MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department of Mechanical Engineering

M. Tech. : Industrial Engineering

Course code	Course Title		Course Category	Total Number of Contact hours				Credits
				Lecture (L)	Tutorial (T)	Practical (P)	Total hours per week	
Semester-1								
MET651	Applied Statistics		Core	3	0	0	3	3
MET652	Production Planning and Control		Core	3	0	0	3	3
MET653	Work System Design		Core	3	0	0	3	3
MET654	Quality System Engineering		Core	3	0	0	3	3
MET655	Operations Research		Core	3	0	0	3	3
MET656	Manufacturing Systems Lab		Core	0	0	2	3	2
	Total Credits							**17**
Semester-2								
-	Elective-1	Students can opt any six electives in a semester	PE/OE	3	0	0	3	3
-	Elective-2		PE/OE	3	0	0	3	3
-	Elective-3		PE/OE	3	0	0	3	3
-	Elective-4		PE/OE	3	0	0	3	3
-	Elective-5		PE/OE	3	0	0	3	3
-	Elective-6		PE/OE	3	0	0	3	3
	Total Credits							**18**
Semester-3								
MET691	Seminar		PC	0	0	4	8	4
MET692	Dissertation		PC	0	0	16	-	16
	Total Credits							**20**

Semester-4								
MET693	Dissertation		PC	0	0	16	-	16
	Total Credits							**16**
	Grand Total			**36**	**0**	**36**		**71**

PC= Program Core; PE= Program Elective; OE= Open Elective

List of Electives

Subject Code	Course Title	Course Category	Credits	L	T	P
MET661	Artificial Intelligence in Manufacturing	PE/OE	3	3	0	0
MET662	Supply Chain Management	PE/OE	3	3	0	0
MET663	Human Resource Management	PE/OE	3	3	0	0
MET664	Financial Decision Making	PE/OE	3	3	0	0
MET665	Manufacturing Strategy	PE/OE	3	3	0	0
MET666	Productivity Engineering	PE/OE	3	3	0	0
MET667	Manufacturing System Analysis	PE/OE	3	3	0	0
MET668	Computer Integrated Manufacturing Systems	PE/OE	3	3	0	0
MET669	Product Design and Development	PE/OE	3	3	0	0
MET670	Strategic Information Technology & Systems	PE/OE	3	3	0	0
MET671	Project Management	PE/OE	3	3	0	0
MET672	Rapid Prototyping & Tooling	PE/OE	3	3	0	0
MET673	Maintenance Management	PE/OE	3	3	0	0
MET674	Six Sigma & Lean Manufacturing	PE/OE	3	3	0	0

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET651

Course Name : Applied Statistics

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Core
Prerequisites : none

Course Contents

Fundamentals of probability theory and statistical inference used in engineering and applied science, descriptive statistics, Probability models, random variables, expectations, moment generating functions and its properties, conditional probability, useful discrete and continuous distributions, their properties and applications in Q-ing, reliability, quality control and simulation, law of large numbers, central limit theorem and its applications, case studies, statistical inference, confidence interval estimation, point estimation, case studies, concept of null hypothesis, testing of hypothesis, goodness of fit tests, linear regression, non-parametric test procedures, industrial applications, curve fitting and other techniques of estimation, introduction to software in statistics.

Course Outcomes

After completing this course, student will be able:

- Learn the basic concepts of probability theory
- Understand basic principles of statistical inference
- Build a statistical model for secondary data sets
- Use analysis of variance techniques to test the equality of two or more means.

Recommended Readings

Text Books: -

1. Principles of Applied Statistics. Cox, D.R., and Donnelly, C.A., (2011). Camridge Press.
2. Probability and Statistics for Engineers. Johnson, R.A., (2011). 8th Ed., PHI Learning.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET652

Course Name : Production Planning and Control

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Core
Prerequisites : None

Course Contents

Management of Production Systems, Forecasting, Materials Management, Aggregate Planning, Master Planning Schedule, Capacity Planning, Sequencing and Scheduling, MRP, JIT, OPT, TOC.

