NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF PRODUCTION ENGINEERING

Curriculum and Syllabus

With effect from July 2020

M.Tech. Industrial Engineering & Management

Curriculum Structure

M.Tech. (Industrial Engineering & Management) *Min. Total Credits required: 69*

CODE	Semester 1	L	T	P	C	CODE	Semester 2	L	T	P	C
PR651	Data Analytics	3	1	0	4	PR654	Advanced Operations Research	2	1	0	3
PR652	Industrial Engineering and Productivity Management	3	0	0	3	PR655	Modeling ,Simulation and Analysis	2	1	0	3
PR653	Analysis and Control of Manufacturing Systems	3	0	0	3	PR656	Supply Chain Management	3	0	0	3
------	**Elective I**	3	0	0	3	------	**Elective IV**	2	1	0	3
------	**Elective II**	3	0	0	3	------	**Elective V**	3	0	0	3
------	**Elective III**	3	0	0	3	------	**Elective VI**	3	0	0	3
PR 657	Data Analytics Lab	0	0	3	2	PR659	Simulation Lab	0	0	3	2
PR 658	Operations Management Lab.	0	0	3	2	PR660	Supply Chain Management Lab.	0	0	3	2
	TOTAL	**17**	**2**	**6**	**23**		**TOTAL**	**17**	**1**	**6**	**22**

CODE	Semester 3	L	T	P	C	CODE	Semester 4	L	T	P	C
PR689	Project Work-Phase I	**0**	**0**	**24**	**12**	PR690	Project Work-Phase II	**0**	**0**	**24**	**12**

LIST OF ELECTIVES

CODE	INDUSTRIAL ENGINEERING STREAM	L	T	P	C	CODE	MANAGEMENT STREAM	L	T	P	C
PR661	Industrial Engineering Economic Analysis	3	0	0	3	PR674	Project Management	3	0	0	3
PR662	Intelligent Manufacturing Systems	3	0	0	3	PR675	Financial Management	3	0	0	3
PR663	Research Methodology	3	0	0	3	PR676	Marketing Management	3	0	0	3
PR664	Design and Analysis of Experiments	3	0	0	3	PR677	Total Quality Management & Six Sigma	3	0	0	3
PR665	Lean and Agile Manufacturing	3	0	0	3	PR678	Human Resource Management	3	0	0	3
PR666	Facilities Planning and Design	3	0	0	3	PR679	Product Life Cycle Management	3	0	0	3
PR667	Production Management Systems	3	0	0	3	PR680	Technology Management	3	0	0	3
PR668	Industry 4.0 and Cloud Manufacturing	3	0	0	3	PR681	Advanced optimization techniques	3	0	0	3
PR669	Work Design and Ergonomics	3	0	0	3	PR682	Product Design and Development	3	0	0	3
PR670	Sustainable Manufacturing	3	0	0	3	PR683	E-waste Assessment and Management	3	0	0	3
PR671	Quality & Reliability Engineering	3	0	0	3		**INDUSTRIAL INFORMATION SYSTEM STREAM**	**L**	**T**	**P**	**C**
PR672	Value Engineering	3	0	0	3	PR684	Enterprise Resource Planning	3	0	0	3
PR673	Cost Measurement and Productivity Measurement	3	0	0	3	PR685	Decision Support Systems	3	0	0	3
						PR686	Knowledge Management	3	0	0	3
						PR687	Multi-Criteria Decision Making Techniques	3	0	0	3
						PR688	Intelligent Industrial Systems	3	0	0	3

PR651 **Data Analytics**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To realize the importance of data analytics.
- To gain competence on data analytics packages.
- To explore industrial applications of data analytics methodologies.

Introduction to Multivariate Statistics-Degree of Relationship among Variables-Review of Univariate and Bivariate Statistics-Screening Data Prior to Analysis-Missing Data, Outliers, Normality, Linearity, and Homoscedasticity.

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

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

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

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

REFERENCES:

1. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. “Multivariate data analysis”, (7thedition). Pearson India.2015
2. Tabachnick, B. G., &Fidell, L. S., “Using multivariate statistics”, (5thedition). Pearson Prentice Hall,2001
3. Gujarati, D. N. , “Basic econometrics”, Tata McGraw-Hill Education,2012
4. Malhotra, N. K., “ Marketing research: An applied orientation”, 5/e. Pearson EducationIndia, 2008
5. Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. “ Applied multiple regression/correlation analysis for the behavioral sciences”, Routledge.,2013
6. Han, J., Kamber, M., & Pei, J. “Data mining: concepts and techniques: concepts and techniques”, Elsevier,2011

7. Anil Mahershwari , Data Analytics, McGraw Hill Education; First edition (1 July 2017)

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓	✓					
CO2	✓	✓	✓	✓	✓	✓	✓		✓		✓
CO3	✓	✓	✓	✓	✓	✓	✓		✓		✓

PR652 Industrial Engineering and Productivity Management

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. Students will gain sound knowledge on the need to increase productivity with techniques that eliminate waste, efficient operations, and effective resource utilization.
2. Students will learn methods and tools for improving operations and controlling the production costs and enhancing quality.

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

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

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

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

Systems Engineering: Introduction to Systems Engineering, Management Information System, Phases in System Engineering, System Life Cycle, System Maintenance.

REFERENCES:

1. Prokopenko, J. "Productivity Management, A Practical Handbook", International LabourOrganisation, 1992.
2. ILO, "Introduction to Work Study", George Kanawaty, 4th revised edition, Universal Book Corporation 2007.
3. Apple, J.M. "Plant layout and materials handling", Ronald Press Company, Newyork, 1977.
4. Tutty Herald G, "Compendium on Value Engineering", Indo-American Society, 1983.
5. Andrew P Sage & James E Armstrong, "Introduction to Systems Engineering", Wiley series (2000).

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								
CO2					✓						
CO3							✓				

PR653 Analysis and Control of Manufacturing Systems

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To enable the students to understand the production and operations function and its subsystem.
- To study the manufacturing planning and control activities in the organization.
- To study the production control concepts, strategies, policies in organization.

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

Inventory costs – Types of systems – Policies – Analysis & static models

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

MRP concepts – Problems – Lot sizing – Techniques

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

REFERENCES:

1. Elsayed A. Elsayed and Thomas O. Boucher, “Analysis and Control of Production Systems”,Prentice Hall, 1994.
2. Monks J.G., “Operations Management”, John Wiley, 1992.
3. Buffa.E.S. and Sarin, R.K., “Modern production /Operations Management”, John Wiley & Sons, 1994.
4. Panneerselvam.R. “Production and Operations Management”, PHI, 2005.
5. Chary S.N., “Production and Operations Management”, McGraw Hill Education (India) Private Limited, 2013.

