M.Tech. DEGREE
in
Industrial Engineering and Management

SYLLABUS
FOR
CREDIT BASED CURRICULUM
OPERATIVE FOR STUDENTS FROM 2015 -2016 ADMISSION
4 SEMESTER PROGRAMME
CODE : PR

DEPARTMENT OF PRODUCTION ENGINEERING
Department Vision

To establish a world class academy for Manufacturing and Industrial Engineering

Department Mission

- Curriculum development with state-of-the-art technologies.
- Pursue research interests of manufacturing and industrial engineering.
- Consultancy in design, manufacturing and industrial engineering
- Industry-Institute interaction
- Equipping Laboratories with state-of-the-art equipment.

Programme Educational Objectives (PEOs):

PEO 1: Graduates of the programme will be capable of integrating Engineering fundamentals and advanced Industrial Engineering concepts.
PEO 2: Graduates of the programme will be professionally competent for gainful employment in Industrial Engineering and Management functions and sustain future challenges.

Programme Outcomes (POs):

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<tr>
<th>M.Tech. – Industrial Engineering &amp; Management</th>
<th>Programme Outcomes</th>
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<tr>
<td><strong>Attributes</strong></td>
<td>On successful completion of the programme, the graduates will be able to</td>
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<tr>
<td>1 Scholarship of Knowledge</td>
<td>Acquire in-depth knowledge of industrial engineering with an ability to define, evaluate, analyse and synthesize existing and new knowledge.</td>
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<tr>
<td>2 Critical Thinking</td>
<td>Analyse complex real time industrial engineering problems critically, apply independent judgement for synthesizing information to make intellectual and/or creative advances for conducting research.</td>
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<tr>
<td>3 Problem Solving</td>
<td>Conceptualize and solve industrial engineering problems and evaluate potential solutions after considering economic and eco-friendly factors.</td>
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<td>4 Research Skill</td>
<td>Develop scientific/technological knowledge in industrial engineering domain through literature review and design and analysis of experiments.</td>
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<tr>
<td>5 Usage of modern tools</td>
<td>Apply tools for modelling and simulation of complex system, life cycle assessment, ergonomic assessment, supply chain assessment and data analysis.</td>
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<td>6 Collaborative and multi-disciplinary work</td>
<td>Perform collaborative-multidisciplinary industrial engineering research, through self-management and teamwork.</td>
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<td>7</td>
<td>Project Management and Finance</td>
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<td>Communication</td>
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<td>Life-long Learning</td>
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<td>Ethical Practices and Social Responsibility</td>
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<td>11</td>
<td>Independent and Reflective Learning</td>
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### NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
### DEPARTMENT OF PRODUCTION ENGINEERING
### M. Tech (Industrial Engineering & Management)
### Total minimum credits required: 66
### (Operative for students from 2015-2016 admission)

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<th>CODE</th>
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### LIST OF ELECTIVES

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SEMESTER 1

PR651 DATA ANALYTICS

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COURSE OUTCOMES:

1. Recognize the importance of data analytics
2. Exhibit competence on data analytics packages
3. Apply solution methodologies for industrial problems


Multiple Regression- Linear and Nonlinear techniques- Backward-Forward-Stepwise-Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).

Logistic regression: Regression with binary dependent variable -Simple Discriminant Analysis-Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).

Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).

Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis- Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.

References

PR653 ADVANCED OPERATIONS RESEARCH

COURSE OUTCOMES:
1. Make decisions in certainty / uncertainty conditions
2. Formulate models and solve real time problems
3. Apply advanced OR techniques to confront industrial requirements

Linear programming- Simplex method – Big M method – Two phase method cases - Goal programming. Duality, sensitivity analysis-Changes in right- hand side constants of constraints-changes in objective function co-efficient-adding a new constraints-adding a new variable.


Unconstrained nonlinear algorithms-Constrained algorithms- Separable programming -Quadratic programming-Geometric programming-Stochastic programming.

References
COURSE OUTCOMES:

1. Explain the importance of production management
2. Classify various models
3. Solve industrial problems involved in inventory, MRP and scheduling

Basics of Product management – Forecast models, errors, tracking signals.