Course Outcomes

After completing this course, students will be able:

- To explain the concept and importance of different decisions in production planning and control
- To identify the areas that require advanced planning and control in production and service systems
- To develop the capability of decision making in design, planning and control of production and service systems

Recommended Readings

Text Books: -

1. Integrated Production control Systems, Bedworth, David, D & James E Bailey, John Wiley & Sons.

Reference Books: -

1. Production Planning & Inventory Control, Narsimhan S. L., Mcleavy, Billirgton, PHI.
2. Operations Management, G.Cachon, C. Terwiesch, Mc Graw Hill

Online/E Resources: -

1. https://www.managementstudyguide.com/production-planning-and-control.htm
2. https://www.yourarticlelibrary.com/production-management/production-planning/production-planning-and-control-business/69520

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET653

Course Name : Work System Design

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Core
Prerequisites : None

Course Contents

Introduction of Work System Design, Concept of Productivity, Factors Influencing Productivity, Productivity Measurement Models, Productivity Improvement Techniques, Numerical Problems on Productivity; Work Study: Basic Concept, Concept of Work Content, Techniques of Work Study, Human Aspects of Work Study; Method Study: Basic Concept; Recording Techniques: Charts and Diagrams; Principles of Motion Economy; Micro-Motion Study; Therbligs; SIMO Charts; Memo-Motion Study, Cycle graph and Chrono-Cycle Graph; Work Measurement: Basic Concept, Techniques of Work Measurement, Performance Rating, Allowances; Time Study, Work Sampling, Numerical Problems; Synthetic Data, PMTS; Ergonomics: Basic Concept, Industrial Ergonomics, Man-Machine-Environment Interaction System; Physiological and Psychological Aspects of Ergonomics; Anthropometry, Positioning of Displays and Controls, Effect of Noise, Illumination, Vibration, Temperature and Humidity on Workplace Design; Case Studies.

Course Outcomes

On successful completion of the course, the student will be able to:

- Explain the scope and history of work study.
- Explain different concepts used in method study and apply time study principles for determination of standard time.
- Describe the physical and social requirements of the workplace design along with the use of anthropometric data in ergonomics study.

Recommended Readings

Reference books:

1. Mark S.Sanders, and Ernest J. McCormick, —Human factors in Engineering and Design, McGraw Hill, New York.
2. Davind J.Oborne, Ergonomics at Work, John Willy and Sons Ltd., New York.
3. International Labour Organisation, Introduction to Work Study,‖ Universal Book Corporation, New Delhi.
4. Francis and White,‖Facilities Location-an analytical approach,‖ McGraw Hill, New York

5. R.S.Bridger, Introduction to Ergonomics, McGraw Hill, New York.

Online/E resources: -

1. Work System Design (NPTEL)

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET654

Course Name : Quality System Engineering

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Core
Prerequisites : None

Course Contents

Fundamental of Quality, Contribution of quality gurus, quality cost. statistical process control & process capability. Acceptance Sampling plans for attribute and variable. Taguchi quality loss function and concept of robust design. Concept of six sigma, FMEA, QFD, Poka Yoke. ISO 9000 series of standard, QS 9000, TQM, Quality circles. Benchmarking. Reliability.

Course Outcomes

On successful completion of the course, the student will be able to:

- Understand and interpret the concept of quality and its connotations.
- Learn various tools of quality system and their application in industry.
- Demonstrate reasons for variation and its quantification analysis for process control.

Recommended Readings

Text Books: -

1. Grant, E.L.& Leavenworth R.S. Statistical Quality Control, McGraw Hill.
2. Juran J.M & Gryna F.M. Quality planning and analysis, McGraw Hill.
3. Koru Ishikawa, Guide to Quality Control, Asian Productivity Organization.
4. Amitava Mitra –Fundamentals of Quality Control & Improvement, Mcmillan Publishing Company.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET655

Course Name : Operations Research

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Core
Prerequisites : None

Course Contents

Review of Business Statistics and Probability, Probability Distributions, Sampling Distributions, Co-relation and regression analysis. Revision of Linear Programming Problem, Duality and Post Optimal Sensitivity Analysis. Integer Linear Programming, Goal Programming, Dynamic Programming. Introduction to Non-linear Programming Problems.

