CURRICULUM

Academic year 2022 – 2023

**DEPARTMENT OF
INDUSTRIAL ENGINEERING AND MANAGEMENT**

I to IV Semester M. Tech.

M.Tech in INDUSTRIAL ENGINEERING (MIE)

RAMAIAH INSTITUTE OFTECHNOLOGY
(Autonomous Institute, Affiliated
to VTU)
BANGALORE – 54

About the Institute:

Ramaiah Institute of Technology (RIT)(formerly known as M.S. Ramaiah Institute of Technology) is a self-financing institution established in Bangalore in the year 1962 by the industrialist and philanthropist, Late Dr. M S Ramaiah. The institute is accredited with "A⁺" grade by NAAC in 2020 and all engineering departments offering bachelor degree programs have been accredited by NBA. RIT is one of the few institutes with prescribed faculty student ratio and achieves excellent academic results. The institute was a participant of the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. All the departments have competent faculty, with 100% of them being postgraduates or doctorates. Some of the distinguished features of RIT are: State of the art laboratories, individual computing facility to all faculty members. All research departments are active with sponsored projects and more than 304 scholars are pursuing PhD. The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus. RIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air conditioned library withover1,35,427 books with subscription to more than 300 International and National Journals. The Digital Library subscribes to several online e-journals like IEEE, JET etc. RIT is a member of DELNET, and AICTE INDEST Consortium. RIT has a modern auditorium, several hi-tech conference halls and all are air-conditioned with video conferencing facilities. It has excellent hostel facilities for boys and girls. RIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. RIT obtained Academic Autonomy for all its UG and PG programs in the year 2007. As per the National Institutional Ranking Framework, MHRD, Government of India, Ramaiah Institute of Technology has achieved 59th rank in 2022 among the top 100 engineering colleges across India.

About the Department:

The department was established in the year 1979 as Industrial & Production Engineering and renamed as Industrial Engineering & Management in the year 1992 with an intake of 60 students and M.Tech program commenced in the year 2012. The department has been recognized as R&D center by VTU with 14 students perusing their Ph.D. The department has well modernized laboratories namely Industrial & Quality Engineering lab, Computer Lab and Metrology & Mechanical Measurement lab. The department is having highly qualified, motivated and result oriented faculty members. All the faculty are involved in research and technical paper publications in reputed technical journals, conferences across the world. The department was accredited by the NBA in 2001, 2004, 2010, 2015 & reaccredited in year 2018 as per the new NBA format laid down by Washington Accord. It has consistently bagged university ranks in Bangalore University & VTU. It has set a unique record of achieving 1st rank eleven times. The department has successfully conducted around 40 faculty development programs, seminars & workshops for academicians, Industry personnel, students and technical staff. The society of Industrial Engineering and Management, "INDEMAN SOCIETY" was established in the year 1996. The activities of this society includes: Regular Industrial visits and Guest Lectures which are conducted twice every semester for all students. The department also has Quality Engineering Club, Materials & Manufacturing Club and Productivity Club, the students can enroll to carryout activities based on their interest. Many funded research projects are executed which are sponsored by UGC, AICTE, DST, VTU and VGST.

Focus of the Department:

The department mainly focuses on the following thrust areas which include optimization, productivity enhancement, quality control, work system design, supply chain management, Computer Integrated Manufacturing, Operations Planning and Control and other related areas. Our graduates are placed in a spectrum of manufacturing and service industries. Our focus is also on developing future entrepreneurs.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization

- Establishing research clusters in emerging areas in collaboration with globally reputed organizations

- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned.

THE VISION OF THE DEPARTMENT

To, produce globally competent Industrial engineers, researchers and entrepreneurs capable of developing solutions to continually improve socio technical systems and add value to the society.

THE MISSION OF THE DEPARTMENT

The Industrial Engineering and Management Department shall transform the entrants of the Industrial Engineering and Management program into

- Professionally competent engineers through innovative educational curricula

- Balanced research program

- Effective collaboration with industry and academia.

M.Tech Program Educational Objectives (PEO's)

The Post Graduates of Industrial Engineering will effectively:

PEO 1: Apply the skills and competence of Industrial Engineering to interpret and solve real life problems

PEO 2: Engage, empower, build and lead the cross-functional teams to solve integrated eco-systems

PEO 3: Involve continued competitive research leading to cutting edge solutions

M.Tech Program Outcome's (PO's)

The Post Graduates of Industrial Engineering will have ability to:

PO1: Independently carry out research/investigation and development work to solve practical problems.

PO2: Write and present a substantial technical report/document.

PO3: Identify advanced engineering and IT tools to solve innovative industrial engineering challenges.

PO4: Demonstrate the importance of environmental sustenance through the application of professional ethics along with techno-social responsibilities.

PO5: Implement the principles of project management to solve societal issues.

PG Curriculum Course

Credits

2022-23

Scheme Structure of M. Tech Program from the Academic Year 2022-23

Semester	Professional Core Courses- (PCC)	Professional Core Courses Lab- (PCCL)	Professional Electives Courses - (PEC)	Mandatory Credit Courses (MCC)	Project Work/ Seminar (PW)	Internship- (INT)	Total semester load
First	6	2	11	3	-	-	22
Second	8	2	12	-	-	-	22
Third	4	-	4	-	4	4	16
Fourth	-	-	-	-	20	-	20
Total	18	4	27	3	24	4	80

M.Tech - Industrial Engineering (Mie)
Scheme of Teaching and Examination 2022-23

I SEMESTER

Sl. No.	Subject Code	Subject	Credits			Total
			L	T	P	
1	MIE11	Probability and Statistical Modeling	2	1	0	3
2	MIE12	Work System Design and Ergonomics	3	0	0	3
Elective – A						
3	MIEE131	Computerized Facilities Planning and Design	3	0	0	3
	MIEE132	Enterprise Resource Planning				
	MIEE133	Product Cost analysis and optimization				
	MIEE134	Theory of Inventive Problem Solving				
Elective – B						
4	MIEE141	Advanced Production Planning and Scheduling	4	0	0	4
	MIEE142	Product Design and Manufacturing				
	MIEE143	Innovation and Design Thinking				
	MIEE144	Human and Organizational Factors				
Elective – C						
5	MIEE151	Lean Manufacturing Systems	4	0	0	4
	MIEE152	Management Information Systems				
	MIEE153	Product Lifecycle Management				
	MIEE154	Managerial Economics				
6	RMI16	Research Methodology & IPR	3	0	0	3
7	MIEL17	Probability and Statistical Modeling Lab	0	0	1	1
8	MIEL18	Work System Design and Ergonomics Lab	0	0	1	1
		Total	19	1	2	22

L: Lecture   **T:** Tutorial   **P:** Practical

M.Tech - Industrial Engineering (Mie)
Scheme of Teaching and Examination 2022-23

II SEMESTER

Sl. No.	Subject Code	Subject	Credits			Total
			L	T	P	
1	MIE21	Systems Simulation and Modeling	3	1	0	4
2	MIE22	Quality Engineering	4	0	0	4
Elective – D						
3	MIEE231	Experimental Design and Analysis	4	0	0	4
	MIEE232	Cyber Security				
	MIEE233	Additive Manufacturing				
	MIEE234	Rapid Prototyping				
Elective – E						
4	MIEE241	Management Accounting and Finance	4	0	0	4
	MIEE242	Python Programming				
	MIEE243	Block Chain Technologies				
	MIEE244	Data Warehousing and Mining				
Elective – F						
5	MIEE251	Evaluation of Supply Chain Management	4	0	0	4
	MIEE252	Innovation and Technology Management				
	MIEE253	Systems Engineering				
	MIEE254	Artificial Intelligence and Expert System				
6	MIEL26	Systems Simulation and Modeling Lab	0	0	1	1
7	MIEL27	Quality Engineering Lab	0	0	1	1
		Total	**19**	**1**	**2**	**22**

L: Lecture   **T:** Tutorial   **P:** Practical

M.Tech - Industrial Engineering (Mie)
Scheme of Teaching and Examination 2022-23

III SEMESTER

Sl. No.	Subject Code	Subject	Credits			Total
			L	T	P	
1	MIE31	Quantitative Techniques in Decision Making	3	1	0	4
		Elective – G				
2	MIEE321	Project Management for Business, Engineering and Technology	4	0	0	4
	MIEE322	Industry 4.0				
	MIEE323	Software Engineering				
	MIEE324	Computational Methods for Queuing Networks				
3	MIEI33	Internship/Industrial Training	0	0	4	4
4	MIEP34	Project Work - I	0	0	4	4
		Total	**7**	**1**	**8**	**16**

L: Lecture   **T:** Tutorial   **P:** Practical

SCHEME OF TEACHING
IV SEMESTER
M.TECH - INDUSTRIAL ENGINEERING (MIE)

IV SEMESTER

Sl. No.	Subject Code	Subject	Credits			Total
			L	T	P	
1	MIEP41	Project Work - II	0	0	20	**20**
		Total	**0**	**0**	**20**	**20**

L: Lecture   **T:** Tutorial   **P:** Practical

I SEMESTER

PROBABILITY AND STATISTICAL MODELING

Course Code: MIE11	Credits:2:1:0
Pre-requisites :Nil	Contact Hours: 28Theory+ 14Tutorial session
Course Coordinators: Dr. Niranjan C A	

Course Contents

Unit – I

Introduction to probability theory, Properties of probability models, Uniform probability on finite spaces, Conditional probability and Independence (simple problems), Total Probability and Bayes' Theorem (Simple Problems).
Introduction to statistics: Measure of central tendency and dispersion, Tabular and Graphical display- Histogram, Ogive curve, Box plot, Stem and Leaf plot

- ➢ **Pedagogy:**   ➢ Black board teaching
- ➢ **Links:**   ➢ https://www.youtube.com/watch?v=asxiPIVhj3g
  - ➢ https://www.youtube.com/watch?v=ALzXH-U8W6U
  - ➢ https://www.youtube.com/watch?v=dY5xhLgfV1A
  - ➢ https://nptel.ac.in/courses/111106112
  - ➢ http://elearning.vtu.ac.in/econtent/courses/video/MBA/MBA23.html

Unit -II

Concept of Random Variables and Probability distributions: Introduction to Discrete Random variables (No analytical treatment), Probability distributions and Probability mass functions, Cumulative distribution functions, Mean and Variance of a discrete random variable, discrete uniform distribution, Binominal distribution, Hyper-Geometric distribution, Poisson distribution, Applications.
Mathematical Expectation; Mean of random variable

- ➢ **Pedagogy:**   ➢ Black board teaching
- ➢ **Links:**   ➢ https://www.youtube.com/watch?v=6x1pL9Yov1k
  - ➢ https://www.youtube.com/watch?v=xFss2H1Cq5w
  - ➢ https://www.youtube.com/watch?v=1YkfeR05YXY

Unit -III

Continuous Probability Distribution; Probability distributions and probability density functions, cumulative distribution functions, Mean and Variance of a continuous random variable, uniform distribution, Exponential Distribution, Normal distribution, Chi Square Distribution, Normal approximation to Binominal and Poisson distribution

Unit – IV

Hypothesis Testing: Introduction to Statistical inference, Point and Interval Estimation, Hypothesis Testing on Means; single and two population means, **Introduction to Non-Parametric Statistics Test**, Sign Test, Sign Test for paired samples, Wilcoxon Signed Rank Test, Paired Observations, Wilcoxon Rank Sum test

Unit – V

Regression Analysis: Introduction, Scatter plot.
Simple Linear Regression Model, Least square and Fitted Model, Properties of Least square estimators, Inference Concerning the regression co-efficients, Correlation.
Multiple Linear Regression Model, Estimating the co-efficients, Study of residuals.