Inventory costs – types of systems – policies – Analysis & static models

Concept of aggregate production planning – strategies – Charting techniques – Problems
Value stream management

MRP concepts – Problems – Lot sizing – techniques

Scheduling concepts – Various types of scheduling – Methods and tools to solve scheduling problems – Assembly line balancing problems

References
PR 657 DATA ANALYTICS LAB

The objective of this lab is to enable students to have exposure on Data Analytics using SYSTAT, SPSS and GaBi.

1. Linear Regression and Correlation
2. Testing of Hypothesis – I & II
3. Analysis of Variance (ANOVA)
4. Factor analysis
5. Life Cycle Assessment of products
6. Cluster Analysis
7. Performance Measurement of Industrial systems

PR 659 OPERATIONS MANAGEMENT LAB

The objective of the lab is to have practical exposure on operations management packages like OM Expert, CPLEX, LINDO, GAMS, TORA extra and also to study on the ergonomic aspects of human evaluation.

1. Forecasting Models
2. Linear Programming Problem
3. Transportation Model
4. Inventory Models
5. Scheduling Case studies
6. Material Requirements Planning
7. Project management
8. Facilities layout
9. Ergonomics Study
   a. Performance rating using stop watch
   b. Peg board experiment
   c. Time study trainer
   d. Fitness study using treadmill
   e. Fitness study using ergo cycle
SEMESTER 2

PR 652 QUALITY AND RELIABILITY ENGINEERING  

L T P C  
3 0 0 3

COURSE OUTCOMES:
1. Summarize the fundamentals and significance of Quality  
2. Develop control charts for variables and attributes  
3. Implement kaizen techniques for improved production environment

Basics of quality – Process capability analysis – Quality Gurus and their philosophies  

Quality standards – ISO 9000 series and 14000 series  


Control charts for variables and attributes - Taguchi methods, cases  

Concurrent engineering Quality function deployment – FMEA – Quality circles - Total quality management – Kaizen

References
PR654 MODELING AND SIMULATION

COURSE OUTCOMES:
1. Develop Manufacturing Models of Discrete event systems
2. Generation of Uncertainty using Random numbers and Random Variates
3. Perform Input, Output Analysis: Verification & Valediction of Models and Optimization

Introduction to systems and modeling - discrete and continuous system - Monte Carlo Simulation. Simulation of Single Server Queuing System. Simulation of manufacturing shop
Simulation of Inventory System


Random variates-Inverse Transform Technique –Direct Transform Techniques Convolution Method Acceptance Rejection Technique – Routines for Random Variate Generation

Testing -Analysis of simulation data-Input modeling – verification and validation of simulation models – output analysis for a single model.

Simulation languages and packages-Case studies in WITNESS; FLEXSIM, ARENA, SIMQUICK-Simulation based optimization-Modeling and Simulation with Petrinets-case studies in manufacturing systems

References
COURSE OUTCOMES:

1. Explain the major building blocks, major functions, major business processes, performance metrics, and major decisions in supply chain networks
2. Summarize the foundation for design and analysis of supply chains and synthesize advanced and specialized concepts, principles and models for operational and strategic improvement
3. Analytically examine the supply chain of organizations and measure performance improvement

Introduction to supply chain management - Supply Chain Performance: Achieving Strategic Fit and Scope - Supply Chain Drivers and Metrics

Planning in Supply chain - Demand Forecasting in a Supply Chain - Aggregate Planning in a Supply Chain – Inventories in supply chain

Designing the Supply chain network – Distribution networks – Transportation networks - Network Design in an Uncertain Environment - supply chain optimization

Managing cross-functional drivers in supply chain - Sourcing Decisions in a Supply Chain - Pricing and Revenue Management in Supply Chain - Information Technology in Supply Chain - Coordination in Supply Chain

Modern Supply chain management - Reverse supply chain strategies – Green and sustainable practices of Supply chain – Supply chain cases

References

2. V.V. Sople, “Supply Chain Management, text and cases”, Pearson Education South Asia,2012
PR 658 SIMULATION LAB

(Packages: ARENA, Flexsim, QUEST, Simquick & Witness and other emerging packages, Programming in C and Matlab)

LIST OF EXERCISES

1. Random Number Generation approaches
2. Random Variate Generation
3. Simulation of Manufacturing Shop
4. Simulation of Multiple Servers Queuing System
5. Simulation of Supply Chain Inventory System
6. Simulation of Batch Production System
7. Simulation of Multi Machine Assignment System
8. Simulation of Manufacturing and Material Handling Systems
9. Simulation of a Shop Floor
10. Simulation of Material Handling Systems

PR 660 SUPPLY CHAIN MANAGEMENT LAB

The objective of this lab is to enable students to understand the practical applications of Supply Chain Management concepts.

