I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **15EPMC702**	Course Title: **Mechatronics Systems**
L-T-P**: 4-1-0** Credits: **5**	Contact Hrs: **6 hrs/week**
CIE Marks: **50** SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**	Exam Duration: **3 hrs**

Introduction to mechatronics system: Advanced mechatronics design Approaches, Review of fundamentals of electronics, Application of mechatronics in manufacturing like CNC, TMS, FMS, CIM, MVS, APS etc.

Mechatronics elements: Data conversion devices, macro sensors, micro sensors, modern transducers, micro actuators, signal processing devices, relays, contactors and timers. MEMS.

Drives and mechanisms: Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems.

Hydraulic and pneumatic system: Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Distribution and conditioning of compressed air, system components and graphic representations Design of hydraulic and pneumatic circuits.

CNC technology and Robotics: Importance of CNC Systems, CNC variety, comparison of CNC with SPM, types of CNC machines, Advanced machining- 3, 4 & 5 axis, retrofitting applications CNC machines and part programming, Industrial Robotics.

Signal systems and real time interfacing: System and interfacing and data acquisition, DAQS, Overview of the I/O process, Installation of the I/O card and software. I/O ports, peripheral adapters, and serial communications interface, Dynamic Models and analogies, System response.

Programmable Logic Controllers: Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC.

Design and mechatronics case studies: Design of mechatronics systems & future trends. Designing - Possible design solutions - Case studies of Mechatronics systems- pick and place robot, PC based CNC drilling machine, conveyer based material handling system etc.

References:

1. Bolton W.,"Mechatronics", Pearson publications, New Delhi.
2. Shetty D. and Kolk R.A., "Mechatronics System Design", Thomas Learning.
3. Histand M. B. and Alciatore D. G., "Introduction to Mechatronics & Measurement System",.TATA McGraw Hill Publishing Company, New Delhi.
4. Aulander D. M. and Carl J., "Mechatronics Mechanical System Interfacing", Kemp Prentice-Hall, Inc.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMC703**   Course Title: **Project Management**
L-T-P**: 4-1-0**   Credits: **5**   Contact Hrs: **6 hrs/week**
CIE Marks: **50**   SEE Marks: **50**   Total Marks: **100**
Teaching Hrs: **50 hrs**   Exam Duration: **3 hrs**

Planning Overview: Capital investments, Phases and objectives of capital budgeting, Facets of project analysis, Capital Allocation Framework: Key criterion, Elementary investment options, Portfolio planning modes, Strategic planning and capital budgeting, Market and Demand Analysis: Situational analysis and specification of objective, Conduct of market survey, Demand forecasting and Uncertainties in demand forecasting, Technical Analysis: Manufacturing process/technology, Technical arrangements, Material inputs and utilities, Product mix, Plant capacity, Location and site, Machineries and equipment, Structures and civil works, Environmental aspects, Project charts and layouts. Financial Estimates and Projections: Cost of a project, Means of finance, Estimates of sales and production, Cost of production, Working capital requirement and its financing, Profitability projections, Projected cash flow statements. Advance Project Network Analysis and Scheduling: Introduction to CPM and PERT, Theory of constraints and critical chain method, Allocating resources and multiple project scheduling, TOC method for allocating Resources to multiple projects, GERT. Project Selection and Portfolio Management: Project portfolio management, Framework for project selection and portfolio management, Methods for individual project analysis, Methods for comparing and selecting projects, Periodic project review and assessment. The Impact of Sustainability on Project Management: The concept of sustainability, Sustainability in project management, Inter-relating life cycles, The impact of sustainability on project management processes, Measuring and reporting projects, The impact of sustainability on project management competencies.

References:

1. Prasanna Chandra, "Projects: Planning, Analysis, Financing, Implementation and Review", Tata McGraw-Hill Publishing Company Limited, New Delhi.

2. Nicholas J. M. and Steyn H. "Project Management for Business, Engineering and Technology: Principles and Practice", Elsevier.

3. Harold R. Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", Wiley, New York.

4. Scott Berkun, "Art of Project Management". Cambridge, MA: O'Reilly Media.

5. Choudhury, S., "Project Management", Tata McGraw Hill.

6. Wiest J. D. and Levy F. K., "A Management Guide to PERT/CPM", Prentice Hall, Englewood Cliffs.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **15EPME702**   Course Title: **Design of Experiments and Robust Design**

L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Taguchi's approach to quality and quality loss function, noise factors and average quality loss, exploiting non linearity, classification of parameters, Analysis of variance: No-Way ANOVA, One-Way ANOVA, Two-Way ANOVA and Three-Way ANOVA, Two Level Experiments: Two factor factorial design, model adequacy checking and estimating model parameters, 2^2 full factorial design, 2^3 full factorial design, 2^k full factorial design and Two level fractional factorial design, General 2^{k-p} fractional factorial design. Steps in Robust Design, Identification of process and its main function, Noise factors and testing conditions, Control factors and their levels, Matrix experiment and data analysis plan, Conducting the experiment and data analysis, Verifying experiment and future plan. Signal to Noise Ratios, Comparison of the quality of two process conditions, Relationship between Signal to Noise Ratio and quality loss after adjustment, Identification of a scaling factor, Signal to Noise Ratios for static problems, Signal to Noise Ratios for dynamic problems, Analysis of ordered categorical data. Taguchi inner and outer arrays, Orthogonal arrays and fractional factorial designs, Parameter design and tolerance design, Analysis of inner/outer array experiment, Alternative inner/outer Orthogonal array experiments, Constructing orthogonal arrays, Dummy level technique, Compound factor method, Linear graphs and Interaction assignment, Modification of linear graphs, Column merging method, Branching design.

References:

1. Montgomery, D. C., "Design and Analysis of Experiments", John Wiley & Sons.

2. Khuri A. I. and Cornell J. A. "Response Surfaces: Designs and Analyses, Marcel Dekker, Inc., New York.

3. Myers R. H., Montogomery, D. C. and Anderson-Cook C. M. "Response Surface Methodology: Process and Product Optimization Using Designed Experiments", John Wiley & sons, Inc., New York.

4. Mason R. L., Gunst, R. F., Hess J. L., "Statistical design and Analysis of Experiments with Applications to Engineering and Science", John Wiley & sons, Inc., New York.

5. Phadke M. S., "Quality Engineering using Robust Design", Prentice Hall PTR Englewood Cliffs, New Jersey.

6. Ross P. J., "Taguchi Techniques for Quality Engineering", McGraw -Hill International.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPME704**	Course Title: **Finite Element Applications in Manufacturing**

L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Equations of equilibrium, stress-strain relations for 2-D and 3-D, Potential energy and equilibrium, Boundary conditions, Von Misses Stresses. Approximation Analysis: Variational methods, Rayleigh-Ritz (R-R) methods applied to simple problems on axially loaded members R-R method applied to Cantilever, simply supported arid fixed beam, with point loads and UDL, Galerkin's method as applied to simple elasticity problem. FEM for 2D Problems: Shape functions, stiffness matrix, strain matrix, load vectors for CST Elements and application problems. FEM for Axisymmetric Problems: Higher order elements in bar, triangular, quadrilateral, tetrahedral and hexahedral elements, axisymmetric formulation, triangular elements, PE approach, Body force term, application problems. FEM applications in machining processes such as turning, drilling, milling and grinding. Applications of FEM in forming processes such as forging, rolling, drawing, extrusion and deep drawing, Applications of FEM in various casting processes. Dynamic Analysis: Equations of motion for dynamic problems –consistent and lumped mass matrices --formulation of element mass matrices, free vibration and forced vibration problems formulation, Standard FE Packages and their features.

References:

1. Chandrupatla and Belegundu, "Introduction to Finite Elements in Engineering", PHI learning Pvt Ltd, New Delhi.
2. Desai G.S. and Abel J.F., "Introduction to Finite Element Method", CBS Publishers, New Delhi.
3. Rao S. S., "The Finite Element Method in Engineering", Elsevier Publications.
4. Madenci E. and Guven I., "The Finite Element Method & Applications in Engineering Using ASYS", Springer International Edition.
5. Krishnamoorthy C. S., "Finite Element Analysis", Tata McGraw Hill Publishing Co. Ltd, New Delhi.
6. Lakshiminarayana H V., "Finite Element Analysis Procedures in Engineering", Universities Press.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **15EPMP701**   Course Title: **Machining and Mechatronics Lab**
L-T-P**: 0-0-2-0**   Credit: **2**   Contact Hrs: **4 hrs/week**
CIE Marks: **80**   SEE Marks: **20**   Total Marks: **100**
Practical Hrs: **48 hrs**

- CNC programming practices on turning and milling.
- Generation of CNC programming using CAM software.
- Machinability studies in turning, drilling, milling and non-traditional machining.
- Analysis of automation circuits for a manufacturing system using electro-hydraulic and pneumatic circuits.
- Interfacing, programming and analyzing the various working modules with PLC system.
- Open ended experiments
  - ✓ Parametric analysis in traditional/non-traditional machining for a specified work tool combination
  - ✓ Construction and validation of a mechatronic system device for a given task.

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15ECRC701** Course Title: **Philosophy and Practice of Engineering Education**

L-T-P**: 2-0-1**	Credits: **3**	Contact Hrs: **3hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Module 1: Fundamental Principles of Effective Teaching and Learning
Teaching Philosophy, How Learning Works, Classroom Communication Skills, Teaching and Learning Styles, Bloom's Taxonomy.

Module 2: Fundamentals of Instructional Design
Different Instructional Design Models.

Module 3: Technology Enhanced Learning
Role of Technology, TPACK Model, Technology Tools.

Module 4: Basics of Assessment and Evaluation
Different Methods, Techniques.

Module 5: Micro Teaching
Practice and Assessment

Reference Books:
Ambrose, S., Bridges, M., DiPietro, M., Lovett, M., & Norman, M. (2010) How learning works: 7 Research-Based principles for smart teaching. San Francisco: Jossey-Bass.

Suggested Web Resources:
https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/
http://educationaltechnology.net/instructional-design/
https://www.nwea.org/blog/2014/33-digital-tools-advancing-formative-assessment-classroom/
http://oedb.org/ilibrarian/101-web-20-teaching-tools/

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMC706**	Course Title: **World Class Manufacturing**
L-T-P: **4-1-0** Credits: **5**	Contact Hrs: **6 hrs/week**
CIE Marks: **50** SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**	Exam Duration: **3 hrs**

World-Class Manufacturing (WCM), Manufacturing Excellence and Competitiveness, Meaning of World-class, Competing in World markets, WCM Techniques, Review of frameworks for WCM, Justification of WCM, Case studies.