Course Outcomes

At the end of the course of study, individual will be able to demonstrate following skills which would be evaluated though various assessments:

- Understanding of dynamic programming problems and general principles of sequential optimization:
- Formulate mathematical programs for practical problems in Industrial engineering.
- Develop mathematical programming, heuristics and metaheuristics to solve real-world optimization models

Recommended Readings

Text Books: -

1. Operations research: applications and algorithms, Wayne L. Winston, Vol. 3. Belmont^ eCalif Calif: Thomson/Brooks/Cole, (2004).
2. Introduction to Management Operation Research and Management Science, J.L Rigss, Mc Graw-Hill Book Company, (1975)
3. Operations Research: A Practical Introduction, Ghaith Rabadi, Taylor and Francis (2018)

Reference books: -

1. Hamdy A Taha, Operations Research: An Introduction, Pearson Education/PHI, 8/E, 2007.
2. Singiresu S Rao, Engineering Optimization: Theory and Practice, New Age International (P) Limited, Third Edition, 1996
3. F S Hillier and G J Lieberman, Introduction to Operations Research, TMH, 8/E, 2006.

4. Winston,W.L., Operations Research: Applications and Algorithms, Thomson Learning, 4th Edition, 2004.

Online/E resources: -

1. Fundamental of operation research (NPTEL)
2. Operation Research (1) & (2) (Coursera)

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET656

Course Name : Manufacturing Systems Lab

Credits : 2 **L -** 0 **T -** 0 **P -** 2

Course Type : Program Core

Prerequisites : None

Course Contents

Study of SPSS/LISREL package & perform t-test, Correlation & regression analysis, ANOVA test. Practice on basic material flow objects in the simulation package, Modeling of assembly lines on simulation package, Design a manufacturing system with simulation package

Course Outcomes

On successful completion of the course, the student will be able to:

- Perform hypothesis testing and ANOVA.
- Perform Correlation & Regression analysis.
- Interpret the results of various statistical tests in the form of reports.
- Model and simulate a simple manufacturing system.

Recommended Readings

- SPSS/MINITAB
- LINGO Manual
- ARENA Manual

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET661

Course Name : Artificial Intelligence in Manufacturing

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : None

Course Contents

Introduction to artificial intelligence. Application of artificial intelligence (AI) techniques: Meta-heuristics such as simulated annealing, tabu search, genetic algorithms, particle swarm intelligence; Artificial Neural Networks (ANN); Fuzzy Logic Systems (FLS); Knowledge Based Systems (KBS); and Petri nets in manufacturing systems planning and control. Distributed AI and Multi Agent Systems (MAS).

Course Outcomes

After completing this course, student will be able:

- To have an appreciation for and understanding of both the achievements of AI and the theory underlying those achievements.
- To have an appreciation for the engineering issues underlying the design of AI systems.
- To have a basic proficiency in to write simple to intermediate learning algorithms programs and an ability to understand code written in that language.
- To have an understanding of the basic issues of knowledge representation, and heuristic search.

Recommended Readings

Text Book: -

1. Artificial Intelligence: A Modern Approach, Second Edition, Russell, S. and Norvig, P., Pearson Education (2009).

Reference book: -

1. Machine Learning, First Edition, Dutt, S., Chandramouli, S. and Das, A.K. Pearson Education (2018).

Online resources: -

1. https://towardsdatascience.com/how-can-artificial-intelligence-be-applied-in-manufacturing8662eaaea999#:~:text=In%20addition%20to%20facilitating%20the,can%20hel

p%20organizations%20design%20products.&text=These%20algorithms%20then%20explore%20all,iteration%20and%20improve%20upon%20it
2. https://www.seebo.com/machine-learning-ai-manufacturing/

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET662

Course Name : Supply Chain Management

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : None

Course Contents

Role of Supply Chain Management, Scope and Importance. Customer driver Strategies, Logistics and Competitive Strategy; System View, Co-ordination and Management of Transportation, Inventory, Order Processing, Purchasing, Warehousing, Materials Handling, Packaging. Customer Service Management. Marketing and Supply Chain Interface, finance and supply Chain Interface. Distribution Policies and Plans. International Logistics, Ocean Carrier Management. Import-Export Logistic Management Decision Support Models of Supply Chain Management: Transportation Systems. Warehouse Design, Distribution Policies, Transshipment. Etc. Information Systems.