Text Books

1. Douglas C Montgomery, George C Runger ; Applied Statistics & Probability, 6th Edition , Wiley, 2013
2. Walpole, R.E., Myers, R.H., Myers, S.L., Ye, K.Y. Probability and statistics for Engineers and scientists, Macmillan, Pearson, 9th Edition, 2016
3. Probability and Statistics in Engineering by William W. Hines, Douglas C. Montgomery, David M. Goldsman, Connie M. Borror, John Wiley and Sons, Inc, Fourth Edition , 2002
4. Sheldon M Ross : Introduction to Probability and Statistics for Engineers and Scientists, 5th Edition , Elsevier, 2014

Reference Books
1. Sheldon M Ross : Introduction to Probability Models 10th Edition, Academic Press, 2009
2. Richard l. Levin , David S Rubin, Statistics for Management , 7th Edition ,2008
3. Introduction to Stochastic Process with R, Robert P Dobrow , Wiley , 2016

Course outcomes
At the end of the course, students will be able to:
1. Understand the formulation of modern probability theory and understand the statistical inference tools. Use principles of Bayes' theorem in problem solving situations. (PO-1, PO-3)
2. Understand the concept of probability distribution of a discrete random variable. Learn how to apply the rules of mathematical expectation to a function of random variables. (PO-1, PO-3)
3. Use a probability distribution for a continuous random variable to estimate probabilities and identify unusual events. Understand the difference between a discrete and continuous probability distribution. (PO-1, PO-3)
4. Understand hypothesis testing as making an argument and learn the logic and framework of the inference of hypothesis testing. Identify multiple applications where nonparametric approaches are appropriate. (PO-1, PO-3)
5. Estimate the relationship between explanatory and response variable using regression analysis. Determine the effect of each explanatory variables on the response variable. (PO-1, PO-3)

WORK SYSTEM DESIGN AND ERGONOMICS

Course Code: MIE12	Credits:3:0:0
Pre-requisites : Nil	Contact Hours: 42
Course Coordinators: Dr.S.Appaiah / Dr. Hemavathy S	

Course Contents

Unit I

Introduction: Nature of work (Pyramidal Structure of work, Importance of time), **Work System**: Physical work system, Professional Practice, Types of Occupation, Productivity: Labor, Multifactor, Productive work Content,

Manual work and Worker Machine Systems: Types of Manual work, Cycle time analysis of manual work, Worker-Machine Systems:Types of worker-machine systems, Cycle time worker machine systems, Automated Systems, determination of worker and machine requirements (Set up not included).

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos

➢ **Link:**   ➢ https://nptel.ac.in/courses/112107142

Unit II

Method & Motion Study: Outline Process Chart, Flow Process Chart, Two Handed Process Chart, Multiple Activity Chart, String Diagram, Travel Chart, Principles of Motion Economy, Motion Study: Therblig, SIMO chart

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos

➢ **Link:**   ➢ https://nptel.ac.in/courses/112107249

Unit III

Work Measurement : Types, Average worker and standard performance, allowances, Accuracy, precision and speed ratio, Direct Time study : Procedure, Determination of standard time, Determination of work cycles, Performance rating, Time study equipment, Predetermined motion time systems : procedure, Methods of time measurement, Work sampling

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos

➢ **Link :**   ➢ https://www.youtube.com/watch?v=8xFt6BIQTHA

Unit IV

Ergonomics: Introduction, Man Machine system, Physical ergonomics: Human Physiology, Muscular effort and work Physiology, Anthropometry: variables,

Principles and Application. Cognitive Ergonomics: Human Sensory System, Perception, Attention resources, Memory

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos

- ➤ **Link:**   ➤ https://nptel.ac.in/courses/112104222

Unit V

Cognitive Ergonomics contd.: Response Selection and execution, Common cognitive tasks, Design Guidelines for cognitive work

Physical Work Environment: Visual Environment and Lighting, Auditory Environment and Noise, Climate Control in work Environment

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos

- ➤ **Link:**   ➤ https://onlinecourses.nptel.ac.in/noc20_de12/preview

Text books

1. M.P.Groover-Work Systems: The Methods, Measurement & Management of Work, ISBN: 978-93-325-8124-1, Pearson, 1st Edition, 2013.
2. Geroge Kanawaty - ILO -Introduction to work study, ISBN 13:9788120406025 Publisher: India Book House Pvt. Ltd, 4th Revised Edition, 2008.

References

1. Ralph M Barnes -Motion and Time study, ISBN:13:978981426182 Publisher: John Wiley, 7th edition 2009.
2. Andris Freivalds and Benjamin Niebel - Niebel's Methods, Standards, & Work Design, ISBN-13: 978-0073376318, Mc Graw Hill, 13th Edition, 2014
3. M S Sanders and E J McCormic - Human Factors in Engineering Design, ISBN: 13:9780070549012, Mc Graw Hill, 7th Edition.

Course Outcomes

At the end of the course, the student will be able to

1. Identify various types of work and provide various measures of analyzing work (PO-1,3)
2. Identify and Develop various method study techniques for solving real time problems(PO-1,3,4)
3. Develop work measurement techniques for solving real time problems (PO-1,3,4)
4. Develop, Design Analyze Man machine system using principles of anthropometry (PO-1,3,4)
5. Develop, Design various Man Machine system based on consideration of cognitive, lighting and noise aspects (PO-1,3,4)

ELECTIVE-A

COMPUTERIZED FACILITIES PLANNING AND DESIGN

Course Code: MIEE131	Credits:3:0:0
Pre-requisites :Nil	Contact Hours: 42
Course Coordinators: Dr. M Rajesh/ Dr. M R Shivakumar	

Course Contents

Unit I

Defining Requirements – Facilities planning defined, significance, objectives, planning process. Flow, Space and Activity relationships, flow patterns, flow planning, measuring flow, space requirements.

- ➢ **Pedagogy:**
- ➢ **Links:**
  - ➢ Chalk and talk, Power Point presentation, Videos
  - ➢ https://www.youtube.com/watch?v=TG7kzh2Uz08
  - ➢ https://www.youtube.com/watch?v=TCb4iZCMmXo

Unit II

Definition of material handling, material handling principles, design material handling systems, unit load design, material handling equipment, estimation material handing cost, safety considerations. AGVS, types of AGVS, Guidance methods, routing, traffic management, load transfer, application.

- ➢ **Pedagogy:**
- ➢ **Links:**
  - ➢ Chalk and talk, Power Point presentation, videos
  - ➢ https://www.youtube.com/watch?v=bq9mgk5zLPE
  - https://www.youtube.com/watch?v=OHAC6EO86Ls

Unit III

Layout Planning Models and Design Algorithms-Introduction, basic layout types, layout procedure, algorithmic approaches.

- ➢ **Pedagogy:**
- ➢ **Links:**
  - ➢ Chalk and talk, Power Point presentation, Videos
  - ➢ https://www.youtube.com/watch?v=bq9mgk5zLPE
    https://www.youtube.com/watch?v=OHAC6EO86Ls

Unit IV

Facility Design for Various Functions - Warehouse Operations, Mission of warehouse, functions, receiving and shipping operation, dock locations, order picking.

- ➢ **Pedagogy:**
- ➢ **Links:**
  - ➢ Chalk and talk, Power Point presentation, Videos
  - ➢ https://www.youtube.com/watch?v=bq9mgk5zLPE
  - ➢ https://www.youtube.com/watch?v=OHAC6EO86Ls

Unit V

Facility location models, preparing the facilities plan, presenting the facilities plan, implementing the facilities plan, maintaining the facilities plan.

- ➢ **Pedagogy:**
- ➢ **Links:**
  - ➢ Chalk and talk, Power Point presentation, Videos
  - ➢ https://www.youtube.com/watch?v=ppjtVIvzzD4
    https://www.youtube.com/watch?v=KD9aO3D-uq4

Text books
1. Tompkins, James A; White John A; et al; Facilities Planning, Wiley, 2008

Reference Books
1. Andrew A. Signore, Terry Jacobs, Good Design Practices For GmpPharmaceutical Facilities, Taylor & Francis Group, 2005
2. Orin Flanigan, Underground Gas Storage Facilities: Design and Implementation, Gulf Professional Publishing, 1995

Course Outcomes
At the end of the course, the student will be able to
1. Understand the importance of facilities planning and activity relationships in an industry (PO-1, 5)
2. Aware of the different types of modern material handling equipment for their use in the industry. (PO-1, 3)
3. Use computer algorithms to design plant layouts. (PO-1, 3)
4. Independently design the facility for various functions. (PO-3, 5)
5. Evaluate and present the facilities plan of an industry. (PO-2, 5)

ENTERPRISE RESOURCE PLANNING

Course Code: MIEE132	Credits:3:0:0
Prerequisite: Nil	Contact Hours: 42
Course Coordinator: Hamritha S	

Course Contents

Unit I

Introduction: Enterprise – overview, business processes, basic ERP concepts, justifying ERP investment, Risks and benefits, related technologies

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link**   ➢ https://www.coursera.org/lecture/enterprise-systems/1-1b-introduction-to-enterprise-resource-planning-erp-LneSo

Unit II

ERP marketplace and functional modules: ERP marketplace and related dynamics, business modules of ERP packages, criteria for selection of ERP packages

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://www.youtube.com/watch?v=9jceCHPzIPg

Unit III

ERP implementation: Implementation basics and life cycle, transition strategies, deployment models, implementation process, project teams, success and failure factors of ERP implementation, ERP operation and maintenance, maximizing ERP system.