1. Network design and operations
2. Designing and planning transportation networks
3. Designing and planning distribution networks
4. Value Stream Mapping – Development of Current State Map and Future State Map
5. Decision Making in Supply Chains
6. Lean, agile and leagile supply chains
7. Supply chain restructuring
8. Supply chain performance measures
9. Inventory optimization in supply chain
10. Forecasting models in supply chain
Electives

INDUSTRIAL ENGINEERING STREAM

PR661 INDUSTRIAL ENGINEERING AND PRODUCTIVITY MANAGEMENT

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COURSE OUTCOMES:
1. Define and understand basic Productivity Concepts, Productivity Measurement Approaches of the Organizations.
2. Perform Work design and facility planning.
3. Outline the basics of Value Engineering (VE) and System Engineering.

Productivity: Concept, Productivity improvement factors, Productivity appraisal, productivity analysis in the enterprise- The Kurosawa structural approach, Lawlor’s approach, Gold’s approach, Quick Productivity Appraisal approach (QPA), Inter-Firm Comparison (IFC).

Work Design: Work study, Method study, Work measurement, Standard output, Time study, Work sampling, Process analysis.

Facility Layout: Principles of layout and facilities planning, Material flow patterns, Material handling systems, Types of material handling equipment.

Value Engineering: Fundamental concepts and applications of value engineering, Function Analysis System Technique.


References
PR662 INTELLIGENT MANUFACTURING SYSTEMS

COURSE OUTCOMES:

1. Apply various knowledge based techniques
2. Practice diagnosis and trouble shooting
3. Adopt intelligent system

Basic concepts of Artificial intelligence and expert systems - System Components - System architecture and Data flow – System Operations.

Knowledge based systems - knowledge representation – knowledge acquisition and optimization - Knowledge based approaches to design mechanical parts and mechanisms and design for automated assembly.

Knowledge based system for material selection – Intelligent process planning system. Intelligent system for equipment selection - Intelligent system for project management & factory monitoring.

Scheduling in manufacturing – scheduling the shop floor – Diagnosis & trouble shooting.

The role of Artificial Intelligence in the factory of the future – Intelligent systems.

References
PR663 RESEARCH METHODOLOGY

COURSE OUTCOMES:

1. Choose and apply appropriate techniques.
2. Adopt different multi criteria decision making methods for prospective research.
3. Adopt different optimization techniques to identify the suitable process parameters.

Introduction - Hypothesis Testing, Multi criteria decision making-Simple Additive Weighting (SAW) Method-Weighted Product Method (WPM)


Optimization traditional, non-traditional- multi objective optimization-classical weighted sum, goal programming-non-traditional-

Multi objective GA, MOPSO, Intelligent decision making tools ANN, Fuzzy logic

Introduction to Matlab, C++

References:
COURSE OUTCOMES:

1. Explain the practical implications of Design of experiments
2. Adopt ANOVA techniques to identify sufficient factors
3. Apply Taguchi techniques to conduct experiments in research work


Single Factor Experiments- ANOVA - Sum of squares – Completely randomized design, Randomized block design, effect of coding, Comparison of treatment means – Newman Kuel’s test, Duncan’s Multiple Range test, Latin Square Design.

Factorial Experiments - Main and interaction effects – Two and three Factor full factorial Designs, $2^k$ designs with Two and Three factors- Yate’s Algorithm

Special Experimental Designs- Blocking and Confounding in $2^k$ design

Taguchi Techniques- Fundamentals of Taguchi methods, Quality Loss function, orthogonal designs, application to Process and Parameter design.

References

COURSE OUTCOMES:
1. Summarize basic concepts, tools and techniques of Enterprise Resource Planning.
2. Describe the key implementation issues of ERP.
3. Reorganize the current and future trends in ERP.

Introduction to ERP: Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model, Benefits of ERP, ERP and Related Technologies, Business Process Reengineering (BPR), Data Warehousing, Data Mining, OLAP, SCM.