Course Outcomes

On completion of this course, the students will be able to:

- Understand the fundamentals of elements and functions of supply chain, role of drivers and demand forecasting.
- To apply various techniques of inventory management and their practical situations.
- Analyze how supply chain decisions related to facility location can be applied to various industries and designing the supply chain.
- How various warehousing management system and transportation can be practiced in various industries?
- How supply chain performance can be measured using various models?

Recommended Readings

Reference Books: -

1. Ronald H. Ballou, Business Logistics Management, Prentice Hall
2. Martin Christopher, Logishes & Supply chain Management.
3. Mohanty. R. P, Deshmukh. S. G., Supply chain Management, Phoenix publishing

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET663

Course Name : Human Resource Management

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : None

Course Contents

Role and functions of Human Resource management, strategic human resource planning, structuring of organization, design of production organization, Motivation, Leadership, Team Building, Job design, Acquisition of human resources, {Performance Appraisal, Employee training and career development, Management of change, conflict management.

Course Outcomes

On completion of this course, the students will be able

- To develop the understanding of the concept of human resource management and to understand its relevance in organizations.
- To develop necessary skill set for application of various HR issues.
- To analyse the strategic issues and strategies required to select and develop manpower resources.
- To integrate the knowledge of HR concepts to take correct business decisions

Recommended Readings

Reference Books: -

1. Robbins, S.P., Organizational Behaviour, Concepts, Controversies and Aplications, PHI
2. Monappa Arun & Saiyadain M.S., Personnel Management, TMH

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET664

Course Name : Financial Decision Making

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : None

Course Contents

Financial Statement: balance sheet, P&L accounts, Financial analysis, liquidity ratios, leverage ratio, profitability ratios and activity ratios. Profit planning: Break even analysis, marginal analysis, EPS, P/E ratio, Return- on- Investment leverage. Capital Budgeting: Nature of Capital budgeting Decisions, time value of money, Various approaches to evaluate investment proposals. Risk and required return: Capital asset theory, weighted average required return, determination of required return, valuation of the firms' common stock. Short term and long term financial decisions: Sources of short-term finance, Sources of long term financing: convertible securities, warrants, effective cost of long term debt. Dividends policies and decisions: Nature of dividend decision, factors affecting dividend decisions, alternative form of dividends, developing dividend policies.

Course Outcomes

On completion of this course, the students will be able

- Develop an applied understanding of finance and accounting concepts relevant to general management roles.
- Critically analyse external financial statements and make informed decisions through the identification and application of appropriate KPIs
- Evaluate management accounting decision-making techniques and apply them in relevant internal and external situations
- Develop a critical awareness of the time value of money, risk, future returns and the capital investment decision.
- Engage effectively in management discussions on finance and accounting issues

Recommended Readings

Reference Books: -

1. Chandra Prasanna, Financial Management, Theory & Practice, Tata McGraw Hill.
2. Kuchal, S.C. Financial Management & Analytical and Conceptual Approach, Chitanaya Publishing House, Bombay.
3. John J. Humpton, Financial Decision-Making, Prentice Hall India.
4. I.M. Pandey, Financial Management, Vikas Publishing House.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET665

Course Name : Manufacturing Strategy

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : none

Course Contents

Manufacturing Strategy: Relevance and concept, strategic issues in manufacturing, content and process aspect of manufacturing strategy, International innovations in manufacturing. Competitive priorities - quality, delivery, flexibility and cost, improvement activities. Trade-offs in manufacturing priorities, focused manufacturing, Implementation of manufacturing policies, world class manufacturing. Interface between manufacturing and marketing, inter-relationship among manufacturing Managers, suppliers, customers and competitors. Human resource issues. Case Studies.