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://www.youtube.com/watch?v=9QtjvURixXQ

Unit IV

ERP – Present and Future: ERP and E-business, ERP internet and WWW, ERP II, future directions and trends in ERP

➢ **Pedagogy:**   ➢Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢https://www.youtube.com/watch?v=-PcquUtpJ8k

Unit V

ERP Security: Types of ERP security issues, System access security, data security and technology, migration of data

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢ https://www.youtube.com/watch?v=72LLXBkk4r8

Textbooks
1. Enterprise Resource Planning – Alexis Leon (Tata McGraw Hill,2008)
2. Rajesh Ray, Enterprise Resource Planning – Text and Cases, Tata McGraw Hill, New Delhi, 2011,

References
1. "Integrated Business Process with ERP Systems" – Simha R Magal and JeffreyWord (John Wiley & Sons,2010)

Course outcomes
At the end of the course, student will be able to
1. Justify investment in ERP by analyzing its risks and benefits (PO- 3)
2. Select the necessary business module of ERP software package depending on the requirement (PO- 3)
3. Implement ERP in organizations and analyze the success and failure factors (PO- 4)
4. Review the future requirements of ERP in an organization (PO- 3)
5. Analyze the security issues associated with ERP and take necessary measures (PO- 5)

PRODUCT COST ANALYSIS AND OPTIMIZATION

Course Code: MIEE133	Credits:3:0:0
Pre-requisites : Nil	Contact Hours: 42
Course Coordinators: Dr. M Rajesh/ Sudheer D Kulkarni	

Course Contents

Unit I

Introduction: New products, New product strategy , Sequential Decision Process, Market definition and entry strategy, Idea generation, introduction to the design process, forecasting sales potential

➤ **Pedagogy:** ➤Chalk and talk, Power Point presentation, Videos

➤ **Link:** ➤https://www.youtube.com/watch?v=K1TwNKAv0BM

Unit II

Consumer Measurement process, Research Methods, Sampling, Attitude Scaling, Perceptual Mapping: Perceptual Positioning, Perceptual Maps and Analytical methods to Perceptual Maps Product Positioning : Preference in Product Positioning, Proactive Product Positioning, Benefit Segmentation, Managerial use of Preference Models

➤ **Pedagogy:** ➤ Chalk and talk, Power Point presentation, Videos

➤ **Link:** ➤ https://www.youtube.com/watch?v=j2x83s9NrTg

Unit III

Manufacturing Planning: Selection of optimum process, standardization. Break even analysis application and area of use -problems -multi - product analysis and Process planning. Value Analysis: Steps in selection, analysis and implementation, Selection of cutting speed for optimum cost - problems.

➤ **Pedagogy:** ➤ Chalk and talk, Power Point presentation, Videos

➤ **Link:** ➤ https://www.youtube.com/watch?v=Eyp966Ty4xg

Unit IV

Cost Accounting Cost estimation -difference -types -steps involved in cost estimation. Types of Cost: Cost Centers, Direct –indirect, material cost -direct indirect material cost Overhead cost Elements in overheads: Preparation of cost sheet, machine hour rate, apportioning methods Variance Analysis – Labour variance, Material variance and Overhead variance, Activity based costing - Introduction to target costing

➤ **Pedagogy:** ➤ Chalk and talk, Power Point presentation, Videos

➤ **Link :** ➤ https://www.tuko.co.ke/287181-cost-estimation-methods-managerial-accounting.html

Unit V

Cost Calculation Cost calculation for machined components, welding, casting, Sheet Metal and forged components illustrations - calculation of sales cost. Launching the product: Launch Planning, Track Launching, Durable and Industrial Products.

- ➤ **Pedagogy:** ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Link :** ➤ https://www.youtube.com/watch?v=gW3dnyBRas8

Text books

1. Glen L Urban, John R Hauser, "Design and Marketing of New Products", Prentice Hall. New Jersey, ISBN : 40:0257-02-0001
2. T.R.Ranga and S C Sharma, "Mechanical Estimating and Costing",- Khanna Publishers2015. ISBN : 40:0257-02-0001

Reference books

1. Yasuhiro Monden Cost management in the New Manufacturing Age -, Productivity Press-1992, ISBN : 90:0777-02-0001
2. Miles Lewrence, "Technique for Value Analysis And Engineering", McGraw Hill, New york-1972, ISBN : 65:0257-22-0004

Course Outcomes

At the end of the course, the student will be able to

1. Thoroughly understand the new product development process (PO-3).
2. Describe the Value Analysis and new product strategy (PO-3).
3. Apply suitable manufacturing process based on material and product (PO-4).
4. Analyzing the Cost Accounting machined components for a given material (PO-5).
5. Evaluate the parameters for design considerations based on process (PO-5).

THEORY OF INVENTIVE PROBLEM SOLVING	
Course Code: MIEE134	Credits:3:0:0
Pre-requisites : Nil	Contact Hours: 42
Course Coordinator: Dr. R Shobha	

Course Contents

Unit I

Introduction to Design: Fundamentals of Engineering systems, Functional interrelationship, Physical interrelationship, Systematic Design approach, problem solving as information conversion, Algorithmic design procedure

➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
➤ **Link:**   ➤ https://www.youtube.com/watch?v=FPp25m2KVcY

Unit II

Design Process: Steps of Conceptual Design, Establishing function structures, Methods with intuitive Bias, Method 635, Delphi, Theory of Inventive Problem Solving (TRIZ), Application of TRIZ through Case studies of various mechanical system design, Estimating Technical Feasibility, Concept Selection Process, Pugh Concept Selection Charts, Measurement Theory, Numerical Concept Scoring, A Critique of Design Evaluation Scheme

➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
➤ **Link :**   ➤ https://www.youtube.com/watch?v=zMaENMU9MI4

Unit III

Axiomatic Design: Entropy and it's relation to Design, Axiomatic Design, One-FR Design, Multi-FR Design, Design of Systems, Product Design, Axiomatic Quality of a Design

Embodiment Design:Steps of Embodiment Design, Principles of Force Transmission, Principles of the Division of Tasks, Principles of Stability and Planned Instability, Designing to allow for expansion, creep and relaxation, Design for Ease of Assembly

➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
➤ **Link :**   ➤ https://www.youtube.com/watch?v=e60fQ_tAiwU
   ➤ https://www.youtube.com/watch?v=cONX8OVToCA

Unit IV

Physical Prototyping and Robust Design: Prototyping Essentials, Types of Prototypes, Uses of Prototypes, Rapid Prototyping Techniques, Scale, Dimensions Analysis, and Similitude Basics Method: Physical Prototyping Design and Planning, Quality Design Theory, Taguchi's Methods, Probabilistic Design

➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
➤ **Link:**   ➤ https://www.youtube.com/watch?v=hPrQXgQ-dY8

<div align="center">

Unit—V

</div>

Advances in Engineering Design: Sustainable Design, Why DFE? Environmental Objectives, Basic DFE Methods: Design Guideline, Life cycle Assessment, Techniques to Reduce Environment Impact, Intelligent System Design

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://www.youtube.com/watch?v=eJZce5_CuoE

Text books

1. PRODUCT DESIGN- techniques in reverse enginerring and new product development , Otto and Wood, Pearson Education 2001

Reference books

1. AXIOMATIC DESIGN: Advances and Applications, Nam P Suh, MIT-Pappalardo Series in Mechanical Engineering

2. ENGINEERING DESIGN, G. Pahl and W. Beitz, The Design Council, London

Course Outcomes

At the end of the course, the student will be able to

1. Understand the complexities in engineering system approach in problem solving (PO-3)
2. Apply various tools and techniques to obtain comprehensive solution in engineering design concept. (PO-3)
3. Develop models to obtain engineering solution for the conceptual design developed (PO-4)
4. Create prototype modelling and evaluate the performance and feasibility of the design prototype (PO-3)
5. Analyze the advances in engineering design to take up more complex issues with respect to engineering design. (PO-4)

Elective – B

ADVANCED PRODUCTION PLANNING AND SCHEDULING

Course Code: MIEE141	CreditS:4:0:0
Pre-requisites : Nil	Contact Hours:56
Course coordinators: Dr. G S Prakash / Dr. R Shobha	

Course Contents

Unit I

Introduction: Introduction to operations and production Planning & Control, Historical evolution, Latest Trends in Decision Making in business, Operations Management, Competitiveness, strategy and Productivity, Case study/exercise problems

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢ https://www.youtube.com/watch?v=aa1qisNuZ4g

Unit II

Forecasting: Introduction, Features common to all forecasts, Elements of forecast, Steps in forecasting process, Approaches to forecasting, Forecast based on judgment and opinion, forecasts based ion time-series data, Associative forecasting technique, Accuracy & control of forecast, Choosing of right forecasting technique, exercise problems

➢ **Pedagogy:**   ➢Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢https://www.youtube.com/watch?v=fp-1_9mLlbc

Unit III

System Design: Product redesign, Global product design concepts, Phases in product design and development, Designing for Manufacture, Quality Function Deployment, The Kano Model, Service Design for operations strategies, Defining and Measuring capacity, Determinants of Effective Capacity, Forecasting Capacity requirements, Challenges of Planning service capacity, Developing Capacity alternatives and evaluating the alternatives, Case study/Exercise problems

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://www.youtube.com/watch?v=CBDfMETpaH4

Unit IV

Aggregate Planning: Nature and importance of Inventories in Industry, Requirement for Effective inventory management, Quantity models, Techniques for Aggregate Planning, Use of strategies for meeting uneven demand, Master Scheduling Process, overview of Material Resource Planning(MRP), MRP inputs, processing and outputs,

MRP-II, Capacity Requirement planning(CRP), Enterprise resource Planning (ERP), Distribution Requirement Planning. Production Activity Control (PAC), Exercise problems

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢ https://www.youtube.com/watch?v=-sHVaYOB-ho

Unit V

Just in Time (JIT) & Scheduling: Introduction, The Toyota Approach, Supporting goals and building blocks, JIT in services, JIT-II, Scheduling operations, Scheduling in Low-Volume systems, Scheduling services, Operations strategy used in scheduling, case study/exercise problems.

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢ https://www.investopedia.com/terms/j/jit.asp

Text books
1. Operations Management, William J Stevenson, Tata McGraw Hill, 9th Edition, 2009.

Reference books
1. Operations Management for competitive advantage, Richard B Chase/F Robert Jacobs/ Nicholas J Aquilano, McGraw-Hill International edition, Eleventh edition, 2006.

