SYLLABUS

FOR

TWO-YEAR M. TECH. PROGRAMME

IN

INDUSTRIAL ENGINEERING & MANAGEMENT

NAAC – A Grade

DEPARTMENT OF MECHANICAL ENGINEERING

COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous and Constituent College of BPUT, Odisha)

Techno Campus, Mahalaxmi Vihar, Ghatikia,

Bhubaneswar-751029, Odisha, INDIA

www.cet.edu.in

Ph. No.: 0674-2386075 (Off.), Fax: 0674-2386182

COURSE: M. Tech. (ME – Industrial Engineering & Management)
Duration: 2 years (Four Semesters)

Abbreviations Used:

	U= UG, I= Integrated,	P= PG
PC= Professional Core	PE= Professional Elective	OE= Open Elective
LC= Lab Course	MC= Mandatory Course	AC= Audit Course
L= Lectures	P= Practical/Laboratory	IA[*]= Internal Assessment
T= Tutorial	PA= Practical Assessment	EA=End-Semester Assessment

[*]**Internal Assessment Max. Mark (30 marks) consists of Mid Semester (20 marks) and Quiz+Assignment (10 marks)**

Subject Code Format:

1	2	3	4	5	6	7	8
Prog (U/I/P)	Type (PC/PE/OE/LC/MC/AC)		Department (CE/EE/IE/ME/…)		Semester (1/2/…/0)	Serial No. (1/2/3/…/99)	

1st SEMESTER

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	Core 1	PPCME105	Work System Design and HRM	3	0	0	3	30	70	-	100
2	Core 2	PPCME106	Production Planning and Inventory Control	3	0	0	3	30	70	-	100
3	Professional Elective 1 (Any One)	PPEME108	Decision Modelling	3	0	0	3	30	70	-	100
		PPEME109	Stochastic Modelling								
		PPEME110	Simulation Modelling and Analysis								
		PPEME111	Business Ethics and Leadership								
4	Professional Elective 2 (Any One)	PPEME120	New Product Development	3	0	0	3	30	70	-	100
		PPEME121	Manufacturing Strategy								
		PPEME122	Marketing Management								
		PPEME123	Financial Management and Accounting								
5	Mandatory	PMCMH101	Research Methodology & IPR	2	0	0	2	30	70	-	100
6	Lab 1	PLCME105	Computational Lab	0	0	4	2	-	-	100	100
7	Lab 2	PLCME106	Work Design Lab	0	0	4	2	-	-	100	100
			Total	14	0	8	18	150	350	200	700
8	Audit 1	Any one subject from Appendix-I									100
									Grand Total		800

2nd SEMESTER

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	Core 3	PPCME203	Quality Engineering and Management	3	0	0	3	30	70	-	100
2	Core 4	PPCME204	Supply Chain Management	3	0	0	3	30	70	-	100
3	Professional Elective 3 (Any One)	PPEME201	Computational Techniques and Soft Computing	3	0	0	3	30	70	-	100
		PPEME205	Fuzzy System and Neural Network								
		PPEME206	Software Engineering								
		PPEME207	E-Governance								
4	Professional Elective 4 (Any One)	PPEME216	Business Analytics	3	0	0	3	30	70	-	100
		PPEME217	Maintenance, Safety and Reliability								
		PPEME218	Multivariate Statistical Modelling								

Sl. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credit	IA	EA	PA	Total
		PPEME219	Value Engineering and System Thinking								
5	Mandatory 2	PPRME201	Literature Review Seminar	0	0	4	2	-	-	100	100
6	Lab 3	PLCME203	Simulation Lab	0	0	3	2	-	-	100	100
7	Lab 4	PLCME202	Computational Techniques and Soft Computing Lab	0	0	3	2	-	-	100	100
			Total	12	0	12	18	120	280	300	700
8	Audit 2		Any one subject from Appendix-II								100
			Grand Total								**800**

3rd SEMESTER

Sl. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credit	IA	EA	PA	Total
1	Professional Elective 5 (Any One)	PPEME305	Reverse Engineering and Rapid Prototyping	3	0	0	3	30	70	-	100
		PPEME306	Enterprise Resource Planning								
		PPEME307	Management Information System								
		PPEME308	Lean Manufacturing and Service								
2	Open Elective		Any one subject from Appendix-III	3	0	0	3	30	70	-	100
3	Project 1	PPRME301	Phase-I Dissertation	0	0	20	10	-	-	100	100
			Total	6	0	20	16	60	140	100	300

4th SEMESTER

Sl. No.	Subject Type	Subject Code	Subject Name	L	T	P	Credit	IA	EA	PA	Total
1	Project 2	PPRME401	Phase-II Dissertation	0	0	32	16	-	-	100	100
			Total	0	0	32	16	-	-	**100**	**100**

Abstract of Credit and Marks Distribution

Sl. No.	Semester	Maximum Credits	Maximum Marks
1	1st Semester	18	800
2	2nd Semester	18	800
3	3rd Semester	16	300
4	4th Semester	16	100
	Total	**68**	**2000**

NB:
- **Any one of the Courses in Appendix-I is to be Decided by the Concerned Department for Audit-1 (1st Sem)**
- **Any one of the Courses in Appendix-II is to be Decided by the Concerned Department for Audit-2 (2nd Sem)**
- **Any one of the Courses in Appendix-III is to be Decided by the Concerned Department for Open Elective (3rd Sem)**

Semester-1

Core 1: Work System Design and HRM (PPCME105)

Module I:
Work Study Fundamentals: Productivity and Work Study, Definitions and Scope of Work Study, Analysis of Work Content.
Method Study: Process Analysis, Process and Activity Charts, Operation Analysis, Basic procedure, Micro Motion Study, Principles of Motion Economy.