COURSE OUTCOMES:

1. The students will be able to understand importance of production management and its concepts.
2. The various models of sub systems will be known to them.
3. Will be able to solve industrial problems involved in inventory, MRP and scheduling.

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓		✓			✓	✓	✓	✓	
CO2	✓	✓		✓			✓	✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓			✓

PR654 **Advanced Operations Research**

L	T	P	C
2	1	0	3

COURSE OBJECTIVES:

- To understand Linear programming, Dynamic programming & Non-linear programming techniques.
- To make use of duality and sensitivity analysis for real time applications.
- To analyse network models and crashing of various project networks.

Linear programming- Simplex method – Big M method – Two phase method –Dual simplex method – Problems in all the above methods.

Duality analysis, sensitivity analysis-Changes in right- hand side constants of constraints- changes in objective function co-efficient-adding a new constraint-adding a new variable. Integer programming algorithm - Cutting plane algorithm- Branch and Bound technique – Problems.

Deterministic dynamic programming –Recursive nature of computations in dynamic programming - Applications of dynamic programming - Cargo loading model – Work force size model – Equipment replacement model-Inventory model.

Crashing of project network – Problems. Network models - Shortest path model – Systematic Method; Dijkstra's Algorithm; Floyd's Algorithm – Minimum Spanning Tree Problem – PRIM Algorithm; Kruskal's Algorithm; Maximal flow problem.

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

REFERENCES:

1. Handy M.Taha, "Operations Research, an introduction", 7th edition, PHI, 2003.
2. Don T.Phillips, A.Ravindran& James Solberg, Operations Research: Principles and practice, John Wiley, India, 2006.
3. G.Srinivasan , "Operations Research Principles and Applications" ,PHI 2008
4. Panneerselvam, R, "Operations Research", Prentice – Hall of India, New Delhi,2002

COURSE OUTCOMES:

1. To understand the various Linear programming methods.
2. To know about duality analysis, sensitivity analysis and integer programming problems with examples.
3. To understand different dynamic programming concepts and its applications.
4. To solve various network models including crashing of project networks.
5. The basics of non-linear programming techniques.

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓				✓				
CO2	✓	✓	✓		✓						
CO3	✓	✓	✓		✓				✓		
CO4	✓	✓	✓		✓	✓	✓				✓
CO5	✓	✓	✓		✓		✓		✓		

PR655 **Modelling, Simulation and Analysis**

L	T	P	C
2	1	0	3

COURSE OBJECTIVES:

- Building of Models with logic
- Develop routines to capture uncertainty in systems
- Modelling and Simulation of Discrete Event Systems

Introduction to systems and modelling Discrete and continuous system - Monte Carlo Simulation. Simulation of Single Server Queuing System Simulation of a manufacturing shop Simulation of Inventory System

Random number generation, properties - Generation of Pseudo Random Numbers Tests for Random Numbers

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

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

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

Evaluation Scheme: Term Tests 30 Tutorials and Practical Assignments 20 Final Examination 50 Marks

REFERENCES:

1. Jerry Banks & John S.Carson, Barry L Nelson, “Discrete event system simulation” ,Prentice Hall
2. Law A.M, “Simulation Modelling and Analysis”, Tata Mc Graw Hill
3. NarsinghDeo, “System Simulation with Digital Computer”, Prentice H
4. Geoffrey Jordon, “System Simulation”, Prentice hall India Ltd

COURSE OUTCOMES:

1. Develop manufacturing models of discrete event systems
2. A generation of uncertainty using random numbers and random variates
3. Perform input, output analysis: Verification and validation of models and optimization

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓										
CO2		✓	✓		✓			✓			✓
CO3		✓	✓	✓				✓	✓		✓

PR656 **Supply Chain Management**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To demonstrate operational purchasing methods and techniques on supplier management and supply in specific business contexts.
- To explain the strategic importance of logistic elements and describe how they affect supply chain management.
- To analyze the creation of new value in the supply chain for customers, society and the environment.

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

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

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

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

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

REFERENCES:

1. Sunil Chopra And Peter Meindl, “Supply Chain Management, strategy, planning, and operation”6/e –PHI, second edition, 2014
2. V.V.Sople, “Supply Chain Management, text and cases”, Pearson Education South Asia,2012
3. Janat Shah, “Supply Chain Management, text and cases”, Pearson Education SouthAsia,2009
4. Balkan Cetinkaya, Richard Cuthbertson, Graham Ewer,“Sustainable Supply Chain Management: Practical ideas for moving towards best practice”, Springer, 2011
5. Jeremy F.Shapiro, Thomson Duxbury, “Modeling the Supply Chain”, 2002.

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓	✓	✓				✓
CO2	✓	✓	✓		✓	✓	✓				
CO3	✓	✓	✓		✓	✓	✓				
CO4											
CO5											

PR657 **Data Analytics Lab.**

L	T	P	C
0	0	3	2

COURSE OBJECTIVES:

1. To understand dataanalytics methods
2. To gain competence on data analyticspackages

LIST OF EXERCISES

1. Basic statistics
2. Correlation analysis
3. Regression analysis
4. Testing of Hypothesis (One sample t-test)
5. Testing of Hypothesis (Two sample t-test)
6. Testing of Hypothesis (Paired t-test)
7. Case study on Testing of Hypothesis and ANOVA
8. Analysis of Variance (One-way)
9. Analysis of Variance (Two-way)
10. Cluster Analysis and Life Cycle Assessment using GaBi LCA software

REFERENCES:

1. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. “Multivariate data analysis”, (7thedition). Pearson India. 2015
2. Tabachnick, B. G., &Fidell, L. S., “Using multivariate statistics”, (5thedition). Pearson Prentice Hall, 2001
3. Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. “ Applied multiple regression/correlation analysis for the behavioral sciences”, Routledge., 2013
4. Han, J., Kamber, M., & Pei, J. “Data mining: concepts and techniques: concepts and techniques”, Elsevier, 2011

COURSE OUTCOMES:

1. Exhibit competence on data analytics packages.
2. Apply solution methodologies for case/industrial problems.

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	-	✓	-	✓	-	✓	-	✓
CO2	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓

PR658 **Operations Management Lab.**

L	T	P	C
0	0	3	2

COURSE OBJECTIVES:

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

1. Forecasting Models

2. Linear Programming Problem

3. Transportation Model

4. Inventory Models
5. Scheduling Case studies

6. Material Requirements Planning
7. Project management

8. Facilities layout

9. Ergonomics Study

    a. Performance rating using stop watch
    b. Peg board experiment
    c. Time study trainer
    d. Fitness study using treadmill
    e. Fitness study using ergo cycle

COURSE OUTCOMES:

1. Experience operations management packages like OM Expert, CPLEX, LINDO, GAMS, TORA extra and also to study on the ergonomic aspects of human evaluation.