Course Outcomes
At the end of the course, the student will be able to
1. Appreciate the role of PPC in enabling the enterprise to respond to the dynamic business environment. (PO-1, 3)
2. Acquire sufficient theoretical knowledge and analytical skills to forecast demand for production / service operations. (PO-3)
3. Asses and formulate decision making strategies to address operating issues, capacity requirements and developing capacity alternatives. (PO-2, 3)
4. Develop analytical skills in the area of sales and operating planning, ERP, MRP, CRP and PAC. (PO-3)
5. Implementing JIT concepts to minimize the inventory and to produce with minimum time and cost using scheduling techniques. (PO-4, 5)

PRODUCT DESIGN AND MANUFACTURING	
Course Code: MIEE142	Credits:4:0:0
Pre-requisite : Nil	Contact Hours: 56
Course Coordinators: Dr. Sridhar B S /Dr. M R Shivakumar	

Course Contents

Unit I

Introduction to Product Design: Asimov's Model: definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-Consumption Cycle, The Morphology of Design (The seven phases), Primary Design Phases and flowcharting, Role of Allowance, Process Capability and Tolerance in Detailed Design and Assembly.

Characteristics of successful product development, who designs and develops products? Challenges of product development.

➢ **Pedagogy:** ➢ Black board teaching, Power Point Presentation
➢ **Links:** ➢ https://www.youtube.com/watch?v=q6lFFiaNouI
➢ https://www.youtube.com/watch?v=5TyLjrIdUD4
➢ https://www.youtube.com/watch?v=HN9GtL21rb4&list =PLSGws_74K018yZOnbSaqWJZ837QyBB7vu

Unit II

Product Design Practice and Industry: Introduction, product Strategies, Time to Market, Analysis of the Product, The Three S's, standardization, Renard Series (Preferred Numbers), Simplification, The Designer and His Role, the Designer: Myth and Reality, The Industrial Design Organization, Basic Design Considerations, Problems faced by Industrial Designer, Procedure adopted by Industrial Designers, Types of Models designed by Industrial designers, What the Designer Contributes, Role of Aesthetics in Product Design, Functional Design Practice, Product development organizations

➢ **Pedagogy:** ➢ Black board teaching, Power Point Presentation
➢ **Links:** ➢ https://www.youtube.com/watch?v=5TyLjrIdUD4&t=2s
➢ https://www.youtube.com/watch?v=nfWVEbKuD2c
➢ https://www.youtube.com/watch?v=KCcvnMb8vNY

Unit III

Industrial Design: What is industrial design? Assessing the need for industrial design, Impact of industrial design, industrial design process, Management of industrial design process.

Strength Consideration in Product Design: Principal Stress Trajectories Force – Flow Lines, Balanced Design, Criteria and Objectives of Design, Material Toughness: Resilience, Designing for Uniform Strength, Tension vis-à-vis Compression.

Design for Production – Metal Parts : Producibility Requirements in the Design of Machine Components, Forging Design, Pressed Components Design, Casting Design, Design for Machining Ease, The Role of Process Engineer, Ease of Location and Clamping, Some Additional Aspects of Production Design, Die Casting and Special Castings, Design for Powder Metallurgical Parts, Expanded Metals and Wire Forms

- ➢ **Pedagogy:** ➢ Black board teaching, Power Point Presentation
- ➢ **Links:** ➢ https://www.youtube.com/watch?v=eRHBdEIrh_g
  - ➢ https://www.youtube.com/watch?v=d3hJcnWKezk
  - ➢ https://www.youtube.com/watch?v=pHzV_uJMCq4

Unit IV

Optimization in Design: Introduction, Siddal's Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multipliers, Geometric Programming, Johnson's Method of Optimum Design.

Prototyping: What is prototyping? Types of prototypes, what are prototypes used for, Principles of prototyping, Prototype technologies.

- ➢ **Pedagogy:** ➢ Black board teaching, Power Point Presentation
- ➢ **Links:** ➢ https://www.youtube.com/watch?v=-Zn5ofl5WW0
  - ➢ https://www.youtube.com/watch?v=q0C5bawaIi0
  - ➢ https://www.youtube.com/watch?v=Q2dewZweAtU

Unit V

Economic Factors Influencing Design: Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Breakeven Analysis, Economics of a New Product Design (Samuel Eilon Model).

Value Engineering and Product Design: Introduction, Historical Perspective, What is Value? Nature and Measurement of Value, Maximum Value, Normal Degree of Value, Importance of Value, The Value Analysis Job Plan, Creativity, creative techniques.

Modern Approaches to Product Design: Concurrent Design, Quality Function Deployment (QFD)

- ➢**Pedagogy:** ➢ Black board teaching, Power Point Presentation
- ➢**Links:** ➢ https://www.youtube.com/watch?v=mUnJP4gEgjk
  - ➢ https://www.youtube.com/watch?v=J_9S8BkGCQQ
  - ➢ https://www.youtube.com/watch?v=1OEd5KED6Fc

Text books
1. A.C. Chitale and R.C. Gupta -Product Design and Manufacturing, PHI, 4th Edition, 2008.
2. Karl T. Ulrich & Steven D., Epinger -Product Design and Development –Tata Mc Graw Hill, 3rd Edition, 2003.

References

1. Tim Jones, Butterworth Heinmann-New Product Development, Oxford, UIC1997.
2. Roland EngeneKinetovicz-New Product Development: Design & Analysis, John Wiley and Sons Inc.,N.Y.1990.
3. GeofferryBoothroyod, Peter Dew Hurst and Winston Knight - Product Design for Manufacture and Assembly -3rdEdition,Taylor& Francis Group,2011.

Course outcomes
At the end of the course, student will be able to
1. Appreciate the incremental and radical approaches to product design and the steps Involved. (PO-1,2,3)
2. Understand the organization's product strategy and designer's role. (PO- 1,2)
3. Develop an understanding of product design problems and challenges in the strength, function, manufacturability. (PO- 1,2,3)
4. Apply the optimization techniques in product design. (PO- 1,2,3)
5. Analyze the economic consideration, value engineering and modern approaches in product design. (PO- 1,2,3)

INNOVATION AND DESIGN THINKING	
Course Code: MIEE143	Credits:4:0:0
Pre-requisites :Nil	Contact Hours: 56
Course Coordinator: Sri. Sudheer D Kulkarni	

Course Contents

Unit I

The Entrepreneurial Economy; the Practice of Innovation; Purposeful Innovation; Seven Sources for Innovative Opportunity.

- ➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :** ➢ https://www.youtube.com/watch?v=ALzHhOex8lQ

Unit II

The Unexpected; Incongruities; Process Need; Industry and market Structures; Demographics. Changes in Perception; New Knowledge; the Bright Idea; Principles of Innovation.

- ➢ **Pedagogy:** ➢Chalk and talk, Power Point presentation, Videos
- ➢ **Link :** ➢https://www.coursera.org/lecture/big-ideas/incongruities-sUssG

Unit III

The Practice of Entrepreneurship; Entrepreneurial Management; the Entrepreneurial Business; Entrepreneurship in the Service Institution; the New Venture.

- ➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:** ➢ https://www.georgebrown.ca/programs/entrepreneurship-management-program-postgraduate-b416

Unit IV

Entrepreneurial Strategies; Market And Industry Leadership; Surprise And Least Resistance; Ecological Niches; Changing Values And Characteristics; The Entrepreneurial Society.

- ➢ **Pedagogy:** ➢Chalk and talk, Power Point presentation, Videos
- ➢ **Link:** ➢https://www.youtube.com/watch?v=wol_yLOiJEM

Unit V

Design Thinking: Process Awareness Key; Problem Statement; Discovering User Needs; Building Empathy With Users; Finding the Right Focus; Generating Ideas; Structuring and Selecting Ideas; Creating a Good Prototype; Testing Efficiently.

- ➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:** ➢ https://careerfoundry.com/en/blog/ux-design/what-is-design-thinking-everything-you-need-to-know-to-get-started/

Text Books

Design Thinking: Process Awareness Key; Problem Statement; Discovering User Needs; Building Empathy With Users; Finding the Right Focus; Generating Ideas; Structuring and Selecting Ideas; Creating a Good Prototype; Testing Efficiently.

Reference Books
1. Essentials of Entrepreneurship and Small Business Management – Norman Scarborough & Jeffrey Cornwall (Pearson, 2016)
2. Entrepreneurship: The Art, Science, and Process for Success – Charles Bamford & Garry Bruton (McGraw-Hill, 2015)

Course Outcomes

At the end of the course, the student will be able to
1. Understand the fundamentals of entrepreneurship. (PO1)
2. Design and start a basic business plan. (PO1)
3. Manage a new small business. (PO1)
4. Manage the finances of a new small business. (PO5)
5. Understand the fundamentals of design thinking. (PO1)

HUMAN AND ORGANIZATIONAL FACTORS	
Course Code: MIEE144	Credits: 4: 0: 0
Prerequisite: Nil	Contact Hours: 56
Course Coordinators: Dr. S Appaiah / Dr. M Shilpa	

Course Contents

Unit 1

Introduction: Introduction to Human factors, History of Human factors, Human machine systems, displaying information, coding of information, information processing.

Introduction to HRM: Evolution of HRM, Objectives, Functions and Policies.

Man Power Planning: Uses and benefits, Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting. Human Capital: Introduction, Economic Development, Cost of Human Capital

- ➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :** ➢ https://www.linkedin.com/pulse/introduction-human-factors-simon-di-nucci

Unit II

Training And Development : Identification of Training needs, Training Evaluation, Training Budget, Executive Development – Different Approaches, Non-executive development – Different methods, Training as a tool for continuous growth of Individual and Organizers.

Induction & communication: Induction procedure, transfers, promotion exit interview, (Written test, Group Discussion, Interviews). Communication function, communication process, effective communication.

- ➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :** ➢ https://www.hrhelpboard.com/training-development.htm

Unit III

Recruitment and Selection: Sources of man power, advertisement, short listing of candidates for Selection procedure – Written Test, Group Discussion, Interview – Different methods, advantages and Limitations, Psychological testing – Advantages and limitations.

Performance Appraisal: Components (all round performance appraisal) Methods, Advantages and limitations of different methods, Personal counseling based on Annual confidential reports, competency mapping, CSR

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.youtube.com/watch?v=yeVmteq8D_Q

Unit IV

The Organization: Mechanistic and Organic structures, Minitberg's basic elements of organization, Organizational Designs and Employee behaviour, organization development – quality of work life (QWL).

The Group: Definition and classification of groups, factors affecting group formation, stages of group development, Norms, group processes, group tasks, group decision making.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.youtube.com/watch?v=poLPr3-1TY8

Unit V

Learning: Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social Making, learning theory.

Conflict Management: Definition of conflict, functional and dysfunctional conflict, stages of conflict process.