Module I:
Work Measurement: Purposes and uses, Basic procedure &Techniques – Work Sampling, Time Study, Rating and Allowances, Setting Standard Times for Jobs, Standard Data, and Predetermined Time Standards. Job Evaluation: Basic concepts, Objective and Subjective methods, Compensation Schemes, Relationship of Work Study to Incentive Schemes, Wage Incentive Plans. *Human Resource Management:*

Module III:
Introduction to HRM: Strategic Management Approach to HRM, Equal Employment Opportunity, Legal Aspects of HRM, Global Human Resource Management.
Human Resource Planning (HRP): HR Planning Process; Modelling HRP including mathematical models; external and internal strategic integration; HR information system.
Labour-Management Relations and Promoting Safety & Health: Labour Relations and Collective Bargaining, Managing Employee Discipline, Promoting Safety and Health.

Books:
1. Introduction to Work Study, ILO-Indian Adaption Oxford & IBH
2. Motion and Time Study, Mundel M, Printice Hall India
3. John M. Ivancevich, Human Resource Management, 12/e, McGraw- Hill.
4. Ian Beardwell, Len Holden, Tim Claydon: Human Resource Management - A Contemporary Approach, 4/e, Pearson Education.

Core 2: Production Planning and Inventory Control (PPCME106)

Module - I
Generalised model of a production system, Different kinds of production systems, mass, batch job and cellular production
Layout: Optimisation in Product and Process layout; FMS; Manufacturing Strategies

Module - II
Demand forecasting: Moving Average and Exponential Smoothing methods, Multiple regression method, Error in forecasting
Decisions in the life cycle of a production system, Evaluation of investments in new product and services, risk analysis using decision trees, product mix decisions
Aggregate planning, Operation planning and control, Scheduling, Comparison of dispatch rules, Johnson rule

Module - III
Inventory control: EOQ and EBQ, EOQ Sensitivity, Backordering, Determination of safety stock, P and Q System, Joint cycle for multiple products
Materials Requirements Planning (MRP): Independent and dependent items, Master production schedule, MRP Inputs and outputs, Bill of Material, MRP Computation, EOQ-MRP comparison, MRP Types, Capacity planning and control, JIT in production planning and planning

Books:
1. Manufacturing Planning and Control, Vollman, Berry, Whybark & Jacobs, TMH
2. Production Planning and Inventory Control, Narasimhan S L, Mcleavey D W, Billington P J, PHI
3. D.D. Bedworth and J.E.Bailey (1983), Integrated Production Control System Management, Analysis and Design, John Wiley
4. E.G. Coffman (1976), Computer and Job shop Scheduling Theory, Wiley

PE 1: Decision Modelling (PPEME108)

Module I:
Use of quantitative techniques in decision making, Elements of linear algebra, Linear programming and Simplex method, Artificial variable, Duality in LP, Dual Simplex Method, Sensitivity analysis

Module II:
Transportation problem, Degeneracy, Assignment problem, Transhipment Model
Integer Programming: Integer programming problem formulation, Branch and Bound method

Module III:
Queuing Theory: Markov Process - Description of state, Transition probability matrix, Single-channel and Multiple-channel queues
Game theory: Two person Zero-sum game, Saddle point, Mixed strategies, Use of dominance, Subgames method

References:
1. Operation Research: An Introduction, Taha H A, PHI
2. Operation Research, Phillips, Rabindran and Solberg, "John Wiley & Sons
3. Introduction to Operation Research, Hiller F S and Lieberman G J

PE 1: Stochastics Modelling (PPEME109)

Module - I
Probability Theory Review: Probability space, Discrete and Continuous random variables and their moments, independence, joint distribution, conditional probability and conditional expectation; convergence of sequences of random variables; almost surely, in probability and in distribution. Strong Law of Large Numbers

Module - II
Introduction to stochastic process; sample paths and finite dimensional distributions, Kolmogorovs consistency conditions. Renewal processes, reward and cost models, cumulative processes, Poisson process and stopping times. Regenerative processes, relation between a time average and mean of limiting distribution, Walds equation, renewal equation, renewal theorems.