Course Outcomes

On successful completion of the course, the student will be able to:

- Understand and interpret the concept of Manufacturing Strategy.
- Understand strategies used by industry for manufacturing function and their method of application in industry.
- Develop appropriate manufacturing strategy for an industry.

Recommended Readings

Reference Books: -

1. Voss C. A, Manufacturing strategy: Process and content, 1992, London: Chapman & Hall.
2. Steve Brown, Manufacturing the Future: Strategic Resonance for Enlightened Manufacturing, 2000, Prentice Hall
3. Terry Hill, Manufacturing strategy, 1989, Homewood, IL

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET666

Course Name : Productivity Engineering

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : none

Course Contents

Basic definitions and scope of productivity. Significance of productivity in economic development. Productivity Measurement at national level. Diversity of productivity concepts. Partial productivity, total productivity and total factor productivity, Productivity measurement model, Total productivity models. Productivity Evaluation-Expression for total productivity change, the productivity Evaluation Tree. Productivity Planning. Long/short term productivity planning. Causes of low productivity in organization. Strategies for productivity improvement. Analytical productivity improvement model. Productivity improvement techniques: Technology based, materials based, product based, employee based and task based. Productivity in service industries; Case studies.

Course Outcomes

On successful completion of the course, the student will be able to:

- Explain the scope, diversity of productivity concept and productivity evaluation concept.
- Estimate different types of productivity with help of various productivity measures.
- Explain strategies for productivity improvement and describe different productivity improvement techniques.

Recommended Readings

Reference Books: -

1. Scot Sink, Productivity Management: Planning Measurement and Evaluation. Control and Improvement – John Wiley, N.Y.
2. Sumnath, David J., Productivity Engineering & Management, Mc.Graw Hill N.Y.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET667

Course Name : Manufacturing System Analysis

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : none

Course Contents

General System Theory, Fundamental of Manufacturing System, Process System for manufacturing, Management System for manufacturing. Automation System for manufacturing, Information System for manufacturing, Global manufacturing, Manufacturing excellence for future production perspective. System modeling tools and methods, System Planning tools, Integrated manufacturing System Design. Application of simulation in manufacturing systems.

Course Outcomes

On successful completion of the course, the student will be able to:

- Examine the changing roles of manufacturing on local, regional, national or global economies.
- Explore and compare roles and professions commonly found in manufacturing and describe common certifications and credentials required for each.
- Understand, describe, and explain the roles of planning and organizing in a manufacturing system.
- Describe and explain key components of the entire value chain including supplier relationships, manufacturing cost control, and internal and external customer relationships.

Recommended Readings

Reference Books: -

1. Hiltomi, Manufacturing System Engineering Tailor & Francis.
2. David O'Sullivan, Manufacturing System Redesigning, Prentice Hall

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET668

Course Name : Computer Integrated Manufacturing Systems

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : none

Course Contents

Information to automation & CIM, NC, CNC, DNC, PLC Manual & Computer aided part programming Group Technology & Computer aided process planning. Automated material handling system, Automatic storage & retrieval system. Robotics in Manufacturing System. Solid modeling, database for CAD/CAM and data exchange standards. Flexible Manufacturing System.

Course Outcomes

On successful completion of the course, the student will be able to:

- To expose the student to the different types of manufacturing available today such as the Special Manufacturing System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS)
- To learn the fundamentals of computer assisted numerical control programming and programming languages
- The common CAD/CAM data base organized to serve both design and manufacturing, and to practice the PLC control devices and CNC operation skills.

Recommended Readings

Reference Books: -

1. Ranky P.G. Computer Integrated Manufacturing, Prentice Hall
2. Mikell P.Groover, Automation, Production Systems and Computer Integrated Mfg, Prentice Hall
3. Rao, P N, CAD/CAM, TMH

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET669

Course Name : Product Design and Development

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : none

Course Contents

Product definition, New product development concept, product development process, consumer behavior, identifying customer needs. Establishing product specification, concept generation, concept selection and product architecture. Industrial design, design for manufacturing prototyping, Economic analysis of new products. Test marketing and commercialization of new products.