Perception: Definition, Factors influencing perception, attribution theory, selective perception, projection.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.youtube.com/watch?v=Ja93CYIFoAA

Text Books

1. Dr. K Ashwathappa – Human Resource Management, Tata McGraw Hill, 5th Edition, 2005.
2. Hersey and Blanchard -Management of Organization'sBehavior, Prentice Hall of India, 10th Edition –2012.
3. Stephen P Robbins -Organizational Behaviour, Pearson Education Publications, ISBN– 81–7808–561-5, 9thEdn. 2012.

References

1. M S Sanders and E J McCormick -Human factors in Engineering & Design, McGraw Hill, 7th Edition.
2. CB Mamoria -Management of Human Resources, Himalaya Publication House,2003.
3. Aswathappa-Organizational Behavior, Himalaya Publishers.2001.
4. Hersey and Blanchard -Management of Organization's Behavior, Prentice Hall of India, 10th Edition –2012.

Course outcomes

At the end of the course, student will be able to

1. Plan and organize for the manpower in the given type of organization. (PO-1)
2. Design the appropriate training and development programme to the employee after analyzing the training needs. (PO- 3)
3. Analyze and select the right recruitment / rights strategy for a given organization. (PO-1)
4. Identify the different groups and their values and different conflict process in an organization. (PO-1)
5. Manage the art of getting work in the corporate organization and learning with different platform or areas with different views. (PO- 3)

Elective – C

LEAN MANUFACTURING SYSTEMS	
Course Code: MIEE151	Credits:4:0:0
Prerequisites :Nil	Contact Hours: 56
Course Coordinators: Dr. M Shilpa/ Dr. Hemavathy S	

Course Contents

Unit I

Introduction to lean manufacturing systems and cell design: Industrial Revolutions, Empowered Workers, Production and Manufacturing Systems, Understanding a Company's Business, Product Life Cycles, A New Manufacturing System.

Steps to lean production: Successful Lean Manufacturing

➢ **Pedagogy:** ➢Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢https://www.youtube.com/watch?v=ZdHGTCXcJQU

Unit II

Manufacturing system design: System Design Trends, Optimization of the Manufacturing System, Evolution of Functional Structure, Manufacturing Versus Production Systems, Classifications of Manufacturing Systems Designs, Standardized Work, Linked-cell Systems, Group Technology, Design for Flexibility,

 Axiomatic design principles: Key Concept , Decompose the Problem, Creativity, Flexibility, Controllability, and Productivity Design Process Hierarchy, Functional Requirements, Design Axioms and Corollaries,

Manned interim manufacturing and assembly cells: Linked-cell Manufacturing System Interim-cell Design, Decouplers in Manufacturing and Assembly Cells, Work-in-process Versus Stock-on-hand, How a Manufacturing Cell Works, Achieving Superior Quality.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :** ➢ https://www.youtube.com/watch?v=zMq0h-bumsQ

Unit III

Setup reduction: Single-minute Exchange of Dies, Economic Setup-reduction Techniques, Changing Processes to Meet Changing Volumes, Motivation for Single-minute Exchange of Dies, Basic Steps for Reducing Setup Time, Apply Methods Analysis, Single-minute Exchange of Dies Phases.

Integrated quality control: Statistical Quality Control, Integrated Quality Control, Process Analysis Tools and Techniques, Making Process Capability Studies, Teams and Quality Circles, Quality Control Department.

Integrated reliability: Role of Maintenance, Integrate Preventive Maintenance, Manufacturing Engineering, Total Productive Maintenance, Predictive Maintenance, Computerized Maintenance Management System.

- ➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :** ➢ https://www.investopedia.com/terms/q/quality-control.asp

Unit IV

Refining lean production: Leveling, Mixed Model Final Assembly, Long-range Forecasting, Balancing, Manufacturing Cell Types, Synchronization.

Production and inventory control: Kanban, Constant Work-in-process, integrated Inventory Control, An Independent Control Variable, Supply-chain Management, The Paperless Factory of the Future.

Making the vendors lean: Lead Time and Expediting, Lean Supply Chain, Rules for Lean Cell Design, The Plant Trip.

- ➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:** ➢ https://katanamrp.com/blog/lean-inventory/

Unit V

Ergonomics in cell design: Lean Production and Ergonomics, Health Issues, Ergonomic Solutions, Physiology, Human and Machine Interfacing.

Automation and Autonomation: Automaticity, Automation in Lean Manufacturing, the Factory with a Future. **Simulation:** Advantages and Limitations, 3D Computer Simulation Tools, Industry Success.

The Toyota production system today: Eliminating Waste, TPS History, Getting Ready for Lean, Roots of Autonomation, JIT Production, Internal Customer Satisfaction, Standardized Work and Cell Design, Toyota Supplier Support Center.

- ➢ **Pedagogy:** ➢Chalk and talk, Power Point presentation, Videos
- ➢ **Link :** ➢https://www.youtube.com/watch?v=BVp0dL8i2w4

Text Book
  1. Ronald G. Askin, Jeffrey B. Goldberg, Design and Analysis of Lean Production Systems, Wiley, 2007

Reference Book
  1. JT Black, Steve L. Hunter, Steve L. Hunter, Lean Manufacturing Systems and Cell Design, Society of Manufacturing Engineers, 2003

Course Outcomes

At the end of the course, the student will be able to

1. Understand the fundamentals of lean manufacturing. (PO-1, 3)
2. Design a basic lean manufacturing system. (PO-1, 2)
3. Integrate a lean system into an industry. (PO-3, 4)
4. Refine a lean manufacturing system. (PO-2, 3)
5. Design a basic automation system. (PO-3, 4)

MANAGEMENT INFORMATION SYSTEMS

Course Code: MIEE152	Credits:4:0:0
Prerequisites : Nil	Contact Hours: 56
Course coordinators: Dr. M Shilpa / Dr. Siddharth Kar	

Course Contents

Unit I

Introduction to Information Systems in Business: Why study Information Systems? Why Businesses Need Information Technology.

Fundamentals of Information Systems: Fundamentals of Information Systems concepts, Overview of Information systems.

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Link:**   ➤ https://www.techtarget.com/searchdatacenter/definition/IT

Unit II

Solving Business Problems with Information Systems: A Systems Approach to Problem Solving, Developing Information System Solutions.

The Internet and Electronic Commerce: The Internet Business, Fundamentals of Electronic Commerce.

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Link:**   ➤ https://www.youtube.com/watch?v=SqajmSCOInQ

Unit III

Internets, Extranets and Enterprise Collaboration: Internets Extranets in Business, Enterprise Collaboration Systems.

Information Systems for business Operations: Business Information Systems, Transaction Processing Systems.

- ➤ **Pedagogy:**   ➤Chalk and talk, Power Point presentation, Videos
- ➤ **Link:**   ➤https://study.com/academy/lesson/intranet-and-extranet-comparing-information-and-data-dissemination.html

Unit IV

Information Systems for Managerial Decision Support: Management Information and Decision Support Systems, Artificial Intelligence Technology in Business.

Information Systems for Strategic Advantage: Fundaments of Strategic Advantage, Strategic Application and Issues in Information Technology.

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Link :**   ➤ https://emeritus.org/in/learn/information-system/

Unit V

Managing IT: Planning and Implementing Change: Planning for Business Change with IT, Implementing Business Change with IT

Managing IT: Security and Ethical Challenges: Security and Control Issues in Information Systems, Ethical and Societal Challenges of Information Technology.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://study.com/academy/lesson/what-strategic-change-management-definition-models-examples.html

Text Book:
1. James A O'Brien, G.M. Marakas and Ramesh Behl. Management Information Systems, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 10th edition, 2010, ISBN: 0073376817
2. S. Sadagopan, Management Information Systems, PHI, second edition, 2014

Reference:
1. Laudon and Laudon, Essentials of Management Information Systems, Prentice Hall, 2009.

Course Outcomes:
At the end of the course, the student will be able to
1. Identify the role of Information Systems (IS) applications in business. (PO: 1,2)
2. Analyze business problems and solve them using IS (PO: 1,2)
3. Analyze the opportunities for collaboration using internet (PO: 1,3)
4. Analyze the strategic advantage of IS (PO: 1,3)
5. Manage the security and ethical challenges of IS (PO: 3,5)

PRODUCT LIFECYCLE MANAGEMENT	
Course Code: MIEE153	Credits:4:0:0
Prerequisites : Nil	Contact Hours: 56
Course coordinators: Dr. R Shobha / Dr. M. R. Shivakumar	

Course Contents

Unit I

Introduction: Product; Product Life-cyle Management; Background; Corporate Challenges.Product Data; Product Information; PLM; PLM Concepts; Items; PLM Systems; System Architecture; Information Models; Product Structures.

PLM Systems: Functionality of the Systems; Use of PLM Systems in Different Organisation Verticals; Product Development and Engineering; Production; After-Sales; Sales and Marketing; Sub-Contracting; Sourcing and Procurement.

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Link:**   ➤ https://www.youtube.com/watch?v=MsnbqLWjlmA

Unit II

Product Structures: Examples of Product Structures.

Integration of PLM System: Different Ways to Integrate PLM Systems; Transfer File; Database Integration; System Roles; Enterprise Resource Planning; Computer Aided Design; Configurators; Enterprise Application Integration

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Link :**   ➤ https://www.youtube.com/watch?v=g6qqMb_5XC8

Unit III

Deployment of PLM System: Different Stages of Deployment; Present Processes; Objective Processes; Choosing a System; Realisation Stage of the Project; Accomplishing Change in the Organisation.

Business Benefits of PLM: Factors Leading to PLM; Benefits of PLM; Measuring Business Benefits in Daily Operations; Material Costs; Improving the Productivity of Labour; Costs of Quality; PLM and Data-Warehousing; Analysing the Cost of Acquisition; PLM Software Licences; Database Licences; Hardware Acquisitions; Maintenance of Equipment.

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Link :**   ➤ https://www.youtube.com/watch?v=hP8eYB-beVw

Unit IV

PLM in Manufacturing: Challenges of PLM in Engineering and Manufacturing Industry; Special Challenges of PLM in High-Tech Industry; Frame of Reference for PLM; Developing PLM in Project Workshop; Advantages and Development Potential

of PLM; Breakthroughs on Sub-Projects; Controlled Entry of Documentation; Business Processes; Guidelines for the Future

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.clevr.com/solutions/product-lifecycle-management/manufacturing

Unit-V

PLM in Services: Introduction; Service; PLM in Service Business.