ERP Market: ERP Market Place, SAP AG, PeopleSoft, Baan, JD Edwards, Oracle, QAD, SSA, Enterprise Integration Applications (EIA), ERP and E-Commerce, ERP and Internet.

ERP Present and Future: Future Directions and Trends in ERP.

References
PR666 LEAN AND AGILE MANUFACTURING

COURSE OUTCOMES
1. Describe the principles of lean and agile manufacturing
2. Recognize the potential applications of lean and agile manufacturing
3. Apply the tools/techniques of lean and agile manufacturing to industrial problems

Introduction to Lean Manufacturing, Comparison of Mass Manufacturing and Lean Manufacturing, Lean Principles, Types of Wastes – Seven basic categories, Types of activities – Value Added, Non Value Added and Necessary but Non Value Added activities, Examples


Lean rules, Training and Implementation for lean systems, How to succeed with lean manufacturing, Leanness assessment – Indicators, methods and illustrative example.


Strategic approach to agile manufacturing, Information Technology applications in Agile Manufacturing, Assessment of agility – Activity Based Costing - Application Case studies on Lean and Agile Manufacturing.

References
PR667 FACILITIES PLANNING AND DESIGN

COURSE OUTCOMES:
1. Assess the value of facility planning on the strategy of a firm.
2. Describe the product, process and schedule design and their interaction with facility planning and develop a systematic facility layout
3. Explain design and analyze material handling used in the warehousing, manufacturing and supporting operations.

Facilities planning – need and objectives of facilities planning – facilities planning process – facilities planning strategies, Facilities Location Analysis- Single facility location models-Multi-facility location problems

Facilities Layout design- product design – process design – schedule design - Space and Area Requirements of Facilities

Layout design procedure-Algorithmic approach – Computerized layout planning-CRAFT, ALDEP and CORELAP

Group technology - Methods of grouping – Algorithms and models for Group technology – Line balancing

Material handling design – Material handling principles - Classification of material handling equipment - Material handling models

References:
PR668 PRODUCTION MANAGEMENT SYSTEMS

COURSE OUTCOMES:
1. Explain the role of Production Management System.
2. Identify the recent trend of manufacturing like Just in Time (JIT) and Pull Push system.
3. Outline the basics of Value Engineering (VE).

Productivity: Productivity measurement models, Role of work study, Work measurement techniques, Ergonomics.


Just in Time and Lean Operations: Characteristics of Lean systems for services and Manufacturing, Element of JIT manufacturing, Pull and Push method of work flow, Small lot sizes, Kanban system, Value stream mapping.

Introduction to optimized production technology (OPT) - OPT philosophy improvement tools- Requirement and assumption of OPT.

Value Engineering: Approaches of value analysis and engineering, effective organization for value work function analysis system techniques, FAST diagram, Case Study.

References
PR669 ADVANCED OPTIMIZATION TECHNIQUES

COURSE OUTCOMES:
1. Describe the Traditional optimization techniques and apply it in engineering field.
2. Distinguish between the Non Traditional optimization techniques and apply it in engineering field.

Introduction-Engineering Applications of Optimization-Statement of an Optimization Problem-Classification of Optimization Problems - Optimization Techniques

Classical Optimization Techniques- Single-Variable Optimization - Multivariable Optimization with No Constraints - Multivariable Optimization with Equality Constraints- Multivariable Optimization with Inequality Constraints- Transportation


References
COURSE OUTCOMES:

1. List the methods for productivity measurements and improvements
2. Analyze the work study methods for managing resources
3. Analyze the ergonomic methods for workplace design

Introduction to work study - Productivity – productivity measures-productivity measurement models-Kurosawa structural approach, Lawlor’s approach, Gold’s approach Quick Productivity Appraisal approach (QPA) / American Productivity Centre (APC) model-scope of work study for improving productivity


Work measurement and its methods. Determining time standards from standard data and formulas -Predetermined motion time standards – Work factor system – methods time measurement, Analytical Estimation. Work sampling – Group Timing Technique- introduction to work study software

Measuring work by physiological methods – Heart rate measurement– measuring oxygen consumption– Establishing time standards by physiology methods.

Motion economy- Ergonomics practices – human body measurement – layout of equipment– seat design - design of controls and compatibility – environmental control – vision and design of displays. Design of work space, chair table.