Lean Manufacturing: Elements of Lean manufacturing: Stability, Standardized work, Just in time, Jidoka, Hoshin Planning, The culture of lean, Implementation of Lean manufacturing: Implementation framework for the Lean manufacturing, DEMAIC process, Case studies.

Total Productive Maintenance (TPM): An overview of various maintenance systems, Evolution of TPM, Productivity and TP, OEE, TPM and TQC, Small Group Activities, Pillars of TQM, Kobsu-Kaizen (Continuous Improvement), Jishu-Hozen (Autonomous maintenance), Planned Maintenance System, Skill upgrade training, Initial control (Equipment Life cycle management), Hinshitsu-Hozen (Quality Maintenance), Office TPM, Total safety management, Implementation, 5s,Case studies,

Total Quality Management (TQM): Understanding quality, Evolution of TQM, Framework for TQM, Commitment and leadership, Customer satisfaction, Employee involvement, Continuous process improvement, Supplier partnership, Performance, measures, Formulation and implementation of TQM

Concurrent engineering, Design Failure Mode Effects Analysis (DFMEA) and Process Failure Mode Effects Analysis (PFMEA), Manufacturing Quality in Supply Chain Management, Manufacturing Quality and its importance in Product Life Cycle, Case studies.

References:

1. Todd J., "World Class Manufacturing", McGraw Hill, London.
2. Schonberger R.J., "World Class Manufacturing - The Lesson of Simplicity", Free Press.
3. Marcus, A. A., "Management Strategy: Achieving Sustained Competitive Advantage", New York: McGraw-Hill/Irwin.
4. Voss C.A., "Manufacturing Strategy: Process and Content", Chapman & Hall, London.
5. Pascal D., "Lean production simplified", 2nd Edition, Productivity Press.
6. Nakajima S., "Introduction to Total Productive Maintenance", Productivity Press.
7. Besterfield D. H., et al., "Total Quality Management", Pearson Education.
8. Mohanty R.P. and Deshmukh S: G., "Advanced Operations Management", Pearson Education.

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMC707**   Course Title: **Automation in Manufacturing**

L-T-P**: 4-0-0**   Credits: **4**   Contact Hrs: **4 hrs/week**

CIE Marks: **50**   SEE Marks: **50**   Total Marks: **100**

Teaching Hrs: **50 hrs**   Exam Duration: **3 hrs**

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity. Material handling equipment, Analysis. Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Automatic identification methods, Barcode technology, RFID. Control Technologies in Automation: Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Discrete Process Control. Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines & Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly. Evaluation of automatic production: Product manufacturability, orientation devices- active and passive devices, parts orientation. Automated Assembly Systems: Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis. Analysis of Transfer Lines with No Internal Storage, Analysis of Transfer Lines with Storage Buffers. Quality Control And Support Systems: Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vs non-contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production. Rapid manufacturing technology; Introduction to Rapid Manufacturing, Customization and Mass Customization, Classification of Rapid Manufacturing Processes (Additive/Subtractive/Formative) Process Chain for Additive and Other Rapid Manufacturing Processes. Modeling and Simulation for Manufacturing Plant Automation: Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

References:

1. Grover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education Asia.
2. Grover M.P., Weiss M. M., Nagel R.N. and Odrey N.G., "Industrial Robotics, Technology, Programming and Applications", Mc Graw Hill Book Publications.
3. Krishna Kant, "Computer Based Industrial Control" PHI.
4. David W. P., "Industrial Automation" John Wiley and Sons.
5. Radhakrishnan P., "CAD / CAM / CIM", New Age International Pvt. Ltd., New Delhi.
6. Viswanandham, "Performance Modeling of Automated Manufacturing Systems" PHI.

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMP702**   Course Title: **Computer Aided Engineering and Simulation Lab**.

L-T-P**: 0-0-2**   Credit: **2**   Contact Hrs: **4 hrs/week**
CIE Marks: **80**   SEE Marks: **20-**   Total Marks: **100**
Practical Hrs: **48 hrs**   Exam Duration: **3 hrs**

- 3D Modeling and FEM Structural analysis: Exercises on modeling and finite element analysis, Simulation of single point and multi point cutting tools like twist drill and milling cutter. Analysis of results obtained from post processor.

- Forming Simulation: Exercises on forming simulation and analysis of forging, rolling, extrusion/drawing, deep drawing processes. Simulation of the process and analyzing the results to optimize the die design parameters.

- Casting Simulation: Exercises on casting simulation and analysis. Analysis of results to optimize the casting and casting design parameters.

- System Simulation: Exercises on real life problems using discrete event systems simulation software.

- Modern work-study analysis: Data analysis in Method Study and creation of visual charts. Use of work Study knowledge database to do Kaizen, SMED and other Improvements. Use of work-study methodologies to do 5S with examples.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPME802**		Course Title: **Advanced Precision Engineering**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Concept of Measurement methods, Experimental Test plan, Calibration, Static and Dynamic characteristics of signals, Measurement system behavior, Probability and Statistics, Density functions, Infinite and finite statistics, Chi-squared distribution, Regression analysis, Data outlier detection, Uncertainty Analysis, Measurement errors, Design-stage uncertainty analysis, error sources, Bias and precision errors, error propagation, single and multiple measurement, uncertainty analysis, Surface roughness measurement, Stylus instruments (Mechanical and Electrical), Sources of error, Optical instruments (Profiling and Parametric techniques), Data acquisition and filtering, Amplitude and texture parameters, Coordinate Measuring Machines: Coordinate metrology, Configuration of CMM, Hardware components, Control system for CMM, Operating sequence, Measurement program, Automated inspection, Principles, Methods of online, offline, distributed and flexible inspections, Machine vision, Image Acquisition & digitization, Image processing & Analysis, interpretation, applications

References:

1. Figliola R. S. and Beasley, D. E., "Theory and Design for Mechanical Measurements", Third edition, John Wiley & Sons Inc.

2. Thomas Tom R., "Rough Surfaces 2nd ed", Imperial College Press, London.

3. Hooken Rabert and Pereira P. H., "Coordinate Measuring Machines and Systems", CRC press.

4. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", PHI.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPME803**		Course Title: **Simulation and Modeling**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

System Models, System environment, Stochastic activities, Continuous and discrete systems, Systems modeling, Types of models. System Simulation, simulation as problem solving tool, general principles and procedure, the techniques of simulation, Monte Carlo method of simulation, comparison of simulation and analytical methods, experimental nature of simulation, Statistical models in Simulation, Random Variables and their Properties, Estimation of Means, Variances, and Correlations, Confidence Intervals and Hypothesis Tests for the Mean, The Danger of Replacing a Probability Distribution by its Mean Discrete and continuous distributions, Poisson process, empirical distributions, Queuing Models, steady state behaviors, Single and multi-channel queuing models, Random Number Generation, Properties of random numbers, generation of pseudo-random numbers, techniques for generating random numbers, tests for random numbers. Random-Variate Generation, Inverse transform techniques, acceptance-rejection techniques, Analysis of Simulation Data, Data collection, identification of the distribution, parameter estimation, goodness-of-fit tests, multivariate and time-series input models, Output Analysis of a Single Model, Types of simulation with respect to output analysis, stochastic nature of output data, measures of performance and their estimation, analysis for termination simulations, Continuous System Simulation, Historical background, various growth patterns, System dynamics diagrams. Simulation of Manufacturing Systems, Verification and Validation of Simulation Models.

References:

1. Banks J., Carson II J.S., Nelson B.L., and Nicol D.M. "Discrete-event System Simulation", Pearson Education.
2. Gordon G., "System Simulation", PHI, New Delhi.
3. Sterman J. D., "Business Dynamics: Systems Thinking and Modeling for a Complex World", McGraw-Hill International.
4. Neelamkavil F., "Computer Simulation and Modelling", Wiley, New York.
5. Law A. M.and Kelton W. D., "Simulation Modeling and Analysis", McGraw Hill.
6. Shannon R.E., "System Simulation", Prentice Hall.
7. Written J. L., Bentley L. D.and Barice V.M., "System Analysis and Design Methods", Galgotia Publication.
8. Mize J. H. and Cox J. G., "Essentials of Simulation" – Prentice Hall.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPME805**		Course Title: **Enterprise Resource Planning**
L-T-P: **4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

ERP as Integrated Management Information System, Evolution of ERP, Benefits of ERP. ERP versus Traditional Information Systems, Business Process Reengineering, Need and challenges, Management concerns about BPR, BPR to build business Model for ERP, ERP & Competitive advantage, Basic Constituents of ERP, Selection criteria for ERP Packages. Procurement process for ERP Package, ERP packages – PEOPLE SOFT, SAP-R/3, BAAN IV, MFG/PRO, IFS/AVALON, ORACLE-FINANCIAL, Survey of Indian ERP Packages regarding their Coverage, performance &cost, ERP Implementation: issues, Role of Consultants, Vendors, Users, Need for training, customization. ERP implementation methodology and post implementation issues and options, Supply Chain Management, Types of SCM, Potential benefits of SCM, Possible obstacles, Application systems supporting SCM – engineering, Product Data Management, Sales, Procurement, Production, MRP, Distribution, ERP case studies in HRM, finance, production, product database, materials, sales & distribution.

References:

1. Leon Alexis, "Enterprise Resource Planning", Tata McGraw Hill, New Delhi.
2. Garg V. K. and Venkatakrishna N. K., "Enterprise Resource Planning: Concepts and Practices", PHI, New Delhi.
3. Sadagopan S., "Enterprise Resource Planning: A Managerial Perspective", Tata McGraw Hill, New Delhi.
4. Brady, "Enterprise Resource Planning", Thomson Learning.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPME807**		Course Title: **Product Lifecycle Management**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle, Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance and Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM, Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development, Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process, Product Data Management: Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation, Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in product Design, Examples/Case studies, Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle, Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design, Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis, Technology Forecasting: Evolution for technology forecasting and its importance, Future mapping, Methods of technology forecasting such as Relevance Trees, Morphological Methods and Mission Flow Diagram, Combining forecast of different technologies.