Module - III
Discrete time Markov chains, connection with renewal theory, communication classes and class properties, irreducible and positive recurrent chains, frequencies and relative frequencies for ergodic chains, costs and rewards for ergodic chains, transient behavior. Continuous time Markov chains,

Books:
1. An Introduction to Probability Theory and its Applications, Volumes 1 and 2, John Wiley, New York.
2. Cinlar (1975), Introduction to Stochastic Processes, Prentice Hall Inc.,
3. S. M. Ross (1983), Stochastic Processes, John Wiley and Sons
4. W. Wolff (1989), Stochastic Modeling and the Theory of Queues, Prentice Hall Inc.,
5. G. Kulkarni (1995), Modeling and Analysis of Stochastic Systems, Chapman and Hall London.

PE 1: Simulation Modeling and Analysis (PPEME110)

Module - I
Introduction: Systems, modeling, general systems theory, concept of simulation, simulation as a decision making tool, mathematical and statistical models.
Random Numbers And Variates: Pseudo random numbers, techniques and tests for random numbers, inverse-transforms, acceptance-rejection techniques, special properties of variates

Module - II
Design of Simulation Experiments: Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow chart, starting condition, run size, experimental design consideration, output analysis and interpretation validation.

Module - III
Applications: Simulation of manufacturing and material-handling system, performance measures, various failures. Comparison and selection of simulation languages, study of any one simulation language.

References:
1. Jerry Banks and John S.Carson, Barry L Nelson, David M.Nicol, P.Shahabudeen,(2009) "Discrete event system simulation ",Pearson Education
2. Law A.M,(2008)"Simulation Modelling and Analysis ", Tata Mc Graw Hill
3. Thomas J.Schriber,(1991) "Simulation using GPSS ", John Wiley
4. Kelton, W. David,(2006) "Simulation with Arena ", McGraw-Hill

PE 1: Business Ethics and Leadership (PPEME111)

Module - I
Basic Theory: Some basic Principles-Meaning, Types of evil and consequences, Proportionality, Minor evils or Physical evils, Problems, Positive obligations, Rights, Cooperation in Evil, Location of responsibility, The gray areas, Economical and Political Considerations, Relationship between firm and employee, customers, competitors, intermediaries, and unions.

Module - II
Historical perspective, culture and ethics in India, Economics and the environment- green business, ethics and competition, The ethical code, social audit, A framework for analysis and action, The sphere of personal ethics- consequences, rights and duties, virtue and character, Ethical Responsibilities of Economic Agents: role obligations, obligation to shareholder, rights and obligations to customer, obligation to pay taxes, Environmental protection, Corporate accountability, Ethical conflicts, Ethics, Government policies and laws.

Module - III
Ethical responsibilities of Organizational Leader: power, leadership, obstacles to ethical conduct, pressures for conformity, Evaluation and rewards, Job pressures and issues, organizational change, Ethics in use of Information Technology, Intellectual Property Rights, Ethics in Marketing, Ethics of advertising and sponsorship, Acquisition and merger, Multinational decision making-Reconciling International norms.

Books:
1. Badaracco Jr J.L., Business Ethics: Roles and Responsibilities, Irwin, Chicago, 1995.
2. Drummond J., and Bain B.(Ed.), Managing Business Ethics, Butterworth Heinemann, Oxford, 1994.
3. Garrett M.Thomas, Business Ethics, The Times of India Press, Bombay, 1970
4. Mathias T.A.(Ed.), Corporate Ethics, Allied Publishers Ltd., New Delhi, 1994
5. Hendry J., and Sorell T., Business Ethics, Butterworth Heinemann, Oxford, 1994.

PE 2: New Product Development (PPEME120)

Module - I
Introduction: Challenges of product development; Successful product development; Quality aspect of product design; Market Research; Survey. Identify customer needs and Product Planning Processes.

Module - II
Product specifications: Process of setting specifications. Concept generation, selection, testing. Product Architecture: Implication of architecture, establishing the architecture, related system level design issue. Industrial design: Overview

Module - III
Design for manufacturing and assembly - tolerancing, design of gauges; Design for environment; Robust design. Prototyping; Engineering Materials. Concurrent engineering. Product costing, value engineering, Aesthetic concepts; visual effects of form and colour. Product data management.
Innovation and Creativity in Product Design. Case Studies.

Books:
1. Product Design and Development: Karl T. Ulrich, Steven G. Eppinger; Irwin McGrawHill.
2. Product design and Manufacture: A.C.Chitale and R.C. Gupta; PHI
3. New Product Development: Tim Jones, Butterworth, Heinmann, Oxford, 1997.
4. Product Design : Otto and Wood; Pearson education.
5. Industrial Design for Engineers: Mayall W.H, London, Hiffee References Ltd, 1988

PE 2: Manufacturing Strategy (PPEME121)

Module - I
Manufacturing Strategy: Relevance and concept, strategic issues in manufacturing, content and process aspect of manufacturing strategy, International innovations in manufacturing.

Module - II
Competitive priorities - quality, delivery, flexibility and cost, improvement activities. Trade-offs in manufacturing priorities, focused manufacturing, Implementation of manufacturing policies, world class manufacturing.

