mechanical Processes: Development and classification, Considerations in process selection, Tool design, Mechanism of material removal in: Ultrasonic machining, Abrasive jet machining, Abrasive flow machining, Magnetic abrasive finishing, Parametric analysis: Effect of process parameters on material removal rate, surface finish, Process capabilities, Engineering applications, Development of Hybrid processes.

Thermal Metal Removal Processes: Historical background and classification, Characteristics of process, Mechanism of material removal in: Electric discharge, Wire electric discharge, laser beam, Plasma arc, Electron beam advanced machining processes, Parametric analysis, advantages and limitations, applications

Electrochemical Machining and other Processes: Introduction, Mechanics, Tool design, Electrochemistry of ECM process, Kinematics and Dynamics, Effect of heat and H2 bubble generation, Calculation of material removal rate, Parametric analysis, advantages and limitations, applications, Microwave processing, Explosive forming: Principle, Process parameters, Equipment, Mechanics and applications.

Recommended Books:

1. Pandey, P.C. and Shan H.S., Modern Machining Processes, Tata McGraw Hill (2004).

2. Mishra, P.K., Non Conventional Machining, Narosa Publications (2006).
3. Hofy, H.E., Advanced Manufacturing Process, B and H Publication (1998).
4. Jain, V.K., Advanced Machining processes, Allied Publishers Private Limited (2004).
5. Ghosh, A. and Mullik, A., Manufacturing Science, East –West private Limited (2010).

PHDME 1103B OPERATIONS MANAGEMENT

Course Objectives: The objective of this course is to develop understanding of the strategic role of operations management in creating and enhancing a firm's competitive advantages. This will help to apply key concepts and issues of OM in both manufacturing and service organizations. Further, apply analytical skills and problem-solving tools to the analysis of the operations problems like forecast demand, material requirement planning, inventory etc.

Production Systems: Production/ Operations Management: meaning and scope; significance of operations management in increasing productivity of firms; design of different production systems (project, job shop, batch.

Forecasting Analysis: Need, benefits and applications, cost and accuracy of forecasting, factors affecting demand, types of forecast based on methodology, types of forecast based on time horizon (causal methods, time series and qualitative methods); error analysis in quantitative forecasting.

Aggregate Planning: Need of aggregate production planning, inputs for aggregate plan, Reactive aggregate planning strategies, Aggressive aggregate planning strategies, pure and mixed aggregate planning strategies, level and chase strategies, Graphical method to choose aggregate plan.

Master Production Scheduling and MRP: Functions, planning horizon and planning periods for master production schedule, types of master production schedule; Independent Demand versus dependent demand, Functions of material requirements planning and manufacturing resource planning (MRP I and MRP II), inputs for MRP system, performance characteristics of MRP system (planning lead time, lot sizing rules, safety stocks), materials requirement planning explosion

Inventory Management and Control: Objectives and functions of materials management, inventory: need and types, inventory record systems, inventory costs and order quantities, economic order quantity, economic run length.

Recommended Books:

1. Monks, J. G., Operations Management: Theory and Problems, McGraw Hill, New York (1987).
2. Krajewski, L. J., Ritzman, L. P. and Malhotra, M. K., Operations Management, Prentice Hall, New Delhi (2009).

3. Ebert, J and Adams, D.J., Production/Operations Management, Prentice Hall of India, New Delhi (2007).
4. Chase, R. B., Aquilano, N. J. and Jacob, F. R., Production and Operations Management: manufacturing and services, Tata McGraw Hill, New Delhi (1999).

PHDME 1103C ADVANCED MATERIALS TECHNOLOGY

Course Objectives: To understand the various strengthening mechanisms and also failure mechanisms for alloy systems to achieve enhanced mechanical performance. To gain knowledge with regards to kinetics of phase transformations and their effect on mechanical properties of alloys. To gain knowledge about the characteristics, processing and applications of polymers and composite materials.

Strengthening Mechanisms for Alloys: Strengthening by grain refinement, effect of grain size on various mechanical properties, solid solution strengthening, strain hardening, precipitation hardening mechanisms for alloys, especially steels and aluminium.

Failure Mechanisms: Ductile and brittle fracture, principles of fracture mechanics, impact fracture testing, design for fatigue, stages of fatigue failure, factors affecting fatigue life, generalized creep behaviour.

Phase Transformations in Steels: Kinetics of Phase Transformations, mechanisms of phase transformations, isothermal transformation diagrams, continuous cooling transformation diagrams, influence of alloying elements on these diagrams, heat treatment and surface hardening of steels (plain carbon as well as special purpose steels). Effect of phase transformations on mechanical properties of steels. Hardenability determination in steels. Modeling and simulation tools for analysing phase transformations.

Characteristics, Applications, and Processing of Polymers: Mechanical behaviour of polymers, mechanisms of deformation and for strengthening of polymers, glass transition phenomena in polymers, stress–strain behaviour, fracture of polymers, degradation of polymers.

Characteristics, Applications, and Processing of Composites: Classification of composites, factors affecting properties of composites, polymer-matrix composites, metalmatrix composites, processing methods for composites.

Advanced High Strength Steels for Automotive Applications: Dual Phase (DP) steels, Transformation Induced Plasticity steels (TRIP), Complex Phase (CP) steels, Super Martensitic Stainless Steels (SMSS), Super alloys.

Recommended Books:

1. Joachim, R. Harders, S and Baker, M., Mechanical behaviour of engineering materials: metals, ceramics, polymers, and composites, Springer (2007)
2. Parton, V.Z., Fracture mechanics: from theory to practice, CRC Press (1992).
3. Higgins, R. A., Engineering Metallurgy-Applied Physical Metallurgy, Elsevier (2004).
4. Colling, D and Thomas, V., Industrial materials: polymers, ceramics, and composites, Printice-Hall (1995).