References:

1. Stark J., "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, ISBN: 1852338105

2. Giudice F., Rosa Guido La, Risitano A., "Product Design for the environment-A life cycle approach", Taylor & Francis, ISBN: 0849327229

3. Antti S. and Anselmie I., "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314

4. Grieve M., "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, ISBN: 0070636265

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMI801**   Course Title: **Internship/Industrial Training**
L-T-P**: 0-0-2**   Credits: **2**   Contact Hrs: --
CIE Marks: **50**   SEE Marks: **50**   Total Marks: **100**

Each student has to undergo internship/industrial training for a period of 6 weeks at a reputed industry/R&D institution after the completion of III semester SEE. At the organization where the student is undergoing training, the student shall be assigned to work under the supervision of a Project Supervisor assigned for this purpose by the Head of the Department / institution. Student is expected to learn about the organization where the student is undergoing training in terms of its vision, mission, objectives, organizational structure, operations etc. At the end of the training, student must submit a report based on training.

The Project Supervisor at the industry shall award Continuous Internal Evaluation (CIE) marks out of a maximum of 50. The Department will conduct the Semester End Examination (SEE) for a maximum of 50 marks.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMW801**   Course Title: **Minor Project/Project Work Phase I**
L-T-P**: 0-0-8**   Credits: **8**   Contact Hrs: **8**
CIE Marks: **50**   SEE Marks: **50**   Total Marks: **100**

Minor Project: The Guide shall define the problem statement for the Project work. The student shall execute the Minor Project within three months duration during the 3rd semester. The student who has opted **Minor Project** shall opt **Major Project** in IV semester. However, Minor Project is independent of Major Project.

Project Work Phase I:
Student must select a research project in consultation with the Guide. Student should identify the problem and conduct an exhaustive literature survey in Project Work Phase I and shall continue the project in IV semester in Phase II. Student has to submit the report at the end of the III Semester based on the following:
- Back ground and significance of the Research Project
- Problem statement
- Objectives and scope of the project
- Literature review
- Methodology
- Future plan of action

IV Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **15EPMW802**   Course Title: **Major Project/Project Work Phase II**
L-T-P**: 0-0-20**   Credits: **30**   Contact Hrs: **20**
CIE Marks: **50**   SEE Marks: **50**   Total Marks: **100**

The student who has opted **Minor Project** should opt **Major Project** in IV semester. The **Major Project** shall be carried out by the student under the supervision of guide for a period of 6 months. For successful completion of this course the student should be able to identify the problem, define the objectives of the work as specific points indicating the scope within which the work is to be carried out, conduct the comprehensive literature survey, demonstrate the use of methodology adopted, analyze and interpret the experimental/numerical results obtained.

Project Work Phase II:
The student who has opted **Project Work Phase I** shall continue the project in IV semester in **Phase II**.
Phase II is assessed based on the following:

- Quality of literature survey and demonstration of creativity in the research problem
- Clarity in the objectives and scope of the research
- Clarity in the problem definition and feasibility in the problem solution
- Relevance to the current research/industrial trends
- Quality of work
- Analysis and Interpretation of results
- Quality of oral and written presentation
- Publication based on the research work in reputed national/international conference/journal.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **17EPMC701**		Course Title: **Manufacturing Systems and Automation**

L-T-P**: 3-0-0**   Credits: **3**   Contact Hrs: **3 hrs/week**
ISA Marks: **50**   ESA Marks: **50**   Total Marks: **100**
Teaching Hrs: **40 hrs**   Exam Duration: **3 hrs**

Introduction: Production system facilities, Manufacturing support systems, Automation in production system, Automation principles and strategies, Manufacturing operations, Basic elements of an automated system, Advanced automation functions, Levels of automation.

Material handling and identification technology: Considerations in material handling system design, 10 principles of material handling, Automated guided vehicle systems, Conveyor systems, Analysis of material transport system, Automated storage systems, Engineering analysis of storage system. Components of manufacturing systems, Single station automated cells, Applications and analysis of single station cells.

Flexible manufacturing systems: FMS components, FMS application and benefits, Quantitative analysis of flexible manufacturing systems.

Industrial control systems: Sensors, Actuators, Drives and other control system components. Electro-hydraulic and Electro-pneumatics in manufacturing automations

Machine vision systems: Importance of machine vision system in manufacturing automation.

Role of microcontrollers in manufacturing automation system: Microcontroller architecture, interfacing sensors and actuators with microcontroller for industrial automation, Microcontroller programming.

PLCs in manufacturing automation: Application of programmable logic controllers in manufacturing automation, PLC basic and advanced ladder logic programming using RsLogix and CoDeSys format, Usage of timers, counters, sequencing, and interlocking, latching, master control relay for developing programs for manufacturing automation. Temperature control, valve sequencing, conveyor belt control, control of a process etc

SCADA for Automation: Elements of SCADA, Benefits of SCADA, Applications, Types of SCADA systems, Features and functions of SCADA, Building applications using SCADA for manufacturing automation.

References:

1. Grover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education Asia.

2. Grover M.P., Weiss M. M., Nagel R.N. and Odrey N.G., "Industrial Robotics, Technology, Programming and Applications", Mc Graw Hill Book Publications.

3. Krishna Kant, "Computer Based Industrial Control" PHI.

4. W. Bolton , "Programmable Logic Controllers" Fifth Edition, Elsevier

5. Vijay R. Jadhav, "Programmable Logic Controller", Second Edition, Khanna Publishers.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMC702**   Course Title: **CNC Machining Technology and Additive Manufacturing**

L-T-P**: 4-0-0**   Credits: **4**   Contact Hrs: **4 hrs/week**
ISA Marks: **50**   ESA Marks: **50**   Total Marks: **100**
Teaching Hrs: **50 hrs**   Exam Duration: **3 hrs**

Structure of CNC Machine Tools: Evolution of CNC Technology, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre-features and applications, Automatic tool changers and Multiple pallet system, types of control systems, CNC controllers, characteristics, interpolators. CNC Machine building, structural details, configuration and design, guide ways –Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings. Swarf removal and safety considerations

Drives and Tooling Systems: Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives – stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Tooling requirements for turning and machining centres, Qualified, semi qualified and preset tooling, coolant fed tooling system, work holding devices for rotating and fixed work parts, modular fixtures.

Feedback systems and Adaptive Control: Axis measuring system, Adaptive control with constraints (ACC), Adaptive control with optimization (ACO), Geometric adaptive control (GAC), Variable gain AC systems-stability problem, estimator algorithm, variable gain algorithm,

CNC Programming: G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre, generation of CNC codes from CAM packages. Basics of APT

Additive manufacturing (AM) processes: AM based rapid prototyping (RP) Systems like Stereo-lithography, Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), Laminated Object Manufacturing (LOM), 3-D Printing, and LENS etc.

Role of additive manufacturing and rapid prototyping in product design and development: Solid modeling techniques for additive manufacturing with comparison, advantages and disadvantages, Process planning for rapid prototyping, STL file generation, Slicing and various slicing, procedures.

Accuracy issues in additive manufacturing: Properties of metallic and nonmetallic additive manufactured surfaces, Stress induced in additive manufacturing (AM) processes. Surface roughness problem in rapid prototyping, Part deposition orientation and issues like accuracy, surface finish, build time, support structure, cost etc.

.

References:
1. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency.
2. Rao P.N., "CAD/CAM", Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Pabla, B.S. & Adithan, M. "CNC Machines", New Age Publishers, New Delhi.
4. Warren. S. Seames, "Computer Numerical Control: Concepts and Programming", 4th edition, Delmar Thomson Learning Inc.
5. James Madison, "CNC Machining Hand Book", Industrial Press Inc.
6. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2000
7. Chua, C.K., Leong, K.F., "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley and Sons Inc.
8. Hopkinson, N., Hague, R.J.M. and Dickens, P.M., "Rapid Manufacturing and Industrial Revolution for the Digital Age", John Wiley and Sons Ltd, Chichester.
9. Gebhardt, A., "Rapid Prototyping", Hanser Gardner Publications, Inc., Cincinnati.
10. Noorani, R., "Rapid Prototyping: Principles and Applications", John Wiley & Sons, Inc., New Jersey.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMC703**   Course Title: **Operations Management**
L-T-P**: 3-1-0**   Credits: **4**   Contact Hrs: **5 hrs/week**
ISA Marks: **50**   ESA Marks: **50**   Total Marks: **100**
Teaching Hrs: **40 hrs**   Tutorial Hrs: **24 hrs**   Exam Duration: **3 hrs**

Overview of Operations Management: Functional sub systems of organizations, Systems concept of production, Types of production systems, Productivity, Strategic management.

Product Design and Analysis: New product development, Process Planning and Design, Value analysis and Value Engineering, Standardization, Simplification, Make or Buy decisions, Ergonomic considerations in Product design.

Capacity Planning and Investment Decisions: Capacity planning and strategies, Investment formulas and comparisons of alternatives.

Forecasting: Nature and use of forecasting, Measures of Forecasting, Factors affecting forecasting, Types and models of forecasting

Facility Location and Layout: Factors influencing plant location, location evaluation methods, Different types of lay outs for operations and production, arrangement of facilities within the department, CRAFT, ALDEP, CORELAP etc.

Aggregate Planning and Master Production Scheduling: Nature of aggregate planning, Methods of aggregate planning, Approaches to aggregate planning –graphical, empirical and optimization, Development of MPS, MRP-I and MRP-II.

Inventory Analysis and Control: ABC inventory systems, Inventory models, EOQ models for purchased and manufactured parts, lot sizing techniques.

Scheduling and Controlling: Objectives in scheduling, Major steps involved, Information systems linkages in production planning and control , Production control in repetitive, batch / flow shop and job shop scheduling environment - SPT, EDD, WMFT.

Project Planning and Management: Phases of project planning, Evolution of network planning techniques - Critical Path Method (CPM) and Project Evolution and Review Technique (PERT), Crashing of project network, Project scheduling with constrained resources –Graphical Evolution and Review Technique (GERT), Project monitoring, Line balance.

References

1. Vollman.T.E., "Manufacturing Planning & Control Systems", McGraw-Hill.
2. Dilworth. B. James., "Operations Management – Design, Planning and Control for Manufacturing and services", McGraw Hill Inc., New Delhi.
3. Bedworth D.D., "Integrated production control systems: management, analysis,design", John Wiley & sons, New York
4. Panneerselvam. R., "Production and Operations Management", Prentice Hall. gement

Tutorial Exercises:

Forecasting, Facility location and layout, Aggregate Planning and MPS, Inventory Control, Scheduling and Controlling, Project Planning and Management

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPME703**		Course Title: **Design and Analysis of Experiments**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Overview: Taguchi's approach to quality and quality loss function, noise factors and average quality loss, exploiting non linearity, classification of parameters

Analysis of variance: No-Way ANOVA, One-Way ANOVA, Two-Way ANOVA and Three-Way ANOVA

Two Level Experiments: Two factor factorial design, model adequacy checking and estimating model parameters, 2^2 full factorial design, 2^3 full factorial design, 2^k full factorial design and Two level fractional factorial design, General 2^{k-p} fractional factorial design.