Module - III
Interface between manufacturing and marketing, inter-relationship among manufacturing Managers, suppliers, customers and competitors. Human resource issues, Case Studies

Books:
1. Voss C. A, Manufacturing strategy, 1992, Chapman & Hall
2. Steve Brown, Manufacturing the future, 2000, Prentice Hall
3. Terry Hill, Manufacturing strategy, 1989, Homewood, IL

PE 2: Marketing Management (PPEME122)

Module - I

Overview of marketing: Importance and scope of marketing, Marketing management and planning and environments of marketing strategy. Markets and segmentation, Consumer buying behaviour & Organizational buying behaviour

Research for marketing decisions: Problem formulation, Obtaining and organizing data, analyzing associative data, and selected activities in marketing research.

Module – II

Product and pricing strategies: product and service concepts, Product development strategy, Pricing concepts and practices.

Placement and promotion strategy: Marketing channels, Distributing goods. Advertising sales promotion and publicity, Personal selling and sales management

Module - III

Industrial marketing: Managing industrial sales, Industrial marketing communication, and industrial distribution strategy and control.

Books:
1. Marketing Management, Kotler Philip, PHI
2. Fundamentals of Marketing, Stanton William J, TMH
3. Marketing Management, Saxena Rajan, TMH

<center>**PE 2: Financial Management & Accounting (PPEME123)**</center>

Module - I
Introduction: Nature and scope, Finance functions, financial objectives, roles and responsibilities of the finance manager, introduction to Indian financial system, Sources of finance: Equity capital, debenture, preference capital and term loans, Cost of capital, Principles of Valuation: Opportunity Cost of Capital; Money-Time relationships and applications; Present Value; Discount Rates; Comparables

Module - II
Project and Firm Valuation: Evaluating Projects; Net Present Value; Measuring Cash flows, Internal Rate of Return; Firm Valuation; Growth and Free Cash flows; Valuation Models, Accounting vs. Economic Returns
Risk and Return: Introduction to Risk and Return; Historical Evidence; Measuring the Risk of a Portfolio; Statistics Review; Portfolio Theory; Risk in a Portfolio Context, Trade-off between Risk and Return; Measuring the Risk of a Stock; Discount Rates in Practice.

Module - III
Accounting: Cost accounting and its objectives, allocation of overhead cost; Cost and Performance based Systems; Concept of Activity Based Costing (ABC) Systems; System of Book Keeping; References of Accounts; Journalizing; Trial Balance.

Books:
1. Prasanna Chandra, Financial Management: Theory and Practice, TMH, New Delhi.
2. Eugene F Brigham & Michael C Ehrhardt, Financial Management: Theory and Practice, Thomson, Bangalore.
3. I M Pandey, Financial Management, Vikas, New Delhi.
4. Brealey, R., and S. Myers. Principles of Corporate Finance. Irwin/ McGraw Hill.
5. Robin Cooper& Robert S Kaplan, The Design of Cost Management Systems, Prentice Hall

<center>13</center>

MC: Research Methodology & IPR (PMCMH101)

Module I:
Introduction to RM: Meaning and significance of research. Importance of scientific research in decision making. Types of research and research process. Identification of research problem and formulation of hypothesis. Research Designs.
Types of Data: Primary data Secondary data, Design of questionnaire; Sampling fundamentals ad sample designs, Methods of data collection, Measurements and Scaling Techniques, Validity & Reliability Test.

Module II:
Data Processing and Data Analysis-I, Data editing, Coding, Classification and Tabulation, Descriptive and Inferential Analysis, Hypothesis Testing- Parametric Test (z test, t test, F test) and non-parametric test (Chi square Test, sign test, Run test, Krushall-wallis test).

Module III:
Data Analysis II: Multivariate Analysis- Factor Analysis, Multiple Regression Analysis. Discriminant Analysis, Use of Statistical Packages.

Reference Books:
1.   Research Methodology, Chawla and Sondhi, Vikas
2.   Research Methodology, Paneerselvam, PHI

Course Outcomes:
   CO1: Understood the Meaning of research problem, Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
   CO2: Got the knowledge of How to get new ideas (Criticizing a paper) through the Literature Survey (i.e. Gap Analysis).
   CO3: Understood the Filing patent applications- processes, Patent Search, Various tools of IPR, Copyright, Trademarks.
   CO4: Understood How to apply for Research grants and Significance of Report Writing, Steps in Report Writing, Mechanics and Precautions of Report Writing, Layout of Research Report.
   CO5: Got the knowledge of How to write scientific paper & Research Proposal - Structure of a conference and journal paper, how (and How Not) to write a Good Systems Paper:

Lab 1: Computational Lab (PLCME105)

List of Experiments:

Lab 2: Work Design Lab (PLCME106)

List of Experiments:

Audit-1

[To be decided by the Department]: Refer Appendix-I

Semester-2

Core 3: Quality Engineering and Management (PPCME203)

Module - I
Attributes of quality, Evolution of philosophy of Quality Management, Economics of quality and measurement of cost of quality, Data presentation techniques for quality analysis,
Statistical process control, Use of control charts and process engineering techniques for implementing quality plan, Machine and process capability analysis, statistical tolerance analysis, Acceptance sampling: Single, double and multiple sampling plans, Acceptance sampling for variables

Module - II
Reliability analysis and predictions, Bath-Tub Curve, Exponential and Weibull distribution in modelling reliability, System reliability
Experimental designs and factorial experiments: 2k factorial experiments, Taguchi philosophy; Loss function; Signal to noise ratio, Orthogonal arrays for parameter and tolerance design.