Product Information Management: Computer Integrated Manufacturing; Concurrent Engineering; PLM as Enabler of Cooperation; Contents of Collaboration; Successful Cooperation; Tools of Collaboration; Collaborative Product Commerce; Collaborative Product Definition Management.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.oracle.com/dk/scm/product-lifecycle-management/?ytid=4WSdUXIjPcs

Text books
1. Product Lifecycle Management – Antti Saaksvuori & Anselmi Immonen (Springer, 2005)

References
1. Product Lifecycle Management – Michael Grieves (McGraw-Hill, 2005)
2. Product Lifecycle Management – John Stark (Springer, 2011)

Course Outcomes
At the end of the course, the student will be able to
1. Understand the fundamentals of PLM. (PO-1)
2. Integrate a PLM system with enterprise application. (PO-1)
3. Deploy a PLM system in an industry. (PO-1)
4. Analyze the challenges of PLM in a manufacturing industry. (PO-5)
5. Apply PLM in a service industry. (PO-5)

MANAGERIAL ECONOMICS

Course Code: MIEE154	Credits:4:0:0
Prerequisites :Nil	Contact Hours: 56
Course Coordinators :Dr. S Appaiah/ Dr. R Shobha	

Course Contents

Unit I

Introduction: Nature, Scope and Methods, The theory of the firms, Markets. Demand Analysis: Demand theory, Individual demand, Market demand, Demand and Income, Business demand, Elasticity, Elasticity of demand, Own-price Elasticity, Estimating Elasticities, Supply, Elasticity of supply.

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://www.youtube.com/watch?v=vLPpF0hunwc

Unit II

Demand Estimation: Methods, Model specification, Data collection, Simple regression, Goodness of fit, Power regression, Forecasting, Multiple regression, Implications of empirical studies, Problems.

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://www.youtube.com/watch?v=jwIMsUwdj_8

Unit III

Production Theory: Introduction, Basic terms and definitions, Factors of production-The short run and the long run, Problems.

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢ https://www.youtube.com/watch?v=ZgcgYBce_hM

Unit IV

Cost Theory: Introduction, Short run cost behavior, Long run cost behaviour, the learning curve, Cost-volume-profit analysis, Cost estimation- Short run and long run cost estimation.

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos

➢ **Link :**   ➢ https://www.youtube.com/watch?v=bIa9JbfqxPE

Unit V

Market Structure and Pricing: Introduction, Perfect competition, Monopoly, Monopolistic competition, Investment analysis, Cash flow analysis, Risk analysis, Cost of capital, Evaluation criteria, Problems.

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://www.youtube.com/watch?v=-aQfnADG-cI

Text books
1. A Problem solving approach- Nick Wilkinson -Managerial Economics, Cambridge University Press, 2015.
2. Ivan Png -Managerial Economics, Blackwell Publishing, Second Edition,2010.

Reference Books
1. Samuel Paul and G.S.Gupta -Managerial Economics.
2. Theory and Practice by Thomas and J. Webster -Managerial Economics,2003.
3. Michel R Bye -Managerial Economics and Business Strategy, McGraw Hill International, 6th Ed.

Course Outcomes
At the end of the course, the student will be able to
1. Understand the roles of managers and the nature of internal and external decisions to be made by managers. (PO-1,2)
2. Analyze the demand and supply conditions and assess the position of a company.(PO-1,4,5)
3. Design competition strategies, including costing, pricing, product differentiation, and market environment according to the natures of products and the structures of the markets. (PO-1,4)
4. Analyze real-world business problems with a systematic cost estimation. (PO-1,3)
5. Make optimal business decisions by integrating the concepts of economics, mathematics and statistics and assess market risks. (PO-1,3)

RESEARCH METHODOLOGY & IPR	
Course Code: RMI16	Credits:3:0:0
Prerequisites: Nil	Contact Hours: 42
Course Coordinator: Dr. Siddhartha Kar	

Course Contents

Unit I

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is done, Research process, Criteria of Good Research, Problems Encountered by Researchers in India.

Defining the Research Problem: What is Research Problem, Selecting the problem, Necessity of Defining the problem, Technique involved in Defining a problem, An illustration.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Links:** ➢ Research Methodology:
 https://www.youtube.com/watch?v=GSeeyJVD0JU&t=1330s

Unit II

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.

Research Design: Meaning of research design, need for research design, Features of a good design, Importance concepts relating to research design, Different research Designs, Basic principles of experimental design.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Links:** ➢ Writing A Systematic Literature Review:
 https://www.youtube.com/watch?v=N7kmJsAI3J4&t=5790s
 ➢ Understanding Research Design:
 https://www.youtube.com/watch?v=6zQwkNzxMKk&t=545s

Unit III

Sampling Design- Census and sampling survey, Implications of a sample design, Steps in sampling design, Criteria of selecting a sampling procedure, Characteristics of a good sample design, Different types of sample designs, How to select a random sample, Random sample from an infinite universe, Complex random sampling designs.

Methods of Data Collection- Collection of primary data, Observation method, Interview method, Collection of data through questionnaires, Collection of data

through schedules, Different between questionnaires and schedules, some other methods of data collection, Collection of secondary data, Selection of appropriate method for data collection, Case study method.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Links:** ➢ Sampling Design & Procedure:
  https://www.youtube.com/watch?v=RKSld_j2m5U
  ➢ Tools and techniques of data collection:
  https://www.youtube.com/watch?v=_fNzk_0u3S4

Unit IV

Research Ethics and Intellectual Property: Ethics-ethical issues, ethical committees (human & animal), research ethics; IPR- intellectual property rights and patent law, commercialization, copyright, 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.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Links:** ➢ Aspects of Scientific Ethics:
  https://www.youtube.com/watch?v=xi98cD8rB8E
  ➢ Intellectual Property:
  https://www.youtube.com/watch?v=5fvpsqPWZac&list=PLyqSpQzTE6M8PuzP1p2hNPXgpbOBhFgja

Unit V

Multivariate Analysis: The nature of multivariate analysis, Classifying Multivariate techniques, Analysis of dependence, Analysis of interdependence.

Interpretation and Report Writing: 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.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢ Scientific Writing: PhD Thesis:
  https://www.youtube.com/watch?v=Znxlv5gc1hk

Text books
1. Kothari CR and Garg G. 2019. Research Methodology: Methods and Techniques, Fourth Edition, New Age International Publishers, ISBN (13): 978-9386649225.
2. Zikmund WG, Babin BJ, Carr JC and Griffin M. 2013. Business Research Methods, Ninth Edition, Cengage India Private Limited, ISBN (13): 978-9353503260.

Reference Books
1. Panneerselvam R. 2013. Research Methodology, Second Edition, Prentice Hall India Learning Private Limited, ISBN (13): 978-8120349469.
2. Wadhera BL. 2010. Law Relating to Intellectual Property: Patent, Trademarks, Designs and Geographical Indication, Universal Law Publishing, ISBN: ISBN: 9789350350300.

Course Outcomes
At the end of the course, the student will be able to
1. Understand and design appropriate methodology for research. (PO-1)
2. Develop an understanding of conducting a literature review and research design. (PO-2)
3. Have basic knowledge about various sampling procedures and different methods of data collection. (PO-3)
4. Have adequate awareness of intellectual property's relevance and impact in the changing global business environment. (PO-4)
5. Apply multi-variant analysis to real-time situations and know the art of interpretation and writing research reports. (PO-2,3)

PROBABILITY AND STATISTICS MODELING LAB

Course Code: MIEL17	Credits:0:0:1
Prerequisites :Nil	Contact Hours: 14 Sessions
Course Co ordinator : Dr. Niranjan C A	

List of Experiments

1. Determination of Basic Statistics
2. Graphical Interpretation of Data using Histogram
3. Data Visualization with Python (Scatter and Histogram)
4. Scatter Plot and Co-relation Analysis
5. Hypothesis Testing of Single Sample with known variance
6. Hypothesis Testing of Single Sample with unknown variance
7. Hypothesis Testing of two Samples with known variance
8. Hypothesis Testing of two Samples with unknown variance
9. Testing the goodness of fit for Poisson Distribution
10. Testing the goodness of fit for Normal Distribution
11. Conduction of Simple Linear Regression Analysis using SYSTAT
12. Conduction of Simple Linear Regression Analysis using Python
13. Conduction of Multiple Linear Regression Analysis
14. Determination of Multiple Linear Regression Analysis
15. Determination of Principal Components, Factor Analysis; Case Study
16. Conducting discriminate analysis; Case Study

Suggested Software Packages: SYSTAT Version 13, MS Excel, Statistical Minitab, Python 3.9, Matplotlib

Text Books

1. Walpole, R.E., Myers, R.H., Myers, S.L., Ye, K.Y. Probability and statistics for Engineers and scientists, Macmillan, Pearson, 9th Edition, 2016
2. Probability and Statistics in Engineering by William W. Hines, Douglas C. Montgomery, David M. Goldsman, Connie M. Borror, John Wiley and Sons, Inc, Fourth Edition , 2002
3. Hastie, T., Tibshirani, R.,, Friedman, J. (2009). The elements of statistical learning: data mining, inference and prediction. Springer.
4. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".

- **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- **Links:**   ➢ https://www.youtube.com/watch?v=eFByJkA3ti4
  - ➢ https://onlinecourses.nptel.ac.in/noc22_cs08/preview

Reference Books

1. Sheldon M Ross : Introduction to Probability models 10th Edition, Academic Press, 2009
2. Richard I. Levin, David S. Rubin, Statistics for Management, 7th Edition, 2008
3. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8th Edition, 2008, Cengage Learning

Course Outcomes

At the end of the course, the student will be able to

1. Develop Various Probability Models from real time data. (PO-1, 3)
2. Analyze various real time problems through probability & statistical techniques (PO-1, 3)
3. Develop and Evaluate Various Univariate and Multivariate Models for various real life scenarios. (PO-1, 3)

WORK SYSTEM DESIGN AND ERGONOMICS LAB

Course Code: MIEL18	Credits:0:0:1
Prerequisites :Nil	Contact Hours: 14 Sessions
Course Coordinators: Dr.S.Appaiah / Dr. Hemavathy S	

List of Experiments

1. Application of various Recording techniques.
2. Determination of standard time for various operations.
3. Productivity improvement techniques.
4. Rating practices.
5. Measurement of body parameters (heart beat rate, calorie consumption) using walking simulator.
6. Measurement of body parameters (heart beat rate, calorie consumption, revolutions per minute) using Ergometer.
7. Conduction of work sampling in office environment to determine office utilization.
8. Effect of noise, light and heat of human efficiency in work environment.
9. Measurement of body parameters using DASH BOARD-4000.