Steps in Robust Design: Identification of process and its main function, Noise factors and testing conditions, Control factors and their levels, Matrix experiment and data analysis plan, Conducting the experiment and data analysis, Verifying experiment and future plan.

Signal to Noise Ratios: Comparison of the quality of two process conditions, Relationship between Signal to Noise Ratio and quality loss after adjustment, Identification of a scaling factor, Signal to Noise Ratios for static problems, Signal to Noise Ratios for dynamic problems, Analysis of ordered categorical data.

Taguchi inner and outer arrays, orthogonal arrays and fractional factorial designs, Parameter design and tolerance design, Analysis of inner/outer array experiment, Alternative inner/outer orthogonal array experiments.

Constructing orthogonal arrays, Dummy level technique, Compound factor method, Linear graphs and Interaction assignment, Modification of linear graphs, Column merging method, Branching design.

References:

1. Montgomery, D. C., "Design and Analysis of Experiments", John Wiley & Sons.
2. Khuri A. I. and Cornell J. A. "Response Surfaces: Designs and Analyses, Marcel Dekker, Inc., New York.
3. Myers R. H., Montogomery, D. C. and Anderson-Cook C. M. "Response Surface Methodology: Process and Product Optimization Using Designed Experiments", John Wiley & sons, Inc., New York.
4. Mason R. L., Gunst, R. F., Hess J. L., "Statistical design and Analysis of Experiments With Applications to Engineering and SISAnce", John Wiley & sons, Inc., New York.
5. Phadke M. S., "Quality Engineering using Robust Design", Prentice Hall PTR Englewood Cliffs, New Jersy.
6. Ross P. J., "Taguchi Techniques for Quality Engineering", McGraw -Hill International.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPME704**		Course Title: **Finite Element Analysis**
L-T-P**: 4-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Introduction: Introduction to FEA, General FEM procedure, Approximate solutions of differential equations: FDM method, W-R technique, collocation least square sub-domain and Galerkin method Numerical integration, Gauss Quadrature in 2-D and 3-D, Structure of FEA program, Pre and Post processor, commercially available, standard packages, and desirable features of FEA packages, Principal of minimum total potential, elements of variational calculus, minimization of functional, Rayleigh-Ritz method, Formulation of elemental matrix equation, and assembly concepts.

One Dimensional FEM: Coordinate system: Global, local, natural coordinate system, Shape functions: Polynomial shape functions, Natural co-ordinate and coordinate transformation, Linear quadratic and cubic elements, Shape functions using Lagrange polynomials. Convergence and compatibility requirement of shape functions, One dimensional field problems: structural analysis (step-bar, taper-bar), Structural analysis with temperature effect, Thermal analysis.

Two Dimensional FEM: Trusses, Thermal effects in truss members, Beams, Two dimensional finite elements formulations, Three noded triangular element, Four-noded rectangular element, Four-noded quadrilateral element, derivation of shape functions: natural coordinates, triangular elements, and quadrilateral elements, Six-noded triangular elements, Eight-noded quadrilateral elements, Nine noded quadrilateral element, Strain displacement matrix for CST element.

Three dimensional elements: Tetrahedron, Rectangular prism (brick), Arbitrary hexahedron, Three Dimensional polynomial shape functions, Natural co-ordinates in 3D, Three dimensional Truss(space trusses), Introduction to material models: Introduction to plasticity (Von-Mises Plasticity), Hyper –elasticity. Generating and using experimental data to model material behaviour, Errors in FEA, sources of errors, method of elimination, Patch test.

Applications of FEA in Manufacturing: FE analysis of Metal casting, Analysis of metal forming- Sheet metal stamping, Analysis of Machining using standard FE analysis packages

References:

1. Reddy J. N., "Introduction to Finite Element Method", McGraw-Hill.
2. Rao S.S, "Finite Element Method in Engineering", Academic Press, Elsevier.
3. Desai and Abel, "Introduction to the finite element method: A numerical method for engineering analysis", CBS.
4. Chandrupatla R T and Belegundu A D, "Introduction to Finite Elements in Engineering", PHI.
5. David Hutton, "Fundamentals of Finite Element Analysis", McGraw-Hill.
6. Buchanan, G R., Finite Element Analysis, Adapted by: R Rudramoorthy, The McGraw-Hill, Indian Adapted Edition, Schaum's Outlines.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMP701**	Course Title: **Automation Lab**
L-T-P**: 0-0-1** Credit: **1**	Contact Hrs: **2hrs/week**
CIE Marks: **80** SEE Marks: **20**	Total Marks: **100**
Practical Hrs: **24 hrs**	

Laboratory Exercises:

- Non controller based applications
- Controller based applications
- Programming PLC system for small applications using CodeSys and RsLogix software
- Interfacing PLC system for analyzing industrial applications
- Building programs for manufacturing automation processes
- Building and analyzing circuits using electro hydraulics and electro pneumatics system.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMP702**   Course Title: **Machining Lab**
L-T-P**: 0-0-1**   Credit: **1**   Contact Hrs: **2hrs/week**
CIE Marks: **80**   SEE Marks: **20**   Total Marks: **100**
Practical Hrs: **24 hrs**

Laboratory Exercises:

- CNC programming practices on machining centers and WEDM.
- CAD/CAM integration with CNC machine tool.
- Practices in 3D printing**.**
- Machinability studies in turning, drilling, milling and non-traditional machining.
- Open ended experiments on
  - ✓ Parametric analysis in traditional/non-traditional machining for a work tool combination,
  - ✓ CNC Programming

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMW701**		Course Title: **Mini Project I**
L-T-P**: 0-0-3**	Credit: **1**	Contact Hrs: **6hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Practical Hrs: **72 hrs**		

Mini Project I: The Guide shall define the problem statement for the Project work. The student shall execute the Project within during the 1st semester. The student who has opted Mini Project I shall opt automation theme to carry out their work.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **17EPMC705**		Course Title: **Data Analytics**
L-T-P**: 3-1-0**	Credits: **4**	Contact Hrs: **5 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**	Tutorial Hrs: **24 hrs**	Exam Duration: **3 hrs**

Statistical Data Analysis: Data and Statistics- Review of Basic Statistical Measures-Probability Distributions-Testing of Hypotheses-Non Parametric Tests

Data Analysis I: Introduction – Basic concepts – Uni-variate, Bi-variate and Multi-variate techniques – Types of multivariate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation – Approaches to multivariate model building.

Data Analysis II: Simple and Multiple Linear Regression Analysis – Introduction – Basic concepts – Multiple linear regression model – Least square estimation – Inferences from the estimated regression function – Validation of the model.

Factor Analysis: Definition – Objectives – Approaches to factor analysis – methods of estimation – Factor rotation – Factor scores - Sum of variance explained – interpretation of results. Canonical Correlation Analysis - Objectives – Canonical variates and canonical correlation – Interpretation of variates and correlations

Data Analysis III: Multiple Discriminant Analysis - Basic concepts – Separation and classification of two populations - Evaluating classification functions – Validation of the model. Cluster Analysis – Definitions – Objectives – Similarity of measures – Hierarchical and Non – Hierarchical clustering methods – Interpretation and validation of the model.

Data Analysis IV: Conjoint Analysis – Definitions – Basic concepts – Attributes – Preferences – Ranking of Preferences – Output of Conjoint measurements – Utility - Interpretation. Multi Dimensional Scaling – Definitions – Objectives – Basic concepts – Scaling techniques – Attribute and Non-Attributes based MDS Techniques – Interpretation and Validation of models. Advanced Techniques – Structural Equation modeling.

References:
1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, "Multivariate Data Analysis", Pearson Education, New Delhi.
2. Richard A Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", Prentice Hall, New Delhi.
3. David R Anderson, Dennis J Sweeney and Thomas A Williams, "Statistics for Business and Economics", Thompson, Singapore.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **17EPMC706**		Course Title: **Enterprise Resource Planning**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

ERP as Integrated Management Information System: Evolution of ERP, Benefits of ERP,ERP versus Traditional Information Systems, Business Process Reengineering, Need and challenges.

Management concerns about BPR: BPR to build business Model for ERP, ERP & Competitive advantage, Basic Constituents of ERP, Selection criteria for ERP Packages.

Procurement process for ERP Package, ERP packages – PEOPLE SOFT, SAP-R/3, BAAN IV, MFG/PRO, IFS/AVALON, ORACLE-FINANCIAL, Survey of Indian ERP Packages regarding their Coverage, performance and cost

ERP Implementation: Issues, Role of Consultants, Vendors, Users, Need for training, customization. ERP implementation methodology and post implementation issues and options,

Supply Chain Management: Types of SCM, Potential benefits of SCM, Possible obstacles, Application systems supporting SCM – engineering, Product Data Management, Sales, Procurement, Production, MRP, Distribution, ERP case studies in HRM, finance, production, product database, materials, sales & distribution.

References:
1. Leon Alexis, "Enterprise Resource Planning", Tata McGraw Hill, New Delhi.
2. Garg V. K. and Venkatakrishna N. K., "Enterprise Resource Planning: Concepts and Practices", PHI, New Delhi.
3. Sadagopan S., "Enterprise Resource Planning: A Managerial Perspective", Tata McGraw Hill, New Delhi.
4. Brady, "Enterprise Resource Planning", Thomson Learning.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **17EPMC707**		Course Title: **Manufacturing Systems Simulation**
L-T-P**: 3-0-0**	Credits: **4**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Principles of Modeling & Simulation: Basic Simulation Modeling, Systems – discrete and continuous systems, general systems theory, models of systems- variety of modeling approach, concept of simulation, simulation as a decision making tool, types of simulation, Principle of computer modeling- Monte Carlo simulation, Nature of computer modeling, limitations of simulation, area of application.