Module - III
Fundamentals of TQM: Customer orientation, Continuous improvement, Total participation; Some important philosophies and their impact on quality (Deming, Juran,Crossby), QC Tools, Components of Total Quality System (TQS), Quality audit,
Introduction to ISO 9000 and 14000 standards.

Books:
1. Fundamental of Quality Control and Improvement, Mitra A, PHI
2. Quality Planning and Analysis, Juran J M and Gryna F M, Tata McGraw Hill"

Core 4: Supply Chain Management (PPCME204)

Module - I
Introduction and overview of supply chain management; Supply chain performance: Strategic fit and scope; Supply chain drivers and obstacle
Designing distribution network, Network design in uncertain environment

Module - II
Demand forecasting in supply chain, Bullwhip effect in logistics, Aggregate planning in supply chain
Inventory Planning in supply chain, Economy of scale: cycle inventory managing uncertainty in supply chain: Safe inventory, Determination of optimal level of product availability

Module - III
Transportation and servicing, Pricing and revenue management in supply chain
Supply chain information system, E-business and supply chain

Books:
1. Supply Chain Management: Strategy, Planning, and Operation, Chopra Sunil and PHI Meindl Peter
2. Designing and Managing the Supply Chain Concepts, Strategies and Case Studies, David Semchi-Levi, Philip Kaminsky & Edith Semchi-Levi, TMH

PE 3: Computational Techniques and Soft Computing (PPEME201)

Module-I:
Neural Networks: Artificial Neural Network and Introduction, Learning Rules, Knowledge Representation and Acquisition, Different Methods of Learning. Algorithms of Neural Network: Feed-forward Error Back Propagation, Hopfield Model, Kohonen's Featrure Map, K-Means Clustering, ART Networks, RBFN, Application of Neural Network to the relevant field.

Module-II:
Fuzzy Logic: Basic Concepts of Fuzzy Logic, Fuzzy vs Crisp Set, Linguistic variables, Membership Functions, Operations of Fuzzy Sets, Fuzzy If-Then Rules, Variable Inference Techniques, Defuzzification, Basic Fuzzy Inference Algorithm, Fuzzy System Design, FKBC and PID Control, Antilock Breaking System(ABS), Industrial Applications.

Module-III:
NON-LINEAR Programming: Newton's Method, Augmented Langrange Multiplier Method, Dynamic Programming
Genetic Algorithm: GA and Genetic Engineering, Finite Element based Optimization, Hybridization of Optimization Technique, Application of Optimization Technique for Solving Projects (Project solutions)

Books:
1. Neural Networks- by Simon Haykin
2. Fuzzy Logic with Engineering Application- by ROSS J.T (Tata Mc)
3. Neural Networks and Fuzzy Logic – by Bart Kosko
4. Ashok D. Begundu & chandrapatla T.R "Optimization concept and application in engineering", Prentice Hall,1999
5. Rao S.S "Engineering Optimization"
6. Gill, Murray and Wright," Practical Optimization"
7. Optimization Research; Prabhakar Pai, Oxford University Press.

PE 3: Fuzzy System and Neural Network (PPEME205)

Module - I
Fuzzy Logic: Basic concepts of Fuzzy logic, Fuzzy vs Crisp set, Linguistic variables, membership functions, operations of Fuzzy sets, Fuzzy if-then rules, Variables inference techniques, defuzzification techniques, basic Fuzzy interference algorithm, application of fuzzy logic, Fuzzy system design implementation, useful tools supporting design.

Module - II
Neural Networks Characteristics: History of Development in neural networks, Artificial neural net terminology, model of a neuron, Topology, Types of learning. Supervised, Unsupervised learning. Basic Learning laws, Hebb's rule, Delta rule, widrow and Hoff LMS learning rule, correlation learning rule instar and ouster learning rules.

Module - III
Unsupervised Learning: Competitive learning, K-means clustering algorithm, Kohonen's feature maps. Radial Basis function neural networks- recurrent networks, Real time recurrent and learning algorithm. Introduction to Counter Propagation Networks- CMAC Network, ART networks, Application of NN in pattern recognition, optimization, Control, Speech and decision making.

Books:
1. Berkin Riza C and Trubatch, "Fuzzy System design principles- Building Fuzzy IF-THEN rule bases", IEEE Press.
2. Yegna Narayanan, "Artificial Neural Networks". 8th Printing. PHI (2003)
3. Patterson Dan W, "Introduction to artificial Intelligence and Expert systems", 3rd Ed., PHI
4. Simon Haykin, "Neural Networks" Pearson Education.
5. Yen and Langari, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education.
6. Jacek M Zaurada, "Introduction to artificial Neural Networks" Jaico Publishing Home, Fouth Impression.