References

PR 671 SUSTAINABLE MANUFACTURING

COURSE OUTCOMES:
1. Explain the importance of sustainable development
2. Exhibit competence on the usage and applicability of sustainability tools
3. Compute sustainability performance through the indicators


Frameworks for measuring sustainability- Indicators of sustainability – Environmental, Economic, Societal and Business indicators - Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment– Corporate Social Responsibility.

LAB EXERCISES
Life Cycle Assessment of products using GaBi package
Sustainable Product Development – Developing environmentally friendlier products

REFERENCES
COURSE OUTCOMES:

1. Explain the methods for project identification & appraisal
2. Define and plan a project within the constraints of the environment
3. Develop & analyze quantitative models for project selection & scheduling

Introduction - Project Management: An Overview – Types, Characteristics of Projects – Project life cycle. Identification of investment opportunities - Screening and Selection, Project Appraisal,


Financial analysis – cash flows for project appraisal- Investment evaluation using capital budgeting techniques - net present value, profitability index internal rate of return, payback period, accounting rate of return

Mathematical Techniques for project evaluation – Linear programming, goal programming, Network technique for Project Management – CPM, PERT, Multiple projects and constraints, scheduling.

Organization systems for project implementation- Work Breakdown-coordination and control-Project Management Soft wares

References

COURSE OUTCOMES:
1. Start and manage new business
2. Evaluate and monitor short term and long term investments
3. Evaluate and monitor current asset


Capital budget, Nature of capital budgeting- Identifying relevant cash flows - Evaluation Techniques: Payback, Accounting rate of return, Net Present Value, Internal Rate of Return, Profitability Index - Comparison of DCF techniques investment and evaluation

Financial and operating leverage - capital structure - Cost of capital and valuation - designing capital structure. Dividend policy - Aspects of dividend policy - practical consideration


Long term financing -Indian capital and stock market, New issues market Long term finance: Shares, debentures and term loans, lease, hire purchase, venture capital financing, Private Equity

References:
COURSE OUTCOMES:
1. Explain marketing concepts & segmentation factors
2. Classify various pricing methods
3. Explain various sales promotion aspects


Product Pricing and Marketing Research- Pricing, Decisions and Pricing Methods, Pricing Management-Marketing Planning and Strategy Formulation-Portfolio Analysis, BCG, GEC Grids


References:
PR675 TOTAL QUALITY MANAGEMENT AND SIX SIGMA

COURSE OUTCOMES:
1. Recognize the importance of TQM in industrial scenario
2. Competence to apply specific TQM tool for the problems
3. Execute various phases of Six Sigma for real time projects

Principles of Quality Management, Quality Management Gurus and their contributions, Introduction to Total Quality Management (TQM), Concepts of TQM, Obstacles to TQM implementation, Benefits of TQM implementation.

Basic and Advanced Quality Control tools, Quality Function Deployment, Failure Mode and Effect Analysis – Scope, steps, illustrative examples and applications.


Introduction to Six Sigma, Six Sigma DMAIC and DMADV Methodologies, Six Sigma and Lean Management, Benchmarking.

Quality Costing – Cost categories, Prevention, Appraisal and Failure cost, construction of PAF model, TQM and Six Sigma in Service Sector, Application case studies of TQM and Six Sigma.

References
COURSE OUTCOMES:
1. Evaluate and apply theories of social science disciplines to workplace issues
2. Select, develop, and motivate workers using HRM functional capabilities
3. Express analytical, communication, and decision making skills considering ethics

Individual Behavior-Personality–Attribute–Perception–Motivation Theories

Group Behavior-Group Dynamics, Group decision making, Inter personal Relations-Dynamics of Organizational Behavior-Organizational Climate–Organizational change–the Change Process & Change Management-


Values and Ethics-Engineering as experimentation-Engineers as responsible experimenters-Social Responsibility, and Sustainability.