Random Number Generation: Random variables and their properties, Properties of random numbers, generation of Pseudo random numbers, techniques for generating random numbers, Various tests for random numbers-frequency test and test for Autocorrelation,

Random Variate Generation: Different techniques to generate random Variate: Inverse transform technique,-exponential, Normal, uniform, Weibull, direct transformation technique for normal and log normal distribution, convolution method and acceptance rejection techniques-Poisson distribution, **Statistical Techniques:** Comparison of two system designs, Comparison of several system designs – Bonferroni approaches to multiple comparisons for selecting best fit, for screening

Design and Evaluation of Simulation Experiments: Problem formulation, data collection and reduction , time flow mechanism, key variables, logic flow charts, starting condition, run size, experimental design consideration, output analysis, verification and validation of simulation models. **Simulation Languages:** Comparison and selection of simulation languages, study of any one simulation language.

Discrete Event Simulation: Concepts in discrete –event simulation, development of simulation models for queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network, Programming for discrete event simulation, Case studies.

References:
1. Jerry Banks and John S Carson, Barry L Nelson, David M Nicol, "Discrete event system simulation", Prentice Hall, India.
2. Khoshnevi. B., "Discrete system simulation", McGraw Hill International.
3. Ronald G Askin and Charles R Standridge , "Modeling and analysis of manufacturing systems", John Wiley & Sons.
4. Gordon G , "System Simulation", Prentice Hall, India..
5. Thomas J Schriber., "Simulation using GPSS", John Wiley & Sons.
6. Shannon, R.E., "System Simulation – The art and science", Prentice Hall, India.
7. Averill Law & David M.Kelton , "Simulation, Modeling and Analysis", TMH.

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMP703**   Course Title: **ERP Lab**
L-T-P**: 0-0-1**   Credit: **1**   Contact Hrs: **2hrs/week**
CIE Marks: **80**   SEE Marks: **20**   Total Marks: **100**
Practical Hrs: **24 hrs**

- Introduction and selection criteria for ERP Packages, Survey of Indian ERP Packages

- Production Planning and Execution Module: - Exercises on production planning, machine scheduling, Material Requirement Planning, track daily production progress, production forecasting & actual production reporting with case studies.

- Supply Chain Management Module: - Exercises on Management of flow of products from manufacturer to consumer & consumer to manufacturer, demand & supply management, sales returns & replacing process, shipping & transportation tracking with case studies.

- Finance & Accounting module: - Exercises on Track of all account related transactions like expenditures, Balance sheet, account ledgers, budgeting, bank statements, payment receipts, tax management with case studies.

- Human Resource Module:- Exercises on Efficient management of human resources, employee information, track employee records like performance reviews, designations, job descriptions, skill matrix, time & attendance tracking. Payroll System, payment repots, travel Expenses & Reimbursement tracking. with case studies.

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMP704**	Course Title: **Simulation Lab**
L-T-P**: 0-0-1** Credit: **1**	Contact Hrs: **2hrs/week**
CIE Marks: **80** SEE Marks: **20**	Total Marks: **100**
Practical Hrs: **24 hrs**	

Laboratory Exercises:

Development of simulation models for the following systems

- Queuing and Inventory systems, manufacturing system and service operations.
- Maintenance and replacement systems
- Job shop with material handling and FMS
- Exercises on real life problems using discrete event systems simulation software on product, process and FMS layouts.

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **17EPMW702**		Course Title: **Mini Project II**
L-T-P**: 0-0-3**	Credit: **1**	Contact Hrs: **6hrs/week**
CIE Marks: **80**	SEE Marks: **20**	Total Marks: **100**
Practical Hrs: **72 hrs**		

Mini Project II: The Guide shall define the problem statement for the Project work. The student shall execute the Project within during the 2nd semester. The student who has opted Mini Project II shall opt automation theme to carry out their work.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC701**	Course Title: **PLM Fundamentals**
L-T-P**: 2-0-0** Credits: **2**	Contact Hrs: **2 hrs/week**
ISA Marks: **50** ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **30 hrs**	Exam Duration: **3 hrs**

Introduction to Product Lifecycle Management (PLM): PLM Overview, Background for PLM, Scope, Components/Elements of PLM, PLM Grid, PLM Paradigm - Concepts, Consequences and Corollaries, Strategic Benefits, Operational Benefits, Spread of PLM, Overcoming Problems, Enabling Opportunities, Challenges.

The PLM Environment: Issues in the Traditional Environment, Product Data Issues, A Complex Changing Environment-Change, Interconnections, Changes Driving PLM, Product Pains-Aerospace, Automotive and Other Products, Product Opportunities - Globalization Opportunity, Technology Opportunity, Social/Environmental Opportunity, Human Resource Opportunity.

Product Lifecycle Management System: Product Data or Product Information, System Architecture, Information Models and Product Structure, Information Model, Product Information Data Model, Product Model, Reasons for the Deployment of PLM Systems.

PLM in Different Verticals: Functionality of the Systems, Use of PLM Systems in Different Organizational Verticals, Product Development and Engineering, Production, After Sales, Sales and Marketing, Sub-Contracting, Sourcing and Procurement, Different Ways to Integrate PLM Systems, System Roles - ERP, CAD.

Project/Program Management in PLM Environment: Characteristics of Projects, People in Projects, Project Phases, Project Management Knowledge Area, Project Management Tools and Templates, The Importance of Project Management in PLM, Project reality in a Typical Company, Project Management Activities in PLM Initiatives, Pitfalls of Project Management, Top Management Role with Project Management.

References:

1. Stark John, "Product Lifecycle Management: 21st Century Paradigm for Product Realization", Springer, Third Edition, 2015

2. Antti Saakasvuori, Anselmi Immonen, "Product Lifecycle Management" - Springer, 1st Edition, 2003.

3. Grieves Michael, "Product Lifecycle Management - Driving the Next generation of LeanThinking" , McGraw-Hill, 2006.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC702**		Course Title: **Engineering Data Management**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Introduction and Overview of Embedded Product Design: Background, Related Research and Research Problems, Structure of the Report, Design for Manufacture, Design of Embedded Products, Technical Design Disciplines and Document Management, Software Design, Electronics Design, Software-Hardware Co-Design, Mechanical design, Concurrent Engineering, Design Data Management, DFA and DFMA.

PDM Systems and Data Exchange: Product Data Management (PDM), State-of-the-art trends of PDM, Data Formats and Translators in Data Exchange, STEP (Standard for the Exchange of Product Model Data), CDIF (Case Data Interchange Format), SGML (Standard Generalized Markup Language).

PDM and SCM: PDM and Product Life Cycle, PDM Systems – Common Functionality, Product Structure and Document Management, System Architecture, Version Management, Configuration Selection, Concurrent Development, Build Management, Release Management, Workspace Management, Change Management.

Requirements of Design Data Management: Requirements for the Embedded Product's Design Data Management, Data Management, Process and Life-Cycle Management, Data Capture & Distribution, Support for Working Methods, Requirements for Enterprise-Level Design Data Management, Design Data Management Levels, The Design Data Management Features of Design Tools , Team-Level Design Data Management, Team-Level Design Data Management.

Analysis of Needs and Solutions: Comparison of Principles, Comparison of Key Functionalities, Requirements and Needs, Analysis, Different Scenarios in an Integrated Environment, Possible Integrations, Examples of integrations.

Product Data in PLM Environment: Relevance of Product Data in PLM, Product Data Across the Lifecycle, Tools to Represent Product Data, Data model diagrams, Reality in a Typical Company-Issues, Challenges and Objectives, Product Data Activities in the PLM Initiative-Product Data Improvement.

References:

1. Jukka Kaariainen, Pekka Savolainen,Jorma Taramaa & Kari Leppala, "Product Data Management (PDM) Design, exchange and integration viewpoints", VTT- Technical research centre of Finland, 2000.

2. Rodger Burden "PDM: Product Data Management" Volume 1, Resource Publishing, 2003.

3. Annita Persson Dahlqvist et.al "PDM and SCM - similarities and differences", The Association of Swedish Engineering Industries, 2001.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC703**   Course Title: **Product Design and Development**
L-T-P**: 3-0-0**   Credits: **3**   Contact Hrs: **3 hrs/week**
ISA Marks: **50**   ESA Marks: **50**   Total Marks: **100**
Teaching Hrs: **40 hrs**   Exam Duration: **3 hrs**

Introduction: Characteristics of successful product development, duration and cost of product development, Challenges of product development.

Development Process and Organizations: Generic development process, concept development – Front-end process, adapting the generic product development process

Identifying Customer Needs: Defining scope, gathering data from customers, establishing relative importance of needs etc.

Establishing Product Specifications: Target specifications & refining specifications

Concept Generation: Five step methodology of concept generation.

Concept selection: Structured methodology for selecting a concept using selection matrix & ranking of concepts.

Product Architecture: Meaning & implication of product architecture.

Industrial Design: Meaning of ID, & its impact, Aesthetic & Ergonomic considerations, ID process

Design for Manufacturing: DFM meaning, DFM Methodology**.**

Value Engineering and Product Design: Definition of value. Value analysis job plan, creativity etc.

References:

1. Karl T Ulrich and Steven D Eppinger, 'Product design and development', Tata McGraw Hill Publication.

2. A. K. Chitale and R. C. Gupta, 'Product Design and Manufacturing', Prentice Hall India.

3. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Publications.

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC704**   Course Title: **Enterprise Resource Planning - I**

L-T-P**: 3-0-0**   Credits: **3**   Contact Hrs: **3 hrs/week**

ISA Marks: **50**   ESA Marks: **50**   Total Marks: **100**

Teaching Hrs: **40 hrs**   Exam Duration: **3 hrs**

Introduction to ERP: Need for ERP, Characteristics and components of ERP, Suppliers of ERP, Integrated Management Information, Seamless Integration and Functional information system, Marketing, Accounting and Financial Management, Supply Chain Management, Resource Management, Integrated Data Model.