PE 3: Software Engineering (PPEME206)

Module - I
Introduction: Evolution of Software Engineering, Software Life Cycle Models, Requirement Analysis and Specification
Conventional methods for software engineering: System Engineering, Analysis concepts and principles, Structured Analysis and Design; Analysis Modeling (DFD, ER Diagram, Data Dictionary, STD)

Module - II
Design Concepts and principles, Architectural design- Structured Chart, Component level Design.
User Interface Design
Object Oriented Software Engineering: Object Oriented Concepts and principles, UML for Object Oriented Analysis and Object Oriented Design.

Module - III
Implementation and Maintenance: Software Testing Techniques, Software testing Strategies, technical metrics for software, Software Implementation and Integration, Software Maintenance.
Managing software projects: Project management concepts, Software Project Planning, Risk Analysis and Management; Software project metrics, Software Quality Assurance, Software Configuration management.

Books:
1) Roger S. Pressman, "Software Engineering A Practitioners Approach", Mc-Graw Hill Publication.
2) Ian Sommerville, "Software Engineering", Pearson Education Asia.
3) Stephen R. Schach, "Object Oriented and Classical Software Engineering", Tata McGraw-Hill, 2002

PE 3: E-Governance (PPEME207)

Module - I
Basics of E-Governance: e-Governance: Policies, Strategies and Frameworks, Information Society Concepts and Principles, Introduction to ICT and e-Governance, Technology and Society, Business Information Systems, Government Process Re-engineering(GPR), Towards good governance through E-governance, Introduction to e-Democracy

Module - II
E-Governance Architecture: Planning and Implementing e-Governance, Legal Framework of e-Governance, Enterprise Business Architecture Development, Public Management and Administration, Business Models for Implementation of e-Governance, Change Management and Capacity Building in e-Governance Projects, Data System Infrastructural preparedness

Module - III
E-Governance Technologies: Usability of Virtual Environments, Information Management and Digital Archiving, Design and development of Data Exchange Layer for Government Information Systems, Technology and Individual: Ethics of Law and Technology, Internet of Things: Smart Devices, Processes and Services, Legal Aspects of Software and Database Protection, Introduction to Development in Cloud, Technical Change and Techno-economic Paradigms
Case Studies of e-Governance in India

Books:
1. E-governance for Development: A Focus on India, Shirin Madon , Palgrave Macmillan , 2009
2. E-governance: case studies, Ashok Agarwal, University Press India, 2007
3. IT-e-Governance in India, Kamalesh N. Agarwala, Murli D. Tiwari, Macmillan, 2002 4. E-government: from vision to implementation: a practical guide with case studies, Subhash C. Bhatnagar, SAGE, 2004
4. E-Governance: Concepts and Case Studies, C.S.R. Prabhu, PHI ,2011

PE 4: Business Analytics (PPEME216)

Module - I
Business Analytics: Definition, Evolution, Architecture, Benefits, Future; Business Analytics as Solution for Business Challenges, Effective Predictive Analytics, Integrating Analytics in Business Processes, Unstructured Data Analytics, Balanced Scorecard, Quality, Master Data Management, Data Profiling, Emerging Areas of Analytics: Facial Analytics, Retail Analytics, Social Media Analytics

Module - II
Data Modelling Concepts, Data Modelling Types and Techniques, Multidimensional modelling: measures, dimensions, attributes and hierarchies, Schemas, Data Marts,

Module - III
Data Integration: Extraction, Transformation and Load Processes, Data Warehouse: Definition, Architecture, Development and Implementation issues, OLTP and OLAP, Data Mining: Definition, Concepts, Applications and Methods

Books:
1. Business Analytics By Sahil Raj, Cengage Publication, 2015
2. Fundaments of Business Analytics by RN Prasad and Seema Acharya, Wiley India Publication
3. Win With Advanced Business Analytics by Jean Paul Isson and Jesse S. Harroitt, Wiley Publication, 2013
4. Successful Business Intelligence: Secrets to Making BI a Killer App by Cindi Howson, Tata McGraw Hill Edition 2012
5. Business Intelligence: A Managerial Approach by Efraim Turban, Ramesh Sharda, Dursun Delen and Daid King, Pearson Publication, 2012

PE 4: Maintenance, Safety and Reliability (PPEME217)

Module - I
Maintained systems and various definitions associated with them, Type of Maintenance. Maintainability analysis, Maintainability design considerations, Availability and MTTF computations, Renewal Theory Approach, Life Cycle Costs
Optimum Inventory Assessment. Optimal inspection, overhaul, replacement or repair strategies

Module - II
Causes and types of failures, Reliability expressions for constant, increasing and decreasing hazard rates. Data Analysis, Probability plots for various distributions (exponential, Weibull, Normal and Gamma) Maintainability test, demonstration and warranties, Case Studies
Maintenance strategies, Managing change, Selection of maintenance tactics, Planning and scheduling resources, Measurement and benchmarking of performance

Module - III
Safety in Maintenance: Reasons for Safety; Problems in Maintenance Safety and Maintenance Tasks; Guidelines for Equipment Designers to Improve Safety in Maintenance; Maintenance Safety-Related Issues for Equipment Manufacturers; Maintenance Personnel Safety

Books
1. Maintenance Engineering: A Modern Approach, B S Dhillon, CRC Press
2. Total Productive Maintenance, Borris & Steve, McGraw Hill
3. Maintenance Engineering and Management, D G Mahto & Anjani Kumar, Axis Books Pvt. Ltd., New Delhi
4. Reliability and Maintenance Engineering, R C Mishra, New Age International,

PE 4: Multivariate Statistical Modelling (PPEME218)

Module - I
Definitions and basic concepts of multivariate modelling a variate, type of variables, measurement scale, measurement error, multivariate measurement; types of multivariate techniques, classification of multivariate techniques, guidelines for multivariate analysis, structured approach to multivariate model building, and cases for multivariate modelling.