References:
PR677 DECISION SUPPORT SYSTEMS

COURSE OUTCOMES:
1. Define the importance of decisions in the work and the life and use DSS Software Tools
2. Evaluate the Success/Failure of Decision Support Systems
3. Discuss the advantages/disadvantages of different Types of decision support systems and analyze practical cases for different problems (technical, management)

DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development

Group support systems- enterprise DSS- supply chain and DSS-knowledge management methods, technologies and tools

Artificial intelligence and expert systems- Representation in logic and schemas, semantic networks, production rules and frames, inference techniques – DSS applications

References:
1. Efraim Turban and Jay E Aronson, Decision Support and Intelligent Systems, Pearson education Asia, Seventh edition, 2005
2. Elain Rich and Kevin Knight, Artificial intelligence, TMH, 2006
PR678 KNOWLEDGE MANAGEMENT

COURSE OUTCOMES:
1. Appreciate the role and use of knowledge in organizations and institutions, and the typical obstacles that KM aims to overcome
2. Describe the core concepts, methods, techniques, and tools for computer support of knowledge management
3. Apply and integrate appropriate components and functions of various knowledge management systems

Knowledge society- Drivers of knowledge management- Intellectual capital- KM and learning organizations- Strategic alignment- Evaluation and strategic alignment

Infrastructural development and deployment- Role of CKO- Analyzing business environment- knowledge audit and analysis – designing KM team, system- Technology components- Intranet and Groupware solutions- tools for collaborative intelligence


References
COURSE OUTCOMES:
1. Recognize the importance of Product Life Cycle Management
2. Realize potential for Collaborative Product Development and digital manufacturing in contemporary manufacturing applications
3. Exhibit competence to develop PLM strategy and conduct PLM assessment

Introduction to Product Life Cycle Management (PLM)- Definition, PLM Lifecycle model, Need for PLM, Opportunities and benefits of PLM, Components and Phases of PLM, PLM feasibility study

PLM Concepts, Processes and Workflow - Characteristics of PLM, Environment driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM.

Collaborative Product Development- Engineering vaulting, product reuse, smart parts, engineering change management, Bill of materials and process consistency, Digital mock-up and prototype development, design for environment, virtual testing and validation, marketing collateral

Digital Manufacturing – PLM Digital manufacturing, benefits manufacturing, manufacturing the first-one, Ramp up, virtual learning curve, manufacturing the rest, production planning

Developing a PLM strategy and conducting a PLM assessment- Strategy, Impact of strategy, implementing a PLM strategy, PLM initiatives to support corporate objectives. Infrastructure assessment, assessment of current systems and applications

References
PR680 TECHNOLOGY MANAGEMENT

COURSE OUTCOMES:
1. Develop an awareness of the range, scope, and complexity of technological innovation, and the issues related to managing technological change.
2. Explain different approaches to managing innovation, with -criteria decision making techniques
3. Clearly identify drivers and barriers to technological innovation within an organization.

Definition-scope-components -Issues in managing new technology, Life cycle approach to technology management-Approaches to forecasting, Technology performance parameters.

Use of Experts in technology forecasting, planning technological process, Morphological analysis of a Technology system-Techno-Economic feasibility study

Application of multi-criteria decision making techniques in technologies evaluation and selection-AHP, fuzzy AHP-Modes of global technology transfer-Technology–Human Interface-


References
PR681 MULTI-CRITERIA DECISION MAKING TECHNIQUES

COURSE OUTCOMES:

1. Recognize the importance of multi criteria decision making
2. Understand various MCDM methods
3. Apply MCDM methods for real life applications


Fuzzy based MCDM methods – Hybrid MCDM methods – Group Decision Making- Graph Theory and Matrix approach – Principle, steps and illustrative examples.

Goal Programming – Balanced Scorecard Approach - MCDM application areas – Case studies on application of MCDM techniques.

References

**Common Elective with M.Tech. Manufacturing Technology**

**PR 630 PRODUCT DESIGN AND DEVELOPMENT**

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**COURSE OUTCOMES**

1. Understand the challenges and advancements of product development process
2. Execution of various phases of product development
3. Development of environmentally friendly products/processes

Product development process – various phases, Reverse engineering and redesigning product development process, Illustrations of product development process, S-curve, new product development.

Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality. Tear Down and Experimentation- Tear down method, post teardown report, benchmarking and establishing engineering specifications, product portfolios.

Generating Concepts- Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory.

Robust design, Design for Manufacture and Assembly, Axiomatic design, TRIZ, Value Engineering, Industrial design, Poka Yoke – Lean principles – Six sigma concepts.

Design for the Environment: DFE methods, life cycle assessment, weighted sum assessment method, techniques to reduce environmental impact – disassembly, recyclablility, remanufacturing regulations and standards.

**References**