- **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- **Links:**   ➢ https://www.youtube.com/watch?v=8xFt6BIQTHA
  - ➢ https://nptel.ac.in/courses/112104222
  - ➢ https://onlinecourses.nptel.ac.in/noc20_de12/preview

Text books
1. M.P.Groover-Work Systems : The Methods, Measurement & Management of Work, ISBN : 978-93-325-8124-1, Pearson, 1st Edition, 2013.
2. Geroge Kanawaty - ILO -Introduction to work study, ISBN 13:9788120406025 Publisher: India Book House Pvt. Ltd, 4th Revised Edition, 2008.

References
1. .Ralph M Barnes -Motion and Time study, ISBN:13:978981426182 Publisher: John Wiley, 7th edition 2009.
2. Andris Freivalds and Benjamin Niebel - Niebel's Methods, Standards, & Work Design, ISBN-13: 978-0073376318, Mc Graw Hill, 13th Edition, 2014
3. M S Sanders and E J McCormic - Human Factors in Engineering Design, ISBN: 13:9780070549012, Mc Graw Hill, 7th Edition.

Course Outcomes

At the end of the course, the student will be able to

1. Identify   areas where work study tools and techniques can be applied. (PO-3)
2. Apply the tools and techniques to various simulated scenarios and real life problems in industry and society. (PO-1,3)
3. Create novel designs of work place and other areas where improvement can be applied with perspective of various constraints faced in real life situation at society and industry level. (PO-1,3)

II SEMESTER

SYSTEMS SIMULATION AND MODELING

Course Code: MIE21	Credits: 3:1:0
Prerequisites: Nil	Contact Hours: 42Theory+14Tutorial Session
Course Coordinator : Dr. Siddhartha Kar	

Course Contents

Unit I

Introduction - Simulation components, State of a system, Simulation procedure
Simulation Examples - Simulation of queuing models, inventory models, Reliability models and lead time demand models.

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Links :**   ➤ Concept of System, Model and Simulation:
    https://www.youtube.com/watch?v=1rZvbe3FQU8
  - ➤ Performance Measures of Queuing System:
    https://www.youtube.com/watch?v=fQ094_DM-sY

Unit II

Random numbers – Generation and tests for random numbers
Generating Random variates - Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, direct transformation for Normal and lognormal distribution.

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Links :**   ➤ Generation of Random Numbers:
    https://www.youtube.com/watch?v=d7C6MJ49lMM
  - ➤ Generation of Random Variates:
    https://www.youtube.com/watch?v=Q11uUTA-ndY

Unit III

Input Modeling – Multivariate and Time-series input models
Output Analysis for a Single System - Terminating system – confidence interval estimation for fixed number of replications, specified precision and quantiles. Non-terminating system – initialization bias, replication method

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Links :**   ➤ Input modeling: Multivariate input models:
    https://www.youtube.com/watch?v=2nv8XMluWrU
  - ➤ Output analysis of a single system:
    https://www.youtube.com/watch?v=rK9_YXojF74

<div align="center">**Unit IV**</div>

Comparing Two System Configurations - Independent sampling with equal and unequal variances, correlated sampling or common random numbers, confidence intervals with specified precision

Comparison of several system Designs- Bonferroni Approach to multiple Comparisons, Bonferroni Approach to selecting the best

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Links :**   ➤ Comparison of alternative system configurations:
                                       https://www.youtube.com/watch?v=uRQdweufDAI
                                   ➤ Confidence Intervals for comparing more than two systems:
                                       https://www.youtube.com/watch?v=uomDWnrtXh8

<div align="center">**Unit V**</div>

Simulation of Manufacturing Systems, material handling systems – models of manufacturing systems, models of material handling, goals and performance measures, issues in simulation of manufacturing and material handling systems

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Links :**   ➤ Introduction to simulation of manufacturing and material handling system:
                                       https://www.youtube.com/watch?v=xxqCyfpWTPA
                                   ➤ Issues in material handling system:
                                       https://www.youtube.com/watch?v=iVPbB8YRM_E

Text books

1. Banks J, Carson JS II, Nelson BL and Nicol DM. 2010. Discrete-event system simulation. Fifth Edition. Pearson Education Inc.

Reference Books

1. Averill M. Law, Michael G. McComas, SIMULATION OF MANUFACTURING SYSTEMS, Proceedings of the 1997 Winter Simulation Conference ed. S. Andradóttir, K. J. Healy, D. H. Withers, and B. L. Nelson, 1997
2. Law, A. M. 1997. How to select simulation software. Tucson, Arizona: Averill M. Law & Associates.
3. Sheldon Ross, Simulation, 5th Edition, ISBN: 9780124158252, 2012, Academic Press

Course Outcomes

At the end of the course, the student will be able to

1. Apply the concepts of simulation modelling to real life situations and generate & test the random numbers required for simulation. (PO-3)
2. Apply simulation to solve simple real life problems. (PO-1, 3)
3. Generate random variates required for simulation. (PO-1, 3)
4. Conduct output analysis for termination and steady state simulations and evaluate two system designs. (PO-2, 5)
5. Reduce the variation in simulation data and apply simulation for manufacturing and material handling systems (PO-3,5)

Course Code: MIE22	Credits:4:0:0
Pre-requisites :Nil	Contact Hours: 56
Course Coordinators :Dr. G S Prakash / Dr. M. Rajesh	

Course Contents

Unit I

Introduction and Process Control For Variables: Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart

Process Capability – process capability studies. Six sigma concepts.

Control chart for variables – X chart and R chart.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Links:** ➢ https://nptel.ac.in/courses/103105130
➢ https://onlinecourses.swayam2.ac.in/nou21_me04/preview

Unit II

Process Control for Attributes: Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :** ➢ https://nptel.ac.in/courses/112107259

Unit III

Acceptance Sampling: Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :** ➢ https://www.youtube.com/watch?v=xJ3czkvNxpk

Unit IV

System Reliability: Definition, Series, parallel and mixed configuration, Block diagram concept, r-out-of-n structure solving problems using mathematical models. Numerical problems

FMEA: Introduction, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Life Testing, numerical problems, Introduction to Failure Mode and Effect Analysis.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :** ➢ https://www.youtube.com/watch?v=uutg8jKrL9w

Unit V

Quality in Health Care: Reasons for the Rising Health Care Cost, Steps for improving quality in healthcare, Quality Tools for Use in Health Care. Software Quality: Software Quality Factors and their sub factors, Software Quality Cost. Quality Control in the **Textile Industry:** Textile Quality Control Department Functions, Quality Control in Finishing and in the Clothing Industry. Quality Control in the Food Industry: Factors Affecting Food Quality, HACCP Concept, Fruits and Vegetables Quality.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :** ➢ https://onlinecourses.nptel.ac.in/noc20_mg34/preview

Text books

1. Douglas.C. Montgomery, " Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. Dhillon, B.S, Applied Reliability and Quality- Fundamentals, Methods and Procedures Series: Springer Series in Reliability Engineering, 2007
3. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.

Reference Books

1. Hoang Pham, Recent Advances In Reliability And Quality In Design, Springer Series In Reliability Engineering, 2008
2. John.S. Oakland. "Statistical process control", 5th edition, Elsevier, 2005
3. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
4. Besterfield D.H., "Quality Control", Prentice Hall, 1993.
5. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.

Course Outcomes

At the end of the course, the student will be able to

1. Appreciate the role and importance of statistical quality control and reliability in modern industry. (PO:1)
2. Analyze the effects of variation on processes and utilize SPC tools for process control and improvement. (PO:3)
3. Bridge the quality and managerial functions in reference to Quality and Reliability Engineering. (PO:1)
4. Understand the concept of reliability analysis methods and quality analysis methods. (PO:4)
5. Understand the application of Quality Engineering in various streams. (PO:5)

ELECTIVE – D

EXPERIMENTAL DESIGN & ANALYSIS	
Course Code: MIEE231	Credits4:0:0
Pre-requisites : Nil	Contact Hours: 56
Course coordinators : Dr. Sridhar B S/ Dr. Niranjan C A	

Course Contents

Unit I

Experiments with a Single Factor: The Analysis of Variance, Randomized Blocks, Latin Squares, and Related Designs.

- ➤ **Pedagogy:**   ➤ Black board teaching, Power Point Presentation
- ➤ **Links:**   ➤ https://www.youtube.com/watch?v=blgoO4pd2TI
  - ➤ https://www.youtube.com/watch?v=IEUTRhyoHNc&list=PLPjSqI TyvDeWS9Lxp4jreGJ7eNsxHxJA8
  - ➤ https://www.youtube.com/watch?v=u2doEvzb-U0

Unit II

Introduction to Factorial Designs, the 2^k Factorial Design.

- ➤ **Pedagogy:**   ➤ Black board teaching, Power Point Presentation
- ➤ **Links:**   ➤ https://www.youtube.com/watch?v=4JjWWQen_uU
  - ➤ https://www.youtube.com/watch?v=rwQYLtG_AYI
  - ➤ https://www.youtube.com/watch?v=GGvuacZb-AQ

Unit III

Blocking and Confounding in the 2^k Factorial, Two-Level Fractional Factorial Designs.

- ➤ **Pedagogy:**   ➤ Black board teaching, Power Point Presentation
- ➤ **Links:**   ➤ https://www.youtube.com/watch?v=dcr7QMyYNDg
  - ➤ https://www.youtube.com/watch?v=Kc68bxtpe68
  - ➤ https://www.youtube.com/watch?v=8fyzT76di00

Unit IV

Fitting Regression Models, Response Surface Methods: Method of Steepest Ascent, Analysis of Second Order response Surface, Characterizing Response Surface.

- ➤ **Pedagogy:**   ➤ Black board teaching, Power Point Presentation
- ➤ **Links:**   ➤ https://www.youtube.com/watch?v=fCgwSEFlnt8
  - ➤ https://www.youtube.com/watch?v=Q-TtIPF0fCU
  - ➤ https://www.youtube.com/watch?v=lZtyxpHsBlg

Unit V

Random Effects Model: Single Random factor, Nested Design: Two Stage Nested Design, M Stage Nested Design (3 stages). Split Plot Design with Two Factors.