Module - II
Multivariate basics a multivariate descriptive statistic, statistical distance, multivariate normal distribution and its properties, examining data and outliers detection, and multivariate sampling distributions. Comparison of several multivariate means a paired comparison.

Module - III
Multivariate modelling of variance (MANOVA) a Univariate procedure, objectives, design issues and assumptions, estimation of MANOVA model, goodness of fit, interpretation of results, validations, and case examples. Multiple linear regressions - Objectives, design and assumptions, estimating the regression model and assessing overall model fit, interpreting the regressing variate, validation of results, stepwise and hierarchical regression, and case examples. Factor analysis - Objectives, design issues and assumptions, orthogonal factor model, method of estimation, principal component analysis, maximum likelihood method, factor rotation, factor scores, interpretation of factors, and case examples.

Books:
1. Johnson R.A. and Wichern D.W., Applied Multivariate Statistical Analysis, Pearson Education, Delhi, 2002, 767 pp.
2. Hair J.F., Anderson R.E., Tatham R.L., Black W.C., Multivariate data analysis with readings, Prentice Hall, Englewood Cliffs, New Jersey 07632, 1995, 745 pp.
3. Agresti A. Analysis of ordinal categorical data, John Wiley and Sons, New York, 1984, 287 pp.

4. Anderson S., Aquier A., Hauck W.W., Oakes D., Vandaele W., and Weisberg, H.I., Statistical methods for comparative studies, John Wiley and Sons, New York, 1980, 287 pp.

PE 4: Value Engineering and System Thinking (PPEME219)

Module I:
Value Engineering (VE): VE Concepts: Value, Value Analysis & Value Engineering, Function, Cost, Worth, VE in a Project Life Cycle, Reasons for Poor Value VE Methodology: VE Job Plans, Phases of Job Planning. Selection and Evaluation of Value Engineering Projects, Project Selection, Methods of Selection, Value Standards, Application of Value Engineering Methodology. VE Techniques: General Techniques, Special Techniques Function–Cost–Worth Analysis, Function Analysis System Technique (FAST), Creativity Techniques. VE Applications: Team Dynamics, Job Plan, Applications, Value Engineering Case Studies.

Module II:
Systems and Systems Thinking Concepts: Introduction to Systems, General Systems theory, Ways of thinking, Complexity and Systems thinking. Problem situation: Components of a problem situation (mind maps, rich pictures, boundary setting) Complexity: Concepts of Complexity, Relationships between Complexity and Systems thinking, Human Systems and the "Soft" methods of inquiry

Module III:
System Models: Concept of Modelling, Influence Diagrams. Flow Charts, Precedence charts, Spray Diagrams etc. Hard/Soft OR: Classifications of Problem Situations &Systems Approaches, Hard OR and Hard Systems Thinking, Soft OR and Soft Systems Thinking Soft Systems Methodology (SSM): Checkland's Soft Systems Methodology, Application of SSM to Particular Problematic Organizational Management Situations.

Books:
1. Anil Kumar Mukhopadhyaya, "Value Engineering: Concepts, Techniques and applications", SAGE Publications 2010.
2. Del L.Younker, "Value Engineering" Marcel Dekker, Inc. 2010

3. Heller, Edward D., Value Management: Value Engineering and Cost Reduction, Addison-Wesley 2010.
4. Gharajedaghi, J., Systems Thinking, Managing Chaos and Complexity: A Platform for Design Business Architecture, 2nd Edition, Butterworth Heinemann, 2005.
5. Michael C. Jackson. "Systems Thinking: Creative Holism for Managers," John Wiley 2015
6. Peter Checkland. "Soft Systems Methodology in Action" John Wiley 2001

Mini Project with Seminar (PPRME201)

[To be decided by the Department]

Lab 3: Simulation Lab (PLCME203)

List of Experiments:

Lab 4: Computational Techniques and Soft Computing Lab (PLCME202)

List of Experiments:

<u>Audit-2</u>

[To be decided by the Department]: Refer Appendix-II

Semester-3

PE 5: Reverse Engineering and Rapid Prototyping (PPEME305)

Module I:
Classification of manufacturing processes, Different Manufacturing Systems, Introduction to Rapid Prototyping (RP), Need of RP in context of batch production, FMS and CIM and its application; Basic Principles of Generative Manufacturing Processes.
Reverse Engineering: Need & Techniques, Data collection, Point-Cloud of data.