Business Functions and Business Processes: Functional Areas of Operation, Business Processes, A process view of business, Functional Areas and Business process of very small business. Marketing and Sales, Supply Chain Management, Accounting and Finance, Human Resources, Functional Area Information System

Business Process Reengineering: Need for reengineering, Reengineering Model, BPR Guiding principles , Business process reengineering and performance improvement, Enablers of BPR in Manufacturing, Collaborative Manufacturing, Intelligent manufacturing, Production Planning. BPR Implementation

Financial & Accounting Management: Differences between Financial accounting, Cost accounting and Management accounting, Basic finance – Concept of Cost Centre accounting, Cost – Volume – Profit Analysis, Cash Flow Analysis

Role of ERP in Purchasing: Features of purchase module, ERP Purchase System; Role of ERP in Sales and Distribution, Sub-Modules of the Sales and Distribution Module: Master data management, Order management, Warehouse management, Shipping and transportation, Billing and sales support, foreign trade, Integration of Sales and Distribution Module with Other Modules

Inventory Management: ERP inventory management system, Importance of Web ERP in Inventory Management, ERP Inventory Management Module and Sub-Modules of the ERP Inventory Management Module, Bill of Material, Safety stock, Lot number/Batch number, Inventory valuation methods

Material Requirement Planning: Product structure and Bill of Materials (BOM), MRP concept, MRP calculations, Lot sizing in MRP, capacity requirement planning, MRP-II, MRP Exercises

Production and Supply Chain Management Information Systems: Role of ERP in CAD/CAM, MRP, Closed Loop MRP, MRP-II, Manufacturing and Production Planning Module of an ERP System, Distribution Requirements Planning (DRP); ERP Approach to Production Planning, MRP to ERP.

References

1. Ellen Monk , Bret wagner "Concepts in Enterprise Resource planning" Third Edition Course Technology.
2. R.Radha Krishnan " Business Process Reengineering PHI , New Delhi.
3. Garg V. K. and Venkatakrishna N. K., "Enterprise Resource Planning: Concepts and Practices", PHI, New Delhi.
4. Sadagopan S., "Enterprise Resource Planning: A Managerial Perspective", Tata McGraw Hill, New Delhi.
5. Pauline Weetman, "Financial and Management Accounting: An Introduction", Pearson Education Limited.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPME701**	Course Title: **Design for Additive Manufacturing**	
L-T-P:**3-0-0**	Credits: **4**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Overview of Design for Additive Manufacturing (AM): How to design for AM? Challenges & opportunities, Design process, mechanical properties, performance of materials used in AM, process driven & designer driven shape, methods, Additive manufacturing principles & processes.

Drivers for AM: Material efficiency, flow optimization, integration of functions, mass customization, lead time, automated manufacturing, Limitations, Available material, accuracy of the technology, price of the industrial machines, certification of materials and processes, surface finish(supports, post processing), part dimensions.

DFMA Principles for AM: Maximum Part size, Faces requiring support, minimum wall thickness & rigidity, Minimum feature size & manufacturing quality, Typical geometries, DFX rules for additive manufacturing. cost considerations**.**

Topology Optimization for AM: Introduction to topology optimization, Topology optimization process, characteristics, link with AM potentials & Challenges, Current developments.

Accuracy Issues in AM: Properties of metallic and nonmetallic additive manufactured surfaces, Stress induced in additive manufacturing (AM) processes. Surface roughness problem in rapid prototyping, Part deposition orientation and issues like accuracy, surface finish, build time, support structure, cost etc

References:

1. Ian Gibson, David W. Rosen, Brent Stucker, "Additive manufacturing technologies: rapid prototyping to direct digital manufacturing", Springer, 2010.

2. Andreas Gebhardt, "Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing", Hanser Publishers, 2011.

3. Christoph Klahn, Bastian Leutenecker, Mirko Meboldt, "Design for Additive Manufacturing – Supporting the Substitution of Components in Series Products", Procedia CIRP 21 2014, 24th CIRP design conference

4. Rosen, D.W., 2007. "Design for additive manufacturing: A method to explore unexplored regions of the design space". In Proceedings of the 18th Annual Solid Freeform Fabrication Symposium.

I Sem M.Tech. (Production Management)

Curriculum Content

Course Code: **18EPME703**	Course Title: **Supply Chain Management**
L-T-P:**3-0-0**	Credits: **4**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Supply Chain Concepts: Introduction to Supply Chain, SCOR model, Virtual/Extended Enterprise, Delivery Channel, Objective of a Supply Chain, Decision Phases in a Supply Chain, Production Approaches, Supply Chain Process, Push & Pull Production Systems, Push-Pull Boundary, Lack of Coordination and Bullwhip Effect, Order Management, Order-to-Cash Process, Procure-to-Pay Process, Call-off, Replenishment, Sourcing

Supply Chain Performance: Supply Chain Strategies, Value Chain, Capabilities, Uncertainties, Responsiveness vs Cost, Supply Chain Performance Drivers – Facilities, Inventory, Transportation, Information, Sourcing, and Pricing, Supply Chain Visibility, Resilience, Non-Financial Metrics Examples, Financial Metrics Examples, Sustainability

Designing Distribution Network: Introduction, Factors Influencing Distribution Network Design, Design Options for a Distribution Network, Distribution Network for Online Sales, Impact of Online Sales on Cost

Network Design: Introduction, Factors Influencing Network Design Decisions, Framework for Network Design Decisions, Facility Location Mathematical Models, Capacity Allocation Mathematical Models, Network Behavior, Types of Supply Relationship, Factors influencing Nature of Network Relationship, Vertical Integration

Demand Management and Forecast: House of SCM, Managing Demand, Managing Supply, Transportation Model, Just-in-Time in Supply Chain, Forecasting in Supply Chain, Characteristics of Forecasts, Approaches to Demand Forecasting

Inventory Management: Cycle Inventory, Cycle Inventory Related Costs, Economics of Scales, Economic Order Quantity, Multiechelon Cycle Inventory, Uncertainty and Safety Inventory, Safety Inventory Level

Logistic and Warehouse Management: Transportation in Supply Chain, Modes of Transportation, Transportation Network, Trade-offs in Transportation Design, Warehouse Layout and Design, Warehouse Types, Warehouse Operating Processes, Warehouse Management System, Procurement, Material Classification, Material Codification

Trends in SCM: Gartner's Hype Cycle, Capgemini's Consulting Hype Cycle, Trend Categories, Algorithmic Supply Chain Planning, Predictive Analytics, Global Logistics Visibility, Focus on Risk Management and Supply Chain Resiliency

References:

1. Sunil Chopra, and Peter Meindl, "Supply Chain Management – Strategy, Planning, and Operation," Pearson Education.

2. APICS, "Operations Management Body of Knowledge Framework."

3. Lora Cecere, "Supply Chain Metrics that Matter," Wiley.

4. Hartmut Stadtler, "Supply chain management and advanced planning – basics, overview and challenges," European Journal of Operations Research, 163, 2015.

5. Keely L. Croxton, Sebastián J. García-Dastugue and Douglas M. Lambert, "The Supply Chain Management Processes," The International Journal of Logistic Management.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPMP701**	Course Title: **Collaborative Design - Modeling Lab**	
L-T-P**: 0-0-5**	Credits: **5**	Contact Hrs: **10 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Practical Hrs: **120 hrs**		Exam Duration: **2 hrs**

User Interface Platform:

Understand the user interface, Connect to the PLM platform, Access your Dashboard, Use the Tags for searching content, Share various documents with other users through, 3DSpace, Use standard menus and commands, Import new data and export to required file formats, Search for a 3D data using different methods, Explore and open 3D data, Manipulate the tree, Filter data

Sketcher: Exercises on sketch tools, profile tool bar and constraint tool bar.

Part Design: Exercise on 3D models using pad, slot, shaft, groove, hole, rib and stiffener commands, cut revolve etc.

Generative Shape Design (GSD): Exercises using GSD to generate complicate surfaces using sub tool bars

Sheet Metal: Setting sheet metal parameters, bend extremities tab, creating the base wall, creating the wall on edge, creating extrusions etc.

Assembly Design: Assembly design work bench Bottom-Up and Top-Down assembly approaches invoking existing components into assembly work exercise to demonstrate Top-Down assembly approach.

Drafting: Converting existing 3D models into 2D drawings with all relevant details, sectional views etc.

Data Exchange and Collaborative Lifecycle:

Import and export different file formats, manage the Mastership of imported objects, Create a new product structure, Use different sections of the Action bar effectively, Manage the changes in a product structure, Save the product structure in the database

Design Review:

Create a design review, add markups to it, Create slides, and add markers, Create sections and measures, Export sections and measures, compare 3D Objects and 2D Drawings

References

Companion Courses – https://companion.3ds.com/

I Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMP702**   Course Title: **PLM Functional Lab**
L-T-P**: 0-0-3**   Credits: **3**   Contact Hrs: **6 hrs/week**
ISA Marks: **80**   ESA Marks: **20**   Total Marks: **100**
Practical Hrs: **72hrs**   Exam Duration: **2 hrs**

Collaboration and Approvals:

Illustrate the structure of PLM Business Process Services, Create and manage your folders, Create workflows, Identify and manage your assigned tasks, Subscribe to various objects and events, Report and resolve issues in objects, Create, track and organize your documents

IP Classification:

Need of IP Classification, Create different types of libraries and their related hierarchies, Create and manage documents and parts, classify the library objects based on their features, Use the Classification functionality

Engineering Bill of Material:

Create parts and specifications, Create and edit Bill of Materials, Create a Change Request to make the changes in a part or a specification, Complete Change Orders and Change Actions to implement the changes, Review and release the parts

Project Management Fundamentals:

Create programs and projects, Assign members to a project, Add tasks and assign project members to the tasks, Create folders for managing project documents, Create process flow for tasks, Review the status of programs and projects, Exchange and view projects data using Microsoft Project Integration

Project Management Advanced:

Document the various risk areas of a project and track them, Create and manage the resource requirements for a project, Create budgets and benefits to monitor the financials of a project, Track the time spent on a project using time sheets, Create calendars for the projects, Identify the quality factors of a project and monitor them, Create an assessment to measure the project's health, Use dashboards to monitor the status of your projects

Project Execution:

Manage the project schedule, Record risks for tasks, Create and submit timesheets

References

1. Companion Courses – https://companion.3ds.com/
2. Antti Saakasvuori, Anselmi Immonen, "Product Lifecycle Management" - Springer, 1st Edition, 2003.

I Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPMP703**	Course Title: **ERP Functional Lab**
L-T-P**: 0-0-3** Credits: **3**	Contact Hrs: **6hrs/week**
ISA Marks: **80** ESA Marks: **20**	Total Marks: **100**
Practical Hrs: **72 hrs**	Exam Duration: **2 hrs**

Selection Criteria for ERP Packages: Survey of Indian ERP Packages

Financial Accounting: Basic Finance – Chart of accounts, Journal entries, Journal vouchers, Exchange rates; Banking (In and Out); Debit and Credit note

Master Data Management: Item master; Business partner master – Customer, vendor; Pricing; Tax

Supply chain Management

Sales: Sales quotation, Sales order, Delivery, Return, Invoice (A/R)

Purchase: Purchase quotation, Purchase order, Return, GRN, Invoice (A/P)
Production: Assembly BOM, Production order, Goods issue, Goods receipt

Reports: Generation of reports for various functions

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC705**	Course Title: **PLM Advanced**
L-T-P**: 2-0-0** Credits: **2**	Contact Hrs: **2 hrs/week**
ISA Marks: **50** ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **30 hrs**	Exam Duration: **3 hrs**

Deployment of the PLM System: Different stages of deployment, Leading a PLM Project, Understanding the need for change, PLM maturity model, Choosing a system, Realization stage of the project, Start up, Steering group, Project manager, Accomplishing change in the organization.

Challenges of Product Management in Manufacturing Industry: Life cycle thinking, value added services and after sales traceability, Special challenges of product management in the high tech industry, Case studies.

Service Industry and PLM: Introduction, Categorizing services, Rational for building service products, PLM in service business, PLM challenges in service business, Case studies.

Role of product Information Management in Collaborative Business Development: CIM, Concurrent Engineering, Product lifecycle management as an enabler of cooperation between companies, Contents of collaboration, Successful cooperation, Tools of collaboration.

Product and Product Management Strategy: PLM as a business strategy tool, Making a product strategy, Product management strategy, Time to market, Time to react, Time to volume, Time to service.

References:

1. Stark John, "Product Lifecycle Management: 21st Century Paradigm for Product Realization", Springer, Third Edition, 2015

2. Antti Saakasvuori, Anselmi Immonen, "Product Lifecycle Management" - Springer, 1st Edition, 2003.

3. Grieves Michael, "Product Lifecycle Management - Driving the Next generation of LeanThinking" , McGraw-Hill, 2006.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC706**		Course Title: **Enterprise Resource Planning-II**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

ERP implementation Basics: Master Data Management – Item Master, Vendor Master, COA, Customer Master, Machine Master, etc. Vendors- Role of Vendor; Consultants: Types of consultants; Role of a Consultant, Employees; Role of employees; Resistance by employees; Dealing with employee resistance, Role of Top Management, Role of Implementation Partner

ERP –Functional modules: Functional modules of ERP software, integration of supply chain and customer relationship application.

ERP implementation Life cycle: Objectives of ERP implementation, Different phases of ERP implementation. Consultants, vendor and employees

ERP Projects: Project types, Implementation methodology, Project Preparation, Business Blueprinting, Gap Analysis, Realization, Final Preparation, Go Live and Support, User Training

ERP Post Implementation: Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors and ERP Implementation - Case studies.

ERP and e-Business: Introduction ERP and e-business process model, components of e-Business supply chain ERP/ e-business integration ERP to ERP II –Bringing ERP to the Entire Enterprise

Future Directions in ERP: Faster Implementation Methodologies; Business Modules and BAPIs; Convergence on Windows NT; Application Platform; New Business Segments; More Features; Web Enabling; Market Snapshot.

Other Related Technologies of SCM: Relation to ERP; E-Procurement; E-Logistics; Internet Auctions; E-markets; Electronic Business Process Optimization; Business Objects in SCM; E commerce

Case Studies: ERP case studies in HRM, Finance, Production, Product Database, Materials, Sales & Distribution

References:

1. Leon Alexis, "Enterprise Resource Planning", Tata McGraw Hill, New Delhi.
2. Garg V. K. and Venkatakrishna N. K., "Enterprise Resource Planning: Concepts and Practices", PHI, New Delhi.
3. Sadagopan S., "Enterprise Resource Planning: A Managerial Perspective", Tata McGraw Hill, New Delhi.
4. Brady, "Enterprise Resource Planning", Thomson Learning.

III Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC707**		Course Title: **Project Feasibility and Analysis**
L-T-P**: 3-1-0**	Credits: **4**	Contact Hrs: **5 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **50 hrs**		Exam Duration: **3 hrs**

Planning Overview: Capital budgeting and Allocation, Strategic planning.

Market and Demand Analysis: Situational analysis, Demand forecasting and Uncertainties in demand forecasting.

Technical Analysis: Material inputs and utilities, Product mix, Plant capacity and Location, Environmental aspects, Project charts and layouts.

Financial Estimates and Projections: Means of finance, Estimates of sales and production, Working capital requirement and its financing, Profitability projections, projected cash flow statements. Project risk analysis: Sources, Measures and Perspectives on risks, Sensitivity analysis, Scenario analysis, Break-even analysis, Simulation analysis, Decision tree analysis, managing risk.

Sustainability in Project Management: Inter-relating life cycles, The impact of sustainability on project management processes, Measuring and reporting projects

References:

1. Prasanna Chandra, "Projects: Planning, Analysis, Financing, Implementation and Review", Tata McGraw-Hill Publishing Company Limited, New Delhi.

2. Nicholas J. M. and Steyn H. "Project Management for Business, Engineering and Technology: Principles and Practice", Elsevier.

3. Harold R. Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", Wiley, New York.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **17EPME705**	Course Title: **Manufacturing Systems and Automation**

L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Introduction: Production system facilities, Manufacturing support systems, Automation in production system, Automation principles and strategies, Manufacturing operations, Basic elements of an automated system, Advanced automation functions, Levels of automation.

Material handling and identification technology: Considerations in material handling system design, 10 principles of material handling, Automated guided vehicle systems, Conveyor systems, Analysis of material transport system, Automated storage systems, Engineering analysis of storage system. Components of manufacturing systems, Single station automated cells, Applications and analysis of single station cells.

Flexible manufacturing systems: FMS components, FMS application and benefits, Quantitative analysis of flexible manufacturing systems.

Industrial control systems: Sensors, Actuators, Drives and other control system components. Electro-hydraulic and Electro-pneumatics in manufacturing automations

Machine vision systems: Importance of machine vision system in manufacturing automation.

Role of microcontrollers in manufacturing automation system: Microcontroller architecture, interfacing sensors and actuators with microcontroller for industrial automation, Microcontroller programming.

PLCs in manufacturing automation: Application of programmable logic controllers in manufacturing automation, PLC basic and advanced ladder logic programming using RsLogix and CoDeSys format, Usage of timers, counters, sequencing, and interlocking, latching, master control relay for developing programs for manufacturing automation. Temperature control, valve sequencing, conveyor belt control, control of a process etc

SCADA for Automation: Elements of SCADA, Benefits of SCADA, Applications, Types of SCADA systems, Features and functions of SCADA, Building applications using SCADA for manufacturing automation.

References:

1. Grover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education Asia.

2. Grover M.P., Weiss M. M., Nagel R.N. and Odrey N.G., "Industrial Robotics, Technology, Programming and Applications", Mc Graw Hill Book Publications.

3. Krishna Kant, "Computer Based Industrial Control" PHI.

4. W. Bolton , "Programmable Logic Controllers" Fifth Edition, Elsevier

5. Vijay R. Jadhav, "Programmable Logic Controller", Second Edition, Khanna Publishers.

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPME706**		Course Title: **Robust Design Optimization**
L-T-P**: 3-0-0**	Credits: **3**	Contact Hrs: **3 hrs/week**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: **40 hrs**		Exam Duration: **3 hrs**

Robust Design Overview: Taguchi's approach to quality and quality loss function, noise factors and average quality loss, exploiting non linearity, classification of parameters

Analysis of variance: No-Way ANOVA, One-Way ANOVA, Two-Way ANOVA and Three-Way ANOVA

Two Level Experiments: Two factor factorial design, model adequacy checking and estimating model parameters, 2^2 full factorial design, 2^3 full factorial design, 2^k full factorial design and Two level fractional factorial design, General 2^{k-p} fractional factorial design.

Steps in Robust Design: Identification of process and its main function, Noise factors and testing conditions, Control factors and their levels, Matrix experiment and data analysis plan, Conducting the experiment and data analysis, Verifying experiment and future plan.

Signal to Noise Ratios: Comparison of the quality of two process conditions, Relationship between Signal to Noise Ratio and quality loss after adjustment, Identification of a scaling factor, Signal to Noise Ratios for static problems, Signal to Noise Ratios for dynamic problems, Analysis of ordered categorical data.

Taguchi Inner and Outer arrays: Orthogonal arrays and fractional factorial designs, Parameter design and tolerance design, Analysis of inner/outer array experiment, Alternative inner/outer orthogonal array experiments.

Constructing orthogonal arrays: Dummy level technique, Compound factor method, Linear graphs and Interaction assignment, Modification of linear graphs, Column merging method, Branching design.

References:

1. Montgomery, D. C., "Design and Analysis of Experiments", John Wiley & Sons.

2. Khuri A. I. and Cornell J. A. "Response Surfaces: Designs and Analyses, Marcel Dekker, Inc., New York.

3. Myers R. H., Montogomery, D. C. and Anderson-Cook C. M. "Response Surface Methodology: Process and Product Optimization Using Designed Experiments", John Wiley & sons, Inc., New York.

4. Mason R. L., Gunst, R. F., Hess J. L., "Statistical design and Analysis of Experiments With Applications to Engineering and SISAnce", John Wiley & sons, Inc., New York.

5. Phadke M. S., "Quality Engineering using Robust Design", Prentice Hall PTR Englewood Cliffs, New Jersy.

6. Ross P. J., "Taguchi Techniques for Quality Engineering", McGraw -Hill International.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMP704**   Course Title: **Product Automation Lab**
L-T-P**: 0-0-4**   Credits: **4**   Contact Hrs: **8 hrs/week**
ISA Marks: **80**   ESA Marks: **20**   Total Marks: **100**
Practical Hrs: **96 hrs**   Exam Duration: **2 hrs**

Knowledge Based Engineering:

- Customize the tree to display knowledge ware features
- Create parametric models
- Embed design knowledge in the models
- Automate the design and modification processes
- Create design configurations using design tables

HTML:
Tags, Attributes and Elements, Links, Images, Tables, Forms
CSS: CSS basics, styles, CSS syntax

JavaScript:
JavaScript Output,   JavaScript Statements,   JavaScript Syntax,   JavaScript Variables,
JavaScript Operators,   JavaScript Arithmetic,   JavaScript Strings,   JavaScript Events,
JavaScript Loop, JavaScript Objects, JavaScript functions.

Python:
Python programming skills using data structures and constructs, python programming
skills using functions and packages.