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓		✓								
CO2		✓			✓						
CO3				✓				✓			

PR659 **Simulation Lab.**

L	T	P	C
0	0	3	2

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

LIST OF EXERCISES

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓		✓								
CO2		✓			✓						
CO3				✓				✓			

PR660 **Supply Chain Management Lab.**

L	T	P	C
0	0	3	2

COURSE OBJECTIVES:

- To gain sound knowledge on creating the Bill of Materials, and model uncertainties to manage the Internal Supply Chain.
- To generate Sales Order, Work Order and generate Gantt Chart & Supply Chain Diagram.
- To forecast demand and plan for replenishment and reorder.

LIST OF EXPERIMENTS:

1. Creating a Base Model.
2. Generate Sales Order and Work Order from the given base model.
3. Modeling for Uncertainties in Resources, Routing and BOM.
4. Modeling for Alternate routing.
5. Modeling for Additional resources.
6. Modeling for Alternate BOM and Alternate Item.
7. Exercise on By-Products.
8. Demand forecasting over a horizon using various forecasting models.
9. Generating Replenishment plan using Demand Forecast.

COURSE OUTCOMES:

1. Define and understand the basic supply chain concepts, Model building and execution of the same.
2. Planning and managing the Internal Supply Chain during uncertainties.
3. Forecast demand using sales history and perform replenishment planningand reordering.

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								
CO2	✓	✓	✓		✓	✓	✓				
CO3	✓	✓	✓		✓	✓	✓				✓

ELECTIVES

INDUSTRIAL ENGINEERING STREAM

PR661 Industrial Engineering Economic Analysis

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To gain sound knowledge on the need to increase productivity with techniques that eliminate waste, efficient operations, and effective resource utilization.
- To learn methods and tools for improving operations and controlling the production costs and enhancing quality.

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

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

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

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

Systems Engineering: Introduction to Systems Engineering, Management Information System, Phases in System Engineering, System Life Cycle, System Maintenance.

REFERENCES:

1. Prokopenko, J. "Productivity Management, A Practical Handbook", International LabourOrganisation, 1992.
2. ILO, "Introduction to Work Study", George Kanawaty, 4th revised edition, Universal Book Corporation 2007.
3. Apple, J.M. "Plant layout and materials handling", Ronald Press Company, Newyork, 1977.
4. Tutty Herald G, "Compendium on Value Engineering", Indo-American Society, 1983.
5. Andrew P Sage & James E Armstrong, "Introduction to Systems Engineering", Wiley series (2000).

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								
CO2					✓						
CO3							✓				

PR662 **Intelligent Manufacturing Systems**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To apply various knowledge based techniques
- To practice diagnosis and trouble shooting
- To adopt intelligent system

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

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

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

Scheduling in manufacturing – scheduling the shop floor – Diagnosis & trouble shooting. The role of Artificial Intelligence in the factory of the future – Intelligent systems.

REFERENCES:

1. Kenneth R.Baker, “Introduction to sequencing and scheduling”, John Wiley & Sons, New York, 2000.
2. Richard W. Conway, William L.Maxwell and Louis W. Miller, “Theory of Scheduling”, Dover Publications, 2003.

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								
CO2	✓			✓							
CO3	✓			✓	✓		✓				

PR663 **Research Methodology**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize participants with basic of research and the research process.
- To enable the participants in conducting research work and formulating research synopsis and report.
- To familiarize participants with Statistical packages such as SPSS etc.
- To impart knowledge for enabling students to develop data analytics skills and meaningful interpretation to the data sets so as to solve the business/Research problem

Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools,data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

Computer and its role in research, Use of statistical software SPSS, GRETL etc. in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

REFERENCES:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

COURSE OUTCOMES:

1. Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
2. Have basic knowledge on qualitative research techniques
3. Have adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis
4. Have basic awareness of data analysis-and hypothesis testing procedures

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓				✓				
CO2		✓			✓						
CO3				✓				✓			
CO4		✓							✓		
CO5	✓		✓							✓	✓

PR664 **Design and Analysis of Experiments**

L	T	P	C
3	0	0	3

PREREQUISITES: Basic probability and statistics concepts

COURSE OBJECTIVES:

To design experiments to a problem situation using traditional experimental designs as well as Taguchi Methods and also to develop skill to conduct experiments and analyze the data to determine the optimal process parameters that optimize the process.

Introduction- Planning of experiments – Steps – Need, Terminology: Factors, levels, variables, experimental error, replication, Randomization, Blocking, Confounding.

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

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

Special Experimental Designs- Blocking and Confounding in 2k design

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

REFERENCES:

1. Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI learning private Ltd., 2012.
2. Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, Eighth edition, 2012.
3. Nicolo Belavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.
4. Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996

COURSE OUTCOMES:

1. Appreciate the advantages and disadvantages of a design for a particular experiment
2. Construct optimal or good designs for a range of practical experiments
3. Describe how the analysis of the data from the experiment should be carried out
4. Apply experimental techniques to practical problems to improve quality of processes / products by optimizing the process / product parameters

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓		✓								
CO2		✓			✓	✓					
CO3				✓				✓			
CO4		✓							✓	✓	

PR665 **Lean and Agile Manufacturing**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To understand the concepts of lean and agile manufacturing
2. To gain competence on tools/techniques of lean and agile manufacturing
3. To explore the industrial applications of tools/techniques of lean and agile manufacturing

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

Primary Tools of Lean Manufacturing- 5S, Process Mapping and Value Stream Mapping, Work Cells, Total Productive Maintenance – Principle, Procedural steps and Advantages- Secondary Lean Tools.

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

Fundamentals of Agile Manufacturing, Agile Principles, Conceptual models of Agile Manufacturing, Product Development Strategies for agility, Developing the agile enterprise, Managing People in agile organizations.