Module II:
Steps in RP: Process chain in RP in integrated CAD-CAM environment, Advantages of RP; Utility of Rapid Prototyping in Reverse Engineering. Classifications of different RP techniques – based on raw material, layering technique (2D or 3D) and energy sources; Comparative study of: - Stereo-lithography (SL) with photo-polymerization, SL with liquid thermal polymerization,

Module III:
Process Technology: Solid foil polymerization, Selective laser sintering, Selective powder binding, Ballastic particle manufacturing – both 2D and 3D, Fused Deposition Modelling, Shape Melting, Laminated Object Manufacturing, Solid Ground Curing, Repetitive Masking and deposition.

Recommended Text:
1. Product Design: Techniques in Reverse Engineering and New Product Development by K. Otto and K. Wood Prentice Hall, 2001.
2. Reverse Engineering: An Industrial Perspective by Raja and Fernandes. Springer-Verlag 2008
3. Reverse Engineering in Computer Applications. MIT Lecture Notes 2001
4. Rafiq I. Noorani, Rapid Prototyping, "Principles and Applications", Wiley & Sons, 2006.

5. Chua C.K, Leong K.F and Lim C.S, "Rapid Prototyping: Principles and Applications", Second Edition, World Scientific, 2003

PE 5: Enterprise Resource Planning (PPEME306)

Module I:
Introduction to ERP: Overview of ERP - Introduction and Evaluation of ERP, Reasons for the growth of the ERP-Market, Advantages and Disadvantages of ERP, Overview of Enterprise - Integrated Management Systems, Business Modeling, Integrated Data Model.
ERP-and Related Technologies: Business Process Re-engineering (BPR) – Best Practices in ERP, Business Intelligence Systems-Data Mining, Data Warehousing, On-Line Analytical Processing (OLAP).
ERP System Options and Selection Methods: Optimal Means of Developing an ERP, Measurement of Project Impact, IT Selection and Project Approval, ERP proposal Evaluation, Project Evaluation Techniques, Testing.

Module II:
ERP Implementation and Maintenance: Implementation Strategy Options, Features of Successful ERP Implementation, and Strategies to Attain Success, User Training , ERP Maintenance.
ERP - The Business Modules: Introduction: - Finance, Manufacturing (Production), Human Resource, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution.

Module III:
Future Directions in ERP: Introduction - New Markets, New Technologies, Faster Implementation Methodologies, New Business Segments, Trends in Security.

Books:
1. Alexis Leon, Enterprise Resource Planning, 10/E, TMH, 2004.
2. ERP: A Managerial Perspective, Sadagopan, S., Tata Mcgraw-Hill

PE 5: Management Information System (PPEME307)

Module - I
Concepts of MIS: Global factors responsible of growth of information systems, Types of Information Systems Evolution of information theory, Characteristics of management information System, Richard Nolan MIS Stages theory, Information Resource Management, Management information system organization functions MIS Long range planning Meaning and role of MIS in an organization.

Module - II
Analysis and design of information systems; Conceptual modeling of data and process in organizations.
System development life cycle model, Methods of collection of data, Tools for modeling and analysis of data: Concept of Data Base Data base management systems and its functions Data flow diagram, Data dictionary, Data banks.

Module - III
Tools for modelling and analysis of processes: Flow charts, Decision tables, Decision trees. Transform analysis, Transaction analysis. Information systems audit. Impact of MIS on organizations. Usefulness of various industrial engineering techniques in the design of MIS.

Books:
1. Management Information Systems, Lauden and Lauden, PHI(1999)
2. Management Information Systems by Jerome kanter
3. Management Information Systems by Davis Gordon.

PE 5: Lean Manufacturing and Service (PPEME308)

Module - I
Introduction: SEVEN forms of waste and their description; Historical evolution of lean manufacturing; Global competition, Customer requirements, Requirements of other stake holders, Meaning of Lean Manufacturing System (LMS), Meaning of Value and waste, need for LMS, Symptoms of underperforming organizations, Meeting the customer requirement, Elements of LMS

Module - II
Primary tools used in LMS: Meaning and Purpose of 5S Work place organization, 5S process – Sort, Set in order, Shine, Standardize, Sustain, Implementing 5S, Process Mapping and Value Stream Mapping (VSM) – Need for process maps, advantages, types and its construction, steps in preparing VSM; Concept of work Cell and its design, Line balancing algorithms and problems.

Module - III
Secondary tools used in LMS: Cause and effect diagram, Pareto chart, Radar chart, Poke Yoke, Kanban, Automation, SMED, Standardized fixture, DFMA, JIT, Visual workplace.
LMS Rules: Stability, Management, Standardized work, Pull system, Continuous improvement.
Lean Implementation: Training, selecting the projects, preparing project charter; Operator, process, machinery and equipment, workplace organization; LMS Design Process

Books:
  1. Simplifed Lean Manufacture, N. Goplakrishnan, PHI, 2010
  2. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007

Open Elective

[To be decided by the Department]: Refer Appendix-III

Project 1: (PPRME301)

[To be decided by the Department]: Dissertation (Phase-I)

Semester-4

Project 2: (PPRME401)

[To be decided by the Department]: Dissertation (Phase-II)