Course Outcomes

On successful completion of the course, the student will be:

- Able to explain how new products are planned.
- Able to identify approaches to generate and evaluate new product ideas.
- Able to analyse, evaluate and apply various tools and methods to product development process.
- Able to explain the process to create and commercialize new products.

Recommended Readings

Text Books: -

1. Product Design and Development by Karl T Ulrich, Tata McGraw Hill Education

Reference books: -

1. Product Design Method and Practices by Henry W. Stoll CRC Press

Online/E resources: -

1. https://www.lisaadelhi.com/product-development-vs-product-design/
2. https://www.designrush.com/trends/product-design-development

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET670

Course Name : Strategic Information Technology & Systems

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : none

Course Contents

Concepts and Principles of Strategic Information Systems Management Information System (MIS), Information flow and Decision-Making. System Development Life Cycle. Evaluation of MIS in an organization. Database Management System (DBMS) Concepts Models of DBMS. Hierarchical Network & Locational Design Considerations of DBMS Design Considerations of DBMS. Normalization, File Introduction to ORACLE/INGRESSRDMS. Evaluation of RDBMS Packages. Design Support Systems Concepts, Architecture and Implementation. Executive Information System: Distributed DATA Processing: Concept and Implementations considerations; Vertical, horizontal and heterogeneous systems. Network structure & Architecture Type of Networks. Wide Area Network (WAN) Local Area Network (LAN) Design consideration of LAN and its implementation criteria Ethernet, ARCNET, Token ring consideration in LAN environment and its advantages. Difficulty with conventional manufacturing methods needs for intelligence, basic concept of Artificial Intelligence, Problem representation, Problem solution Techniques. K Overview of expert systems.

Course Outcomes

On successful completion of the course, the student will be:

- Apply the strategic framework analysis tools for identifying strategic IT solutions.
- Evaluate strategies for implementing IT-based business solutions.
- Examine customer service and information security management issues.

Recommended Readings

Reference books: -

- C.J.Date, An Introduction to DataBase Management System Narosa Publication House.
- Martin J., Design and Strategy for DDP Prentice Hall.
- Tannabaum, A.S., Computer Network, Prentice Hall.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET671

Course Name : Project Management

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : None

Course Contents

Project as a goal fulfillment venture, projects versus routine production, life cycle of a project, generation of new project ideas, brainstorming, screening of ideas, project appraisal on various fronts: market and demand, technical feasibility, financial evaluation, ecological appraisal, multi-criteria evaluation of projects, work breakdown structure, project network development, project scheduling using PERT and CPM, floats and their interpretation, project simulation, project crashing and resource aggregation, leveling and allocation, project monitoring and control using earned value and the concept of critical chain, human factors in project management.

Course Outcomes

On successful completion of the course, the student will be able to:

- Describe the main aspects of project management and project life cycle
- Select a project, define it and map its elements with organizational structure
- Describe the factors affecting time and cost estimates and methods of cost estimation
- Determine the time needed to complete the project and suggest project crashing plan
- Develop resource feasible project schedule.
- Apply concepts of earned value management system and analyse project progress using calculated indices

Recommended Readings

Reference Books: -

1. Jack R. Meredith and Samuel J. Mantel Jr., Project Management, A Managerial Approach, 6th Edition, John Wiley & Sons.
2. Gray Clifford F. and Erik W. Larson. 2011. Project Management: The Managerial Process. 5th edition. McGraw-Hill Irwin Publishers

3. J.D. Wiest and F.K. Levy, Management Guide to PERT/CPM with GERT/PDM/DCPM John, Prentice Hall.
4. Harold Kerzner, Project Management: A systems approach to project planning scheduling and controlling. John Wiley and Sons Inc.
5. Arun Kanda., Project Management – A Life Cycle Approach, PHI Learning.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET672