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

REFERENCES:

1. Montgomery, J.C and Levine, L. O., “The transition to agile manufacturing – Staying flexible for competitive advantage”, ASQC Quality Press, Wisconsin, 1996.
2. Gopalakrishnan “Simplified Lean Manufacture – Elements, Rules Tools and Implementation”, PHI Learning Private Limited, New Delhi, India, 2010.
3. Hobbs, D.P. “Lean Manufacturing Implementation”, Narosa Publisher, 2004.
4. Devadasan, S.R., Sivakumar, V., Mohan Murugesh, R., Shalij, P, R. “Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities”, Prentice Hall India, 2012.
5. Lonnie Wilson, How to implement lean manufacturing, McGraw Hill

Education; 2nd edition (8 January 2015)

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓	✓					
CO2	✓	✓	✓	✓	✓	✓			✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

PR666 **Facilities Planning and Design**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To assess the value of facility planning on the strategy of a firm.
2. To describe the product, process and schedule design and their interaction with facility planning and develop a systematic facility layout
3. To explain design and analyze material handling used in the warehousing, manufacturing and supporting operations.

Facilities planning – need and objectives of facilities planning – facilities planning process –

Facilities planning strategies, Facilities Location Analysis- Single facility location models Multi-facility location problems

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

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

Group technology - Methods of grouping – Algorithms and models for Group technology – Line Balancing Material handling design – Material handling principles - Classification of material handling equipment - Material handling models

REFERENCES:

1. Tompkins, J.A. and J.A.White, “Facilities planning”, John Wiley, 2010.
2. Richard Francis.l. and John A.White, “Facilities layout and location - An analytical approach”, PHI, 2002.
3. James Apple. M , “Plant layout and Material handling”, John Wiley, 1977.
4. Pannerselvam,R, “Production and Operations management”, PHI,2012
5. B. Mahadevan, “Operations management: Theory and Practice”,2nd Edition, Pearson education South Asia, 2010.

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓	✓					
CO2	✓	✓	✓	✓	✓	✓			✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

PR667 **Production Management Systems**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To give a fair understanding of the role of production management in business processes and make familiarization of various production processes and service systems.

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

CIM and Production Management Systems: Capacity Requirement Planning (CRP), Master Production Schedule, MRP, MRPII, Lot sizing in MRP- Lot for lot, Economic order quantity, Periodic order quantity, Part period balancing.

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

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

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

REFERENCES:

1. Browne, Hairnet &Shimane, “Production management – A CIM perspective”, Addison Wesley publication Co., 1989.
2. Orlicky, J; “Material Requirement Planning: the new way of life in production and inventory management”, McGraw Hill, 1975.
3. Parker, D.E., “Value engineering theory”, Sundaram publishers, 2000.
4. Panneerselvam, R. “Production and Operation management”, PHI, 2005.
5. Schonlenger, R.L., “Japanese manufacturing techniques: 9 hidden lessons simplicity”, The Free press, 1982.

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓										
CO2					✓						
CO3			✓			✓	✓				

PR668 Industry 4.0 and Cloud Manufacturing

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To recognize need and trends of Industry 4.0 and Cloud manufacturing
- To understand concepts and technologies supporting Industry 4.0 and Cloud Systems
- To explore challenges and Industrial applications of Industry 4.0 in manufacturing

Various Industrial Revolutions, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, Lean Production Systems.

Internet of Things (IoT)- IoT design methods, physical devices and enabling technologies, Industrial Internet of Things (IIoT), Smart Manufacturing.

Cyberphysical Systems, Support System for Industry 4.0, Cyber Security, Collaborative Platform and Product Lifecycle Management, Artificial Intelligence, Big Data and Predictive analytics.

Introduction to cloud computing and manufacturing- cloud models, cloud manufacturing examples, cloud based manufacturing, Cloud service and platforms for manufacturing.

Industry 4.0 integration with manufacturing systems, Application domains, Case studies on IoT cloud system in manufacturing and other domains

REFERENCE BOOKS

1. Gilchrist, A. (2016). Industry 4.0: the industrial internet of things. (1st ed.), New York, NY: Apress.
2. Garbie, I. (2016). Sustainability in manufacturing enterprises: Concepts, analyses and assessments for industry 4.0. (1st ed.), Switzerland: Springer International Publishing.
3. T. Erl, Z. Mahmood, and R. Puttini (2013), Cloud Computing: Concepts, Technology & Architecture. (1st ed.), Prentice Hall.
4. Velte, A. T., Velte, T. J., Elsenpeter, R. C., & Elsenpeter, R. C. (2009). Cloud computing: a practical approach. (1st ed.) New York: McGraw-Hill.

COURSE OUTCOMES:

- Understand trends of Industry 4.0 and cloud manufacturing
- Competence on systems and technologies of Industry 4.0 & cloud system.
- Recognize industrial applications of Industry 4.0 in manufacturing

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓										
CO2	✓	✓			✓						
CO3	✓	✓	✓	✓	✓	✓					

PR669 **Work Design and Ergonomics**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know and apply various productivity measurement techniques in real time situations.
- To understand method study and work management techniques.
- To establish time standards by physiology methods.
- To acquire the basic knowledge in motion economy and ergonomic practices.

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

Methods study -process analysis – process chart – flow diagram – assembly process chart –Man and machine chart – two handed process chart – Photographic Techniques - Micro motion and memo motion study - Cycle Graph – Chrono Cycle Graph

Work measurement and its methods. Time study-Stop watch method, Rating factor, Allowances - Work sampling - Determining time standards from standard data and formulas-Predetermined motion time standards – Work factor system – methods time measurement, Basic Motion Time study. Analytical Estimation.

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

Principles of Motion Economy- related to use of human body, related to workplace, related to design of tools and equipment - Ergonomics practices – human body measurement – layout of equipment– seat design - design of controls and compatibility – environmental control – vision and design of displays. Design of work space, chair table

REFERENCES:

1. Barnes, Raeph.M., "Motion and Time Study – Design and Measurement of Work ", John Wiley &sons, New York, 1990
2. Mc.Cormick, E.J., "Human Factors in Engineering and Design", McGraw Hill
3. ILO, "Introduction to Work study", Geneva, 1974

COURSE OUTCOMES:

1. Various methods for productivity measurement and improvement
2. To understand the methods study for managing resources
3. To know the work measurement techniques for managing resources
4. To acquire the knowledge in measuring work by physiological methods
5. To analyze the ergonomic methods for workplace design

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓		✓				
CO2	✓	✓		✓	✓			✓	✓	✓	✓
CO3	✓	✓	✓		✓		✓				✓
CO4	✓	✓	✓		✓				✓	✓	✓
CO5	✓	✓	✓	✓	✓			✓	✓	✓	✓

PR670 **Sustainable Manufacturing**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To recognize the importance of sustainable manufacturing
- To understand and apply appropriate sustainability tools/techniques
- To explore practical applications of sustainability concepts

Concepts of sustainability and sustainable development – Need for sustainable development - Components of sustainability- Social, Economic, Environmental dimensions - Linkages between technology and sustainability - Sustainable Manufacturing –Scope, Need and Benefits.