References:

Companion Courses – https://companion.3ds.com/

II Sem M.Tech. (Production Management)
Curriculum Content

Course Code: **18EPMP705**	Course Title: **PLM Technical Lab**
L-T-P**: 0-0-3** Credits: **4**	Contact Hrs: **6 hrs/week**
ISA Marks: **80** ESA Marks: **20**	Total Marks: **100**
Lab Hrs: **72 hrs**	Exam Duration: **2 hrs**

Variant Management Essentials & Product Architect:

Create the product structure, Define product portfolios based on product roadmaps, Create and manage product configurations and design variants, Use Enterprise Changes to track and release features, Generate BOMs

Traceable Requirements Management Essentials:

Capture requirements from MS Word and MS Excel documents, Create requirements and requirement specifications, Allocate requirements to products and models, Create test cases and use cases, Create revision and multiple versions of requirements, Generate traceability reports

Platform Management and Baseline Behavior:

Create collaborative spaces and users, Assign required access rights to different users, Explore the Control widget and its related features, Configure PLM platform to add additional features as per requirements

Data Model Customization Essentials:

Describe Unified Typing concepts, Create Subtypes and add attributes to it, Create Specialization, Customer and Deployment Extensions, Create Unique Keys, Create Specialization and Deployment Packages

Web Based Customization:

Use MQL to set up the schema, Create and maintain a web application based on UI configurable components, Configure automatic business rules (triggers, notifications) and automatic object naming, Execute advanced MQL commands needed for administration, Extend the application with JSP

References

1. Companion Courses – https://companion.3ds.com/
2. Stark John, "Product Lifecycle Management: 21st Century Paradigm for Product Realization", Springer, Third Edition, 2015
3. Antti Saakasvuori, Anselmi Immonen, "Product Lifecycle Management" - Springer, 1st Edition, 2003.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMP706**		Course Title: **ERP Technical Lab**
L-T-P**: 0-0-3**	Credits: **3**	Contact Hrs: **6 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Practical Hrs: **72 hrs**		Exam Duration: **2 hrs**

Financial Accounting (Advanced): Fixed assets, Budget, Cost center accounting

MRP: Sales forecast, MRP run, Order recommendation

Admin and Technical: Application installation (APP and DB), System initialization, Set-up, Technical Enhancement – UI, Report – Query generation, Crystal report, Print layout design, Basics of Integration

Reports: Generation of reports for various functions

III Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC801**   Course Title: **Manufacturing Execution Systems**

L-T-P**: 3-1-0**   Credits: **4**   Contact Hrs: **5 hrs/week**

ISA Marks: **50**   ESA Marks: **50**   Total Marks: **100**

Teaching Hrs: **50 hrs**   Exam Duration: **3 hrs**

Enterprise and Enterprise Integration: Enterprise and its characteristics, Strategic Planning, Feedback Loops, Time Definitions, Business Processes, Manufacturing Processes, Enterprise Integration, Horizontal Integration and Interoperability, Vertical Integration and Temporal Gap, Digitalization, Standards (ISO 15704)

Manufacturing Execution Systems and its Functionalities: Manufacturing Execution Systems (MES), MES Functionalities, MES Models, Manufacturing Operations Management (MOM), Functional Control Model, MES in Discrete Industry, MES in Process Industry, Standards (IEC 62264, IEC 61512, VDI 5600)

Process and Data Modeling: Enterprise Modeling, Process Modeling, Business Process Modeling Language (BPMN), Sankey Diagram, Entity-Relationship Diagrams, ARIS (ARchitecture for integrated Information Systems), Integrated Definition for Function Modelling (IDEF), Event-Driven Process Chain (EPC), Data Modeling, Data Flow Diagrams (DFDs), Unified Modeling Language (UML), Business to Manufacturing Markup Language (B2MML)

Data Collection: Process Analysis, Process Modeling, Data Modeling, Data Flow Diagrams (DFDs), Communication Patterns, Technologies, OPC (OLE for Process Control)

Traceability And Tracking: Tracing, Traceability, Enterprise Entities, Forward and Backward Traceability, Traceability Granularity, Tracking, Tracking Approaches, Regulations (GMP, US FDA, EudraLex)

PERFORMANCE MEASUREMENT: Performance Measurement, Performance Management, Performance Measurement System and Characteristics, Key Performance Indicators (KPIs), Overall Equipment Effectiveness (OEE), Metrics Maturity Model, KPI Effectiveness, Process Improvement, Standards (ISO 22400, VDMA 66412)

Managerial Accounting: Managerial Accounting, Cost Assignment Techniques, Cost Hierarchal Levels, Activity Drivers, Standard Cost, Actual Cost, Job Costing, Process Costing, Activity-Based Costing (ABC), Time-Driven ABC (TDABC), Resource Consumption Accounting (RCA), Cost of Poor Quality (COPQ)

Real-Time Enterprise: Real-Time Enterprise (RTE), Event-Driven Architecture (EDA), Events, Complex Event Processing (CEP)

Industry 4.0: Industry 4.0, Challenges, Industrial Internet of Things (IIoT), Reference Architecture for Industry 4.0, Cyber-Physical Systems (CPS), Cyber-Physical Production Systems (CPPS), Smart Product, Smart Manufacturing, Smart Logistics, Smart Services

Business Analytics and Business Intelligence, Blockchain: Knowledge Management, Case-Based Reasoning (CBR), Big Data, Decision Analytics, Descriptive Analytics, Predictive Analytics, Prescriptive Analytics, Bitcoin and Blockchain, Merkle Tree, Blockchain Types, Scope and Application of Blockchain in Manufacturing

References:

1. Sachin Karadgi, "A Reference Architecture for Real-Time Performance Measurement," Springer, 2014.

2. Opher Etzion, Peter Niblett, "Event Processing in Action," Manning, 2011.

3. Roger Wattenhofer, "The Science of the Blockchain," CreateSpace Independent Publishing Platform, 2016.

4. Bruce Silver, "BPMN Method and Style - With BPMN Implementer's Guide," Cody-Cassidy Press, 2011.

5. Charles T. Horngren, George Foster, Srikant M. Datar, Madhav V. Rajan, Chris Ittner, "Cost Accounting: A Managerial Emphasis," Prentice Hall, 13th Edition, 2008.

6. Wood C. Douglas (Editor), "Principles of Quality Costs: Financial Measures for Strategic Implementation of Quality Management," ASQ, 4th Edition, 2013.

7. Gary Cokins, "Activity-Based Cost Management: An Executive's Guide," Wiley, 2001.

8. Robert S. Kaplan, Robin Cooper, "Cost & Effect: Using Integrated Cost Systems to Drive Profitability and Performance," Harvard Business Review Press, 3rd edition, 1997.

9. ISO 15704: Industrial Automation Systems—Requirements for Enterprise-Reference Architectures and Methodologies, 2000.

10. IEC 62264: Enterprise-Control System Integration. Multi—part standard.

11. IEC 61512: Batch Control. Multi—part standard.

12. ISO 22400–2: Automation Systems and Integration—Key Performance Indicators for Manufacturing Operations Management, Multi—part standard.

13. VDI 5600 Part 1: Manufacturing execution systems (MES), 2007.

14. OPC Foundation: OPC unified architecture specification part 1: overview and concepts, http://www.opcfoundation.org/.

15. MESA, MES Explained: A high level vision, white paper number 6, 1997.GMP

16. WHO Good Practices for Pharmaceutical Quality Control Laboratories, WHO Technical Report Series, No. 957, 2010.

17. Mike Bourne, Pippa Bourne, Handbook of Corporate Performance Management, Wiley, 2011.

III Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **18EPMC802**   Course Title: **Manufacturing Systems Simulation**
L-T-P: **3-0-1**   Credits: **4**   Contact Hrs: **5 hrs/week**
ISA Marks: **50**   ESA Marks: **50**   Total Marks: **100**
Teaching Hrs: **50 hrs**   Exam Duration: **3 hrs**

Principles of Modeling & Simulation: Basic Simulation Modeling, Systems – discrete and continuous systems, general systems theory, models of systems- variety of modeling approach, concept of simulation, simulation as a decision making tool, types of simulation, Principle of computer modeling- Monte Carlo simulation, Nature of computer modeling, limitations of simulation, area of application.

Random Number Generation: Random variables and their properties, Properties of random numbers, generation of Pseudo random numbers, techniques for generating random numbers, Various tests for random numbers-frequency test and test for Autocorrelation,

Random Variate Generation: Different techniques to generate random Variate: Inverse transform technique,-exponential, Normal, uniform, Weibull, direct transformation technique for normal and log normal distribution, convolution method and acceptance rejection techniques-Poisson distribution, **Statistical Techniques:** Comparison of two system designs, Comparison of several system designs – Bonferroni approaches to multiple comparisons for selecting best fit, for screening

Design and Evaluation of Simulation Experiments: Problem formulation, data collection and reduction , time flow mechanism, key variables, logic flow charts, starting condition, run size, experimental design consideration, output analysis, verification and validation of simulation models. **Simulation Languages:** Comparison and selection of simulation languages, study of any one simulation language.

Discrete Event Simulation: Concepts in discrete –event simulation, development of simulation models for queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network, Programming for discrete event simulation, Case studies.

References:
1. Jerry Banks and John S Carson, Barry L Nelson, David M Nicol, "Discrete event system simulation", Prentice Hall, India.
2. Khoshnevi. B., "Discrete system simulation", McGraw Hill International.
3. Ronald G Askin and Charles R Standridge , "Modeling and analysis of manufacturing systems", John Wiley & Sons.
4. Gordon G , "System Simulation", Prentice Hall, India..
5. Thomas J Schriber., "Simulation using GPSS", John Wiley & Sons.
6. Shannon, R.E., "System Simulation – The art and science", Prentice Hall, India.
7. Averill Law & David M.Kelton , "Simulation, Modeling and Analysis", TMH.

II Sem M. Tech. (Production Management)
Curriculum Content

Course Code: **19EPMW701**		Course Title: **Mini Project**
L-T-P**: 0-0-3**	Credits: **3**	Contact Hrs: **6 hrs/week**
ISA Marks: **80**	ESA Marks: **20**	Total Marks: **100**
Teaching Hrs: **72 hrs**		Exam Duration: **2 hrs**

Mini Project: The Guide shall define the problem statement for the Project work. The student shall execute the Project within three months duration during the 2nd semester. The student who has opted Mini Project shall opt either ERP or PLM theme to carry out their work.