Course Name : Rapid Prototyping & Tooling

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : None

Course Contents

Review of solid modeling techniques with comparison advantages and disadvantages. Basic Principle of RP processes, Classification of RP Processes, Various Industrial RP Systems like Sterolithography, Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing, 3D Printing, Ballistic particle modeling etc., Role of Rapid Prototyping and Rapid Tooling in Product Development and Simultaneous Engineering. Process planning for rapid prototyping, STL file generation Defects in STL files and repairing algorithms, Slicing and various slicing procedures, Accuracy issues in Rapid Prototyping, Strength of RP Parts, Surface roughness problem in Rapid Prototyping, Part deposition orientation and issues like accuracy, surface finish, build time, support structure, cost etc., Rapid tooling techniques such as laminated metallic tooling, direct metal laser sintering, vacuum casting. Introduction to reverse engineering Integration of reverse engineering and rapid prototyping.

Course Outcomes

On successful completion of the course, the student will be able to:

- Demonstrate the knowledge of Rapid Prototyping technologies.
- Describe different RP techniques.
- Discuss fundamentals of Reverse Engineering.

Recommended Readings

Reference Books: -

- K Chua, K F Leong & C S Lim, Rapid Prototyping- Principles and Applications, World Scientific, 2nd Edition, 2005
- Patri K Venuvinod- Weiyin Ma, Rapid Prototyping- Laser Based and Other Technologies, Kluwer Academic Publishers, 2004.
- Ali K Kamrani, Emad Abouel Nasr, Rapid Prototyping- Theory and Practice, Springer, 2006.
- Kenneth G Cooper, Rapid Prototyping Technology- Selection and Application, Marcel Dekker, Inc
- D.T.Pham and S.S. Dimov,Rapid manufacturing; the technologies and applications of rapid prototyping and rapid tooling.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET673

Course Name : Maintenance Management

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : None

Course Contents

Reliability: Hazard rate, mean time to failure. Hazards models. Constant hazard Weibul model. System Reliability: Series, parallel and mixed configurations. k-out-of-n-structure. Economics of introducing a standby or redundancy into a production system, optimum design configuration of a series/parallel system: maximizing reliability subject to budgetary constraint optimum level of active parallel redundancy for equipment with components subject to failure. Maintainability: Maintainability increment Equipment and mission availability. Replacement Decisions: Economic models block replacement policy, age replacement policy, replacement policies to minimize downtime, economics of preventive maintenance. Inspection Decisions: Optimal inspection frequency to profit maximizing, minimization of downtime and availability maximization. Overhaul and Repair Decisions: Optimal overhaul/repair/replace maintenance policies for equipment subject to breakdown finite and infinite time horizon. Optimal repair effort of a maintenance work force to meet fluctuating taking into subcontracting opportunities. Spares Provisioning: Spares provisioning for single and multiechelon systems under budgetary constraints. Maintenance Organisation: Computer application in maintenance management, MIS for maintenance.

Course Outcomes

On successful completion of the course, the student will be able to:

- Use statistical tools to characterize the reliability of an item and determine the reliability of a system
- To understand the application of maintenance strategies in a manufacturing environment;
- To establish maintenance strategies according to system characteristics and design transition programs to implement these strategies.
- To apply concepts of TPM, RCM, & FMECA in managing the manufacturing organization with highest possible levels of reliability/ availability.

Recommended Readings

Reference Books: -

- Gopalakrishnan, P. and Banerji, A.K. (2009), Maintenance and Spare Parts Management, PHI Learning.
- Srivastava, SK. (2012), Maintenance Engineering Principles, Practices and Management, S.Chand Publishers.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET674

Course Name : Six Sigma & Lean Manufacturing

Credits : 3 **L -** 3 **T -** 0 **P -** 0
Course Type : Program Elective
Prerequisites : none

Course Contents

Lean - Evolution & Steps, Lean - Specify Value - Quality at Source, 5S Concepts, 5S Implementation, Lean – Identify Value Stream - Process Mapping, Why is Inventory bad, Process Layouts, Lean - Make It Flow - Setup Time Reduction, Hejunka, Total Productive Maintenance, Lean - Pull - Visual Controls, Lean - Pull - Push & Pull Systems, Lean - Pull – JIT, Six Sigma (basics and history of the approach, methodology, and focus), the application of Six Sigma in production and service industries, Relationship of Six Sigma and Lean Management, linking Six Sigma project goals with organizational strategy; Basic description and application of tools of the DMAIC methodology.