Tools and Techniques of Sustainable Manufacturing – Environmental Conscious Quality Function Deployment, Life cycle assessment, Design for Environment, R3 and R6 cycles, Design for Disassembly -Sustainable Product Development – Various Phases.

EIA Methods –CML, EI 95 and 99, ISO 14001 EMS and PAS 2050 standards, Environmental Impact parameters - Interactions between energy and technology and their implications for environment and sustainable development.

Design for recycling – Eco friendly product design methods – Methods to infuse sustainability in early product design phases – Multi-Criteria Decision Making in Sustainability.

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

REFERENCES:

1. G. Atkinson, S. Dietz, E. Neumayer, — “Handbook of Sustainable Development”. Edward Elgar Publishing Limited,2008.
2. D. Rodick, “Industrial Development for the 21st Century: Sustainable Development Perspectives”, UN New York,2007.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A., “An Introduction to Sustainable Development”, Earthscan, London, 2008.
4. P. Lawn, “Sustainable Development Indicators in Ecological Economics”, Edward Elgar Publishing Limited, 2006
5. S. Asefa, “The Economics of Sustainable Development”, W.E. Upjohn Institute for Employment Research, 2005.

COURSE OUTCOMES:

1. Realize the importance of sustainable manufacturing
2. Exhibit competence on the usage and applicability of sustainability tools
3. Recognize applications of sustainability concepts in various domains

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓	✓				✓	
CO2	✓	✓	✓	✓	✓	✓				✓	
CO3	✓	✓	✓	✓	✓	✓			✓	✓	✓

PR671 **Quality and Reliability Engineering**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To facilitate the students in knowing the application of statistical techniques in Quality control and assurance and also to impart knowledge in reliability concepts, reliability estimation methods and reliability improvement methods

Quality Dimensions – Quality definitions – Inspection - Quality control – Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function - Quality Gurus and their philosophies

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u- Construction and application. Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

Definition of reliability – Performance and reliability - Reliability requirements – System life cycle – Mean time between failures – Mean time to failure – Mortality Curve – Availability – Maintainability – Bathtub curve – Time dependent failure models – Distributions – Normal, Weibull, Lognormal – Life distribution measurements – Accelerated life tests – Data requirements for reliability.

Reliability of system and models – Serial, parallel and combined configuration – Markove analysis, load sharing systems, standby systems, covarient models, static models, dynamic models - Failure rate estimates – Effect of environment and stress – RDB analysis – Standby Systems – Complex Systems – Reliability demonstration testing – Reliability growth testing – Duane curve – Risk assessment – FMEA and Fault tree analysis.

REFERENCES:

1. Douglas, C. Montgomery, “Introduction to Statistical Quality Control”, 2nd Edition, John Wiley & Sons, 2001.
2. K Krishnaiah, Applied Statistical Quality control and Improvement, PHI, 2014
3. Smith, D.J. “Reliability Maintainability and Risk; Practical methods for engineers”, Butterworth-Heinemann, New Delhi, 2001
4. Grant, E.L. and Leavenworth, R.S., “Statistical Quality Control”, TMH, 2000.

COURSE OUTCOMES:

1. Control the quality of processes using control charts for variables in manufacturing industries.
2. Control the occurrence of defective product and the defects in manufacturing companies.
3. Able to perform process capability studies and to control the occurrence of defects in services through proper sampling methods.
4. able to conduct reliability assessment and failure analysis on any complex systems
5. understand the design concepts for reliable system and prediction aspects in industries

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓		✓								
CO2		✓			✓						
CO3				✓				✓			
CO4		✓							✓		
CO5	✓		✓								

PR672 **Value Engineering**

L	T	P	C
3	0	0	3

Course objectives:

- To understand and analyse the theory and methodology of Value Engineering with the Guidelines, Performa and Checklist for a systematic, step by step application of the technique to the current industrial problems.
- To provide the knowledge about Reengineering Principles, the various models and implementation method, which are adopted in the industries.

Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, applications, advantages and limitations of Value analysis.
Brain storming technique, Gordon technique, Feasibility Ranking technique, Morphological Analysis Technique, ABC Analysis, Probabilistic approach, Make or Buy decisions.
Advanced Value Engineering techniques: Function, Cost- Worth Analysis (FCWA) technique, Function Analysis System (FAST) technique, Weighted Evaluation method, Evaluation matrix, Break Even Analysis, Life cycle cost (LCC); Applications of value analysis/ Value Engineering.
Orientation phase – information phase – functional analysis – creative phase – evaluation phase – recommendation phase – implementation phase – audit phase
VE benefits in service, problems using VE, case studies in different sectors.

References

1. Richard J Park, “Value Engineering – A Plan for Inventions”, St.Lucie Press, London, 2017.
2. Anil Kumar Mukopadhaya, “Value Engineering Concepts Techniques and Applications”, Response Books, 2003.
3. Mukhophadhyaya A K, “Value Engineering”, Sage Publications Pvt. Ltd., New Delhi, 2003.
4. Larry W Zimmesman , “VE –A Practical Approach for Owners Designers and Contractors”, CBS Publishers, Delhi, 1992.
5. Arthus E Mudge, “Value Engineering”, McGraw Hill Book Company, 1971

Course outcomes:

- Use of value engineering and reengineering to the current industrial problem
- Ability to use various models and methods to solve the industrial problem

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓			✓					✓
CO2	✓	✓	✓		✓						✓

PR673 Cost Measurement and Productivity Measurement

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To build awareness of phenomena that influence cost of engineering systems across a variety of contexts
- To introduce the basic principles of Productivity Models and the applications of Re-Engineering Concepts required for various organizations.

Cost Estimation Approaches, Sizing and Work Breakdown Structures, – Advanced Cost Modelling Concepts, Economic Principles, Measurement Systems, Enablers and barriers to adoption of process improvement, Risk Estimation & Project Management

Productivity concepts – Macro and Micro factors of productivity, productivity benefit model, productivity cycles.

Need for Productivity Planning – Short term and long term productivity planning – Productivity improvement approaches, Principles – Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques – Managerial aspects of Productivity Implementation schedule, Productivity audit and control.

Productivity Models: Productivity Measurement at International, National and organization level, total productivity models. Productivity Management in manufacturing and service sectors.

References

1. Hubbard, D. W., How to Measure Anything: Finding the Value of "Intangibles" in Business, Wiley, 2010.
2. Sumanth, D.J, Productivity Engineering and Management, TMH, New Delhi, 1990
3. Sudit, Ephraim F., “Productivity Based Management”, Springer 1984
4. References:
5. Edosomwan, J.A, Organizational Transformation and Process re- Engineering, British Cataloging in publications,1996.
6. Premvrat, Sardana, G.D. and Sahay, B.S, Productivity Management – A systems approach, Narosa Publications, New Delhi, 1998.
7. Rotini, Federico, Borgianni, Yuri, Cascini, Gaetano, “How to Achieve Global Success in the Changing Marketplace”, Springer 2012.

Course outcomes

- Understand the practical application of cost modelling and its role in industries
- Measure, evaluate, Plan and implement various productivity techniques.
- Reengineer the process for improving the productivity

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓		✓				✓	✓
CO2	✓	✓	✓	✓				✓		✓	✓
CO3	✓	✓	✓	✓			✓			✓	✓

ELECTIVES

MANAGEMENT STREAM

PR674 **Project Management**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To enable the students to understand the methods for project identification and appraisal.
2. To plan and schedule a project with resource and environmental constraints.
3. To develop quantitative methods for project selection, risk assessment, monitoring and control.

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

Project Appraisal,Market and demand analysis- market survey-demand forecasting methods-Technical analysis – manufacturing process, materials-product mix, plant location-project charts and layouts.

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

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

Organization systems for project implementation- Work Breakdown-coordination and control- Project Management Soft wares, Role of AI in project management

REFERENCES:

1. Prasanna Chandra, “Projects – Planning, Analysis, Financing, Implementation and Review”, Tata McGraw Hill,8th Ed, 2017
2. S.Choudry “Project Management”, ”, Tata McGraw Hill,5th Ed, 1995
3. Mike Field and Laurie Keller, “Project Management”, Thompson Business press, 2002
4. http://nptel.ac.in/courses/110104073/

COURSE OUTCOMES:

1. Understand the process and approaches for executing projects.
2. Develop and analyze quantitative models for project selection and scheduling.
3. Apply engineering and management principles to manage real time projects considering constraints.
4. Apply tools for managing complex projects.
5. Analyse the outcome and offer suggestions for improvement

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓		✓				
CO2	✓	✓	✓				✓				
CO3	✓	✓	✓				✓				
CO4	✓	✓	✓		✓		✓				
CO5	✓	✓	✓	✓			✓			✓	✓

PR675 **Financial Management**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To start and manage new business
- To evaluate and monitor short term and long term investments
- To evaluate and monitor current asset

Financial management – An overview - Nature, Scope, Objectives, Decisions - Management of Current asset - Short and intermediate financing

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

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

Principles of working capital: Concepts, Needs, Determinants, issues and estimation of working Capital - Accounts Receivables Management and factoring - Inventory management – Cash Management – Working capital finance

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

REFERENCES:

1. Bhattacharya, S.K. and John Deardon, “Accounting for Management – Text and Cases”, VikasPublishingHouse, New Delhi, 1996.
2. Charles, T.Horn Green – “Introduction to Management Accounting”, Prentice Hall, New Delhi, 1996.
3. James, C.Van Horne, “Fundamental of Financial Management”, Pearson Education, 12th Edition,2002.
4. Prasanna chandra, “Financial Management theory and practice”, TMH, Vth edition, 2001.

COURSE OUTCOMES:

- To start and manage new business
- To evaluate and monitor short term and long term investments
- To evaluate and monitor current asset

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓	✓				✓	
CO2	✓	✓	✓	✓	✓	✓				✓	
CO3	✓	✓	✓	✓	✓	✓			✓	✓	✓

PR676 **Marketing Management**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the marketing management strategies and segmentation factors.
- To understand the product pricing and marketing research methodologies.
- To understand the techniques of advertising, sales promotion and distribution.

Concepts in Marketing - Marketing Process, Marketing concepts, Environment-Buying Behaviour and Market Segmentation-factors, Motives, Types, Buying Decision, Segmentation factors, Demographic, Psychographic and Geographic Segmentation, Process, Patterns

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

Advertising, Sales Promotion and Distribution-Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics Modern Trends in Retailing.

REFERENCES:

1. Kotler Philip, Kevin Lane Keller, “Marketing Management”, 13th Ed., Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2007.
2. ZikmundDAmico, “The power of Marketing”, 7th edition, South Western , Thomson Learning Publications, 2006.
3. Michael J. Etzel, Bruce J. Walker, William J. Stanton, Ajay Pandit, “Marketing – concepts and cases”, special Indian edition, McGraw Hill

COURSE OUTCOMES:

1. Explain marketing concepts and segmentation factors
2. Classify various pricing methods
3. Explain various sales promotion aspects

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓	✓		✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓		✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓

PR677 Total Quality Management and Six Sigma

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To realize the importance of TQM in industrial scenario
2. To gain competence on applying TQM tool for the problems
3. To deploy various phases of Six Sigma for real time projects

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

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

ISO 9000 standards, ISO 9001:2008 Quality Management System – Eight clauses, Registration, Implementation steps, Quality Audit, Product and Process audit – Scope, Steps and Benefits

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

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

REFERENCES:

1. Besterfield Dale H., BesterfieldCarol ,Besterfield Glen H., Besterfield Mary, Urdhwareshe Hemant, UrdhwareshеRashmi, Total Quality Management (TQM) 5e by Pearson, Pearson Education (30 October 2018).
2. John Bank, “The essence of Total Quality Management”, PHI1993.
3. Logothetis N., “Managing for Total Quality – From Deming to Taguchi and SPC”, Prentice Hall of India Pvt. Ltd.1996.
4. Thomas Pyzdek, “Six Sigma Hand book”, Tata McGraw-Hill,2010.
5. C.M.Creveling, L.Slutsky&D.Autis.Jr., “Design for Six Sigma”, Pearson education,2003.
6. M.P.Poonia, Total Quality Management, Khanna Publishing; First edition (1 May 2017)

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓		✓		✓	✓					
CO2	✓	✓	✓	✓	✓	✓			✓		✓
CO3	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

PR678 **Human Resource Management**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand individual and Group behavior of decision making in Organization
- To recognize Human Resource Planning for the development of Management

Individual Behavior-Personality –Attribute – Perception –Motivation Theories

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

Human Resources Planning–HR audit, Recruitment-Selection-Interviews -Human Resources Development-Employee Training-CareerDevelopment-PerformanceAppraisal-Compensation-safety and Health-Employee Relation-Management Development.