COURSE OUTCOMES

At the end of the course of study, individual will be able to demonstrate following skills which would be evaluated though various assessments:

- Explain the approaches to, concepts, and theories of Lean Manufacturing, including key aspects of Six Sigma & apply appropriate Lean Tools procedures for a Lean manufacturing
- Identify concept of non-value added activities, variation in processes & develop competency for identifying wastes in the processes, draft a project charter and Make Value Stream Map
- Select appropriate Process Capability Six Sigma measurement and data analysis techniques and apply them to improve the value of products and process
- Ability to use DMAIC (Define, Measure, Analyse, Implement and Control) methodology and operate Lean tools for effective implementation and application of Lean Six sigma.
- Ability to use a structured approach to process improvement. Skills to reduce variation in processes and achieve predicted outcomes.

Recommended Readings

Text Books:-

1. The Tactical Guide to Six Sigma Implementation, S Patel, CRC Press (2017)
2. The Ten Commandments of Lean Six Sigma: A Guide for Practitioners, Jiju Antony, Laux Chad, Cudeny Elizabeth, Emerald Group Publishing (2019).
3. Lean Six Sigma for Small and Medium Sized Enterprises: A practical guide, Jiju Antony, Sekar Vinodh, E.V. Gijo, CRC Press (2017)

Reference books:-

1. Becoming Lean - Inside Stories of U.S. Manufacturers, Jeffrey K. Liker, Productivity Press, Portland, Oregon
2. The Six Sigma Handbook, Third Edition, Thomas Pyzdek & Paul Keller, McGrawHill
3. Lean Six Sigma by Michael L George by McGraw Hill
4. The Certified Six Sigma Green Belt Handbook, Second Edition: Roderick A. Munro, Govindarajan Ramu and Daniel J. Zrymiak,ASQ Quality Press
5. Implementing Six Sigma: Smarter Solutions Using Statistical Methods: Forrest W. Breyfogle, John Wiley & Sons
6. James P.Womac, Daniel T Jones, Daniel Rose; The Machine That Changed the World

Online/E resources:-

1. Six Sigma (NPTEL)
2. Introduction a Lean Six Sigma (Coursera)

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET691

Course Name : Seminar

Credits : 4 **L -** 0 **T -** 0 **P -** 4
Course Type : Program Core
Prerequisites : none

Objectives: The students will be able to aware of the exploration of literature survey, learn research methodology and technical report writing.

Course Outcomes:

On successful completion of the course, the student will be able to:

- Search literature on selected cutting-edge technology/research area/contemporary industrial engineering issue.
- Classify and arrange the literature in a meaningful way.
- Critically analyse the assumptions, hypotheses and arguments in the selected literature.
- Summarize previous research in the selected area and draw conclusions.
- Write and present a report for effective communication of the findings.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET692

Course Name : Dissertation

Credits : 16 **L -** 0 **T -** 0 **P -** 16
Course Type : Program Core
Prerequisites : none

Objectives: The students will be able to provide necessary knowledge and skills for solving the complex problems related to industrial engineering. It involves problem identification, formulation and data collection.

Course Outcomes

On successful completion of the course, the student will be able to:

- Identify the problem
- Formulate problem and select appropriate research method(s).
- Search relevant literature and identify research gap.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mechanical Engineering

Course Code : MET693

Course Name : Dissertation

Credits : 16 **L -** 0 **T -** 0 **P -** 16
Course Type : Program Core
Prerequisites : none

Objectives: The students will be able to provide necessary knowledge and skills for solving the complex problems related to industrial engineering. It involves problem formulation, data collection, analysis and interpretation, simulation, model building etc.

Course Outcomes

On successful completion of the course, the student will be able to:

- Identify and formulate problem and select appropriate research method(s).
- Search relevant literature and identify research gap.
- Apply appropriate tools and techniques for data collection.
- Analyse and interpret the results through various statistical tools and validate them.
- Communicate and present the research outcomes through an effective report.