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

REFERENCES:

1. Stephen R. Robbins, “Organizational Behavior”, PHI, 1998.
2. Gary Dessler “Human resources Management” Prentice Hall of India 9 th edn., 2003
3. David A. Decenzo & Stephen R. Robbins, “Personnel/Human Resources Management”, PHI,1997.
4. Fred Lutherans, “Organizational Behavior”, Oxford University Press, 2000.

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓		✓		✓			✓		
CO2		✓				✓		✓	✓		
CO3	✓	✓	✓			✓		✓		✓	✓

PR679 **Product Life Cycle Management**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To realize the scope of product life cycle management.
- To explore the possibility of Collaborative Product Development and digital manufacturing in practical applications.
- To develop strategy for PLM applications

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

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

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

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

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

REFERENCES:

1. Antti Saaksvuori, AnselmiImmonen, “ Product Lifecycle Management”, Springer, 2005.
2. John Stark, “Product lifecycle management: 21st century paradigm for product realization”, Springer 2006 London, 3rd printing -2006. 441 pp., ISBN: 1-85233-810-5.
3. Michael Grieves, “Product lifecycle management: Driving the next generation of Lean thinking”, McGraw-Hill, 2006.
4. Kari Ulrich and Steven D. Eppinger, “Product Design & Development”, McGraw Hill, 5th Edition, 2011

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓	✓	✓			✓		
CO2	✓	✓	✓	✓	✓	✓		✓	✓		✓
CO3	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

PR680 **Technology Management**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand technology development process
- To recognize technology management issues in the context of advanced manufacturing systems

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

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

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

Organization structures and Technology Implementation issues in new technology – Technology Management issues in the context of lean, agile and sustainable systems – Intellectual Property Rights

REFERENCES:

1. Joseph M. Putti, “Management – A Functional Approach”, McGraw Hill, 1997
2. Kenneth C. Lauden ,“MIS: Organisation and Technology”, Prentice Hall, 1995
3. James A.Senn, “Information technology in Business”, Prentice Hall, 1995
4. Ronald J. Jordan, “Security analysis and Portfolio Management”, Prentice Hall,1995

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓						
CO2		✓	✓	✓	✓		✓			✓	
CO3	✓		✓	✓		✓				✓	

PR681 **Advanced Optimization Techniques**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To gain the knowledge of Traditional optimization techniques.
2. To gain the knowledge of Non Traditional optimization techniques.

Classification of Optimization Problems - Optimization Techniques

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

Nonlinear Programming I: One-Dimensional Minimization Methods - Unimodal Function, ELIMINATION METHODS-Unrestricted Search -Exhaustive Search - Dichotomous Search- Interval Halving Method-Fibonacci Method- Golden Section Method, INTERPOLATION METHODS -Quadratic Interpolation Method - Cubic Interpolation Method -Direct Root Methods -Newton Method-Quasi-Newton Method - Secant Method

Nonlinear Programming II: Unconstrained Optimization Techniques -DIRECT SEARCH METHODS -INDIRECT SEARCH (DESCENT) METHODS, Nonlinear Programming III: Constrained Optimization Techniques- DIRECT METHODS- INDIRECT METHODS , Geometric Programming , Dynamic Programming , Integer Programming -INTEGER LINEAR PROGRAMMING - Stochastic Programming.

Modern Methods of Optimization - Genetic Algorithms -Simulated Annealing -Particle Swarm Optimization -Ant Colony Optimization -Optimization of Fuzzy Systems - Neural-Network-Based Optimization, Practical Aspects of Optimization

REFERENCES:

1. Kalyanmoy Deb, Optimization for Engineering design – algorithms and examples. PHI, New Delhi, 1995.
2. Singiresu S.Rao, “Engineering optimization – Theory and practices”, John Wiley and Sons, 1998.
3. Garfinkel, R.S. and Nemhauser, G.L., Integer programming, John Wiley & Sons, 1972.

COURSE OUTCOMES:

1. To learn the Traditional optimization techniques and apply it in engineering field.
2. To learn the Non Traditional optimization techniques and apply it in engineering field.

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PR682 **Production Design and Development**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the challenges and advancements of product development process.
- Execution of various phases of product development.
- Development of environmental friendly products/processes.

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

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

Generating concepts-Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory.
Robust design, Design for Manufacture and Assembly, axiomatic design, TRIZ, value engineering, industrial design Poka Yoke-Lean principles-Six sigma concepts.
Design for the Environment: DFE methods, life cycle assessment, weighted sum assessment method, techniques to reduce environmental impact – disassembly, recyclability, remanufacturing regulations and standards.

REFERENCES:

1. Kevin Otto and Kristin Wood, -Product Design – Techniques in Reverse Engineering and New Product Development, Pearson Education, 2004.
2. Karl T Ulrich and Steven Eppinger, Product Design and Development, McGraw Hill, 2011, Fifth Edition.

COURSE OUTCOMES:

- Understand the challenges and advancements of product development process.
- Execute various phases of product development.
- Develop environmental friendly products/processes.

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓										
CO2	✓	✓		✓	✓						
CO3	✓		✓	✓	✓						

PR683 E-waste Assessment and Management

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

1. To enable the students to understand the e-waste management system towards sustainablity.
2. To understand models and approaches for material flow assessment of e-waste
3. To understand models and approachrs for quality, functionality and reverse logistics and EPR

E-waste, types- Materials from E-Waste- Classification- Evolution of e-waste management system- Challenges and Opportunities of E-Waste Management in Developing Countries

Models for e-waste assessment- volume estimation-market supply method-consumption and use method-regression-system dynamics-Markov chain

Quality issues related to e-waste reuse-remanufacture-models for cost effective refurbishment

Reverse logistics models for e-waste-centralized versus decentralized collection- LP, MILP, stochastic programming – Multi attribute decision making techniques- traditional and non-traditional techniques- simulation models

-waste rules and regulations in India-EPR-sustainable e-waste recycling –life cycle approach- Material Flow Analysis (MFA)-industrial case studies

References:

Rakesh Johri, *E-waste: Implications, regulations and management in India and current global best practices*, The Energy and Resources Institute, 2008.

R E Hester, R M Harrison*, Electronic Waste Management: Design, Analysis and Application*, RSC Publishing, 2009.

Vannessa Goodship, Ab Stevels, *Waste Electrical and Electronic Equipment (WEEE) Handbook*, Woodhead Publishing, 2012.

Sunil Chopra, Peter Meindl, *Supply Chain Management: Strategy, Planning and Operations*-, Prentice Hall India, 3rd ed. (2007)

COURSE OUTCOMES

1.Understand the e-waste management practices

2.Develop and analyze quantitative models for e-waste estimation

3. Apply tools for managing e-waste sustainably

4. Analyse the outcome and offer suggestions for sustainable e-waste management

Mapping of programme outcomes with course outcomes:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	√	√	√		√		√			√	
CO2	√	√	√				√			√	
CO3	√	√	√				√			√	
CO4	√	√	√		√		√			√	

ELECTIVES

INDUSTRIAL INFORMATION SYSTEM STREAM

PR684 Enterprise Resource Planning

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To develop a thorough knowledge on ERP and solve related industrial problems

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

ERP Implementation: ERP Implementation Lifecycle, Implementation Methodology, Organizing the Implementation, Vendors, Consultants and Users, Contracts with Vendors, Consultants and Employees, Project Management and Monitoring. Precautions in ERP Implementation, ERP Post Implementation Options, Guidelines for ERP Implementation

ERP Modules: Business Modules- Manufacturing, Materials Management, Finance, Plant Maintenance, Quality Management, Human Resources and Marketing. ERP for Make to Order Companies.

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

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

REFERENCES:

1. Alexis Leon, “ERP demystified”, Tata McGraw–Hill publishing company Ltd., New Delhi, 2002.
2. Brady, “Enterprise Resource Planning”, Thomson Learning, 2001.
3. S. Sadagopan, “ERP: A Managerial perspective”, Tata McGraw–Hill publishing company Ltd., New Delhi, 1999.
4. Vinod Kumar Garg and Venkitakrishnan N K, “Enterprise Resource Planning – Concepts and Practice”, PHI, New Delhi, 2003.
5. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.
6. Garg V. K. and Venkitakrishnan N.K. *Enterprise Resource Planning: Concepts and Practice* Prentice – Hall of India Private Limited.

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								
CO2								✓			
CO3					✓				✓		

PR685 **Decision Support Systems**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce decision support systems and show their relationship to other computer-based information systems.
- To introduces the software systems that coordinate data, modeling, algorithms and user-friendly interfacing to create an environment for automated or interactive decision making
- To introduce technologies such as OLAP, GSS, AI, Organizational learning and Knowledge management
- To demonstrates development approaches, and to utilize DSS capacities to support different types of decisions

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

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

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

REFERENCES:

1. Efraim Turban and Jay E Aronson, Decision Support and Intelligent Systems, Pearson education Asia, Seventh edition, 2005.
2. Elain Rich and Kevin Knight, Artificial intelligence, TMH, 2006.
3. Vicki L. Sauter, Decision Support Systems for Business Intelligence John Wiley & Sons. Turban, Decision Support And Business Intelligence Systems, 8/E, Pearson Education India, 2011.
4. FradaBurnstein, Clyde W. Holsapple., Handbook on Decision Support Systems Springer, 2008.

COURSE OUTCOMES:

1. Recognize the importance of decisions in the work and use DSS Software Tools
2. Discuss the advantages/disadvantages of different types of decision support systems and evaluate their Success/Failure
3. Identify the types of problems that may be addressed effectively through the use of Decision Support Systems and Intelligent Systems.
4. Analyze practical cases from different real world problems (technical, management)

5. Recognize the role of Decision (and other Management) Support Systems and their potential for assisting in organizational and individual decision making.

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓		✓	✓			✓		✓
CO2						✓	✓		✓		
CO3		✓	✓		✓	✓	✓	✓	✓		✓
CO4		✓	✓	✓			✓	✓			
CO5	✓	✓	✓			✓	✓				✓

PR686 **Knowledge Management**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To understand the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.

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

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

Social networking-package choices- knowledge security-Integrating with web - based and internal operational & support systems- change management- reward systems- continuous improvement – Intellectual Property Rights.

REFERENCES:

1. Guus Schreiber, Hans Akkermans, “Knowledge Engineering and Management”, Universities Press, 2004
2. Elias M.Awad& Hassan M. Ghaziri, “Knowledge Management”, Pearson Education, 2004

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓		✓	✓	✓		✓				
CO2			✓		✓						
CO3	✓			✓	✓		✓				

PR687 Multi-Criteria Decision Making Techniques

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To provide an overview of various MCDM techniques and apply this technique to solve industrial engineering problems.

Multi-Criteria Decision Making – An Overview – Classification of MCDM methods – Simple Additive Weighting method – Weighted Product method – Principle, steps and illustrative examples.

Network based MCDM methods – Analytic Hierarchy Process – Revised Analytic Hierarchy Process – Analytic Network Process – Principle, steps and illustrative examples.

Outranking MCDM methods – PROMETHEE, ELECTRE, TOPSIS - Compromise Ranking method - VIKOR, ORESTE – DEMATEL – Principle, steps and illustrative examples.

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

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

REFERENCES:

1. Belton, V., Stewart, T.J. “Multiple Criteria Decision Analysis: An Integrated Approach”, Kluwer Academic Publishers, Dordrecht, 2003.
2. Triantaphyllou, E., “Multi-Criteria Decision Making Methods: A Comparative Study”, Springer, 2010.
3. Pedrycz, W., Ekel, P., Parreiras, R., “Fuzzy Multi Criteria Decision-Making: Models, Methods and Applications”, John Wiley & Sons, 2011.
4. Kahraman, C., “Fuzzy Multi-criteria Decision Making: Theory and Applications with Recent Developments”, Springer, 2008.

COURSE OUTCOMES:

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		✓									
CO2	✓			✓	✓						
CO3							✓		✓		✓

PR688 **Intelligent Industrial System**

L	T	P	C
3	0	0	3

Course Objectives:

- To apply various knowledge based techniques
- To practice diagnosis and trouble shooting
- To adopt intelligent system

Computer Integrated Manufacturing Systems Structure and functional areas of CIM system – CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems – MAP/TOP, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

Components of Knowledge Based Systems – Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

Machine Learning – Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks – Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

Automated Process Planning – Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem.

Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBST) — Data Base, Knowledge Base, Clustering Algorithm.

REFERENCES:

Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.
Automation, Production Systems and CIM / Groover M.P./PHI/2007
Neural networks in Computer intelligence/ Li Min Fu/ TMH/2003
Neural networks/ James A Freeman David M S kapura/ Pearson education/2004

COURSE OUTCOMES

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

MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓								
CO2	✓			✓							
CO3	✓			✓	✓		✓				