- ➤ **Pedagogy:** ➤ Black board teaching, Power Point Presentation
- ➤ **Links:** ➤ https://www.youtube.com/watch?v=pGDeKSE_Pqc
  - ➤ https://www.youtube.com/watch?v=3_sbitgMeUg
  - ➤ https://www.youtube.com/watch?v=J9UEYUXi6lY

Text books

1. Douglas C. Montgomery, Design And Analysis Of Experiments, 8th Edition, 2012, Wiley

Reference books

1. Angela Dean, Daniel Voss, Design And Analysis Of Experiments, Springer, 2006
2. Douglas C. Montgomery, George C. Runger : Applied Probability&Statistics, 5th Edition, Wiley, 2010

Course Outcomes

At the end of the course, the student will be able to

1. Develop and Analyze Single Factor Model, Latin Square Designs. (PO-3)
2. Develop and Analyze Two Level Design and Apply to real time Scenarios (PO-3)
3. Develop and Design fractional factorial models and conduct analysis (PO-3)
4. Develop Reponses surface models (PO-3)
5. Analyze complex designs such as Random factors, Nested and Split Designs (PO-3)

CYBER SECURITY

Course Code: MIEE232   Credits:4:0:0
Prerequisites : Nil   Contact Hours: 56
Course coordinators: Dr. G S Prakash/ Hamritha S

Course Contents

Unit I

Security Concepts and Mechanisms -Networking Concepts Overview -Information Security Concepts -Security Threats and vulnerabilities.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.youtube.com/watch?v=nBCcFWop15M

Unit II

Cryptography -Security Management -Security Management Practices

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.youtube.com/watch?v=4JKFmauRh_0

Unit III

Network Security -Access Control and Intrusion Detection -Server Management and Firewalls - Security for VPN and Next Generation Networks

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.coursera.org/lecture/real-time-cyber-threat-detection/basics-of-intrusion-detection-ADdP9

Unit IV

System and Application Security - Security Architectures and Models - System Security - OS Security

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.coursera.org/lecture/systems-application-security-sscp/systems-and-application-security-tAFsG

Unit V

Security Laws and Standards - Cyber Laws

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://study.com/academy/lesson/information-security-laws-regulations.html

Text books

1. Cyber Security Essentials - James Graham (Editor), Ryan Olson (Editor), RickHoward (Editor)Auerbach Publications; 1 edition, 2010

Reference Books
1. Cyber Security And Global Information Assurance: Threat Analysis And Response Solutions (Hardcover) by Kenneth J. Knapp (Editor) Publisher: Information Science Publishing, 2010
2. Cyber Laws, Shikha Singh, Global India Publications Pvt Ltd., 2011

Course Outcomes
At the end of the course, the student will be able to
1. Apply to knowledge of basic security and networking concepts to real time problems (PO-1,3)
2. Apply knowledge of Security Management principles to Real Life Problems (PO-1,3)
3. Develop Network Security Systems and Future Systems for various Problems (PO-1,3)
4. Create Security System Architecture and Models (PO-1,3)
5. Apply Knowledge of Security Laws for Various Real time problems (PO-1,3)

ADDITIVE MANUFACTURING

Course Code: MIEE233	Credits:4:0:0
Prerequisites :Nil	Contact Hours: 56
Course Coordinators: Dr. R Shobha / Dr. M R Shivakumar	

Course Contents

Unit I

Introduction, the Basic Principles, Additive Manufacturing Processes, Personal Printer Revolution, AM Process Work flow A Closer Look at Rep-Rap Machines Preparing Files for 3D Printing Choosing the Right Materials

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.youtube.com/watch?v=7L42aRs68WI

Unit II

Extrusion Systems Sheet Lamination Jetting Direct-Write Bio printing Sintering Overview Powder Bed Fusion Directed Energy Deposition Photo Polymerization

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://all3dp.com/1/types-of-3d-printers-3d-printing-technology/

Unit III

Software & Methods, Designing for Additive Manufacturing (DFAM), Software Tools vs. Requirements Pre- & PO-st-processing 3D Scanning & the Scanning Process Sculpting & Repairing Data AM File Formats STEP File Format More Detail on NURBS Model Validation Working with DICOM Files for 3D Printing Medical Imagery

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.cati.com/blog/7-design-additive-manufacturing-dfam-principles/

Unit IV

Materials Choosing, Materials for Manufacturing, Multiple Materials, Metal AM Processes & Materials Composite Materials Biomaterials, Hierarchical Materials & Bio-ceramics Shape-Memory Materials, 4D Printing & Bio-active materials Advanced AM Materials

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.e-education.psu.edu/matse81/node/2094

Unit V

Key Related Processes, Choosing the Right Manufacturing Process, Applications of AM Direct Digital Manufacturing, Distributed Manufacturing, Mass Customization,

Biomedical Applications, Aerospace & Automotive Applications and Architectural Engineering. Intellectual Property, Commercialization, Trends, Business Opportunities & Future Directions

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://strucsoftsolutions.com/blog/what-is-digital-manufacturing/

Text books

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2nd Ed. (2015) , Ian Gibson, David W. Rosen, Brent Stucker
2. Chua C. K., Leong K. F., and Lim C. S., "Rapid Prototyping: Principles and Applications", Second Edition, World Scientific Publishers (2003)
3. Patri K. Venuvinod, Weiyin Ma "Rapid Prototyping: Laser-Based and Other Technologies" Springer , 2004

Reference Books

1. Peter D. Hilton, Hilton/Jacobs, Paul F. Jacobs, "Rapid Tooling: Technologies and Industrial Applications", CRC Press, 2000.
2. Burns. M, "Automated fabrication", Prentice-Hall, 1993.

Course Outcomes

At the end of the course, the student will be able to

1. Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technology.(PO-1,3)
2. Demonstrate comprehensive knowledge of the broad range of AM processes, devices, capabilities and materials that are available. (PO-1,5)
3. Describe different RP techniques and fundamentals of Reverse Engineering. (PO-1,4)
4. Understand the various software tools, processes and techniques that enable advanced/additive manufacturing and personal fabrication(PO-1,3)
5. Understand the latest trends and business opportunities in AM, distributed manufacturing and mass customization. (PO-1,3,5)

RAPID PROTOTYPING	
Course Code: MIEE234	Credits:4:0:0
Prerequisite: Nil	Contact Hours: 56
Course Coordinators: Dr. S. Appaiah/ Sri. Sudheer D. Kulkarni	

Course Contents

Unit I

Introduction: Definition of Prototype, Types of prototype, Need for the compression in product development, History of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.

Stereo lithography Systems: Principle, Process parameter, process details, Data preparation, data files and machine details, Application.
- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.youtube.com/watch?v=ABQ5N9wRGNw

Unit II

Selective Laser Sintering: Type preparation for SLS, Applications, Path generation, Applications. Principle of operation, process parameters, Data Fusion Deposition Modeling**:** Principle, Process parameter.
- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.youtube.com/watch?v=ksLiAjk8yBI

Unit III

Solid Ground Curing: Principle of operation, Machine details, Applications, Laminated Object Manufacturing: Principle, of operation, LOM materials, process details, application.

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genisys Xs printer HP system 5, object Quadra systems, Laser Engineering Net Shaping.
- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.youtube.com/watch?v=VzdJQCm8yes

Unit IV

Rapid Tooling : Indirect Rapid tooling -Silicon rubber tooling —Aluminum filled epoxy tooling Spray metal tooling ,Cast kirksite ,3D keltool, Direct Rapid Tooling —Direct, AIM, Quick cast process, Copper polyamide, Rapid Tool ,DMILS, ProMetal ,Sand casting tooling ,Laminate tooling soft Tooling vs. hard tooling.
- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.youtube.com/watch?v=lkghAmdo344&vl=en

Unit V

Software for RP: Stl. files, Overview of Solid view, Magics, Mimics, magic communicator, etc. Internet based software, Collaboration tools

Application of Rapid Prototyping and Technology:-Functional models, pattern for investment and Vacuum casting, medical models, Art models, Engineering analysis models.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.rp-photonics.com/resonator.html

Text Books:

1. Paul F. Jacobs: "Stereo 1ithography and other RP & M Technologies"-SME NY, 1996.
2. Flham D.T & Dinjoy S.S "Rapid Manufacturing"- Verlog London 2001.

Reference Books:

1. Terry Wohler's " Wohler's Report 2000 "- Wohler's Association 2000
2. Peter D Hilton, Paul F Jacobs, "Rapid Tooling Technologies and Industrial Applications", Marcel Dekker, 2000.

Course outcomes

At the end of the course, student will be able to

1. Understand the basic concepts and principle of RP process. (PO-1)
2. Select and analyze the process parameters related to various machines. (PO-1)
3. Comprehend the working of various machines used in RP process. (PO-1)
4. Select the right tool for the given operation. (PO-3)
5. Apply RP software technology for manufacturing various products. (PO-3)

Elective – E

MANAGEMENT ACCOUNTING AND FINANCE

Course Code: MIEE241	Credits:4:0:0
Pre-requisites :Nil	Contact Hours: 56
Course Coordinators : Dr. NVR Naidu/ Dr. Shobha R	

Course Contents

Unit I

Basic records, Preparing financial statements Financial Accounting Conventions, trading account, profit and Loss account and Balance sheet concepts.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://archive.nptel.ac.in/courses/110/101/110101131/

Unit II

Balance sheet concepts with Adjustment entries, Inventory valuation financial ratios, Sources of funds, Cash Flow statements

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://archive.nptel.ac.in/courses/110/107/110107073/

Unit III

Cost accounting, Cost classification, Allocation and absorption of cost, relevant costs, Allocation joint costs. Design of historical and standard costing systems, Overhead cost control Managerial Economics concept, process costing.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.digimat.in/nptel/courses/video/110101132/L02.html

Unit IV

Working capital management New Trends in Managerial Accounting.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://onlinecourses.nptel.ac.in/noc22_mg66/preview

Unit V

Budgeting and Budgeting Control: Sales budget, production budget, raw materials purchasing budget, selling and administrative expense budget, cash budget, Flexible Budget, Master budget

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ http://nitttrc.edu.in/nptel/courses/video/110107127/L13.html

Text Books

1. Guruprasad Murthy, Financial Accounting, Himalaya, 2009
2. Anthony A. Atkinson, Robert S. Kaplan, S. Mark Young, Ella Mae Matsumura, Management Accounting, Prentice Hall, 2007.

Reference Books

1. Hansen Don R, Mowen M Maryanne, Management Accounting, Cengage Learning, 7th Edition, 200742.

Course Outcomes

At the end of the course, the student will be able to

1. Demonstrate the concept of accounting principles for obtaining comprehensive Solutions in accounting. (PO-1, 5)
2. Apply the accounting ratios knowledge to solve industrial problems. (PO-1, 5)
3. Exhibit knowledge about the cost of product, process and their controlling factors to solve industrial problems.(PO-1, 5)
4. Apply the knowledge of working capital requirement and its management in industry (PO-1, 5)
5. Demonstrate the importance of budgeting and its methods to control finance in industry. (PO-1,5)

PYTHON PROGRAMMING

Course Code: MIEE242	Credits:4:0:0
Prerequisites : Computer Concepts and C Programming	Contact Hours: 56
Course Coordinators : Dr. R Shobha/ Dr. Niranjan C A	

Course Contents

Unit I

Introduction to Python, use IDLE to develop programs, Basic coding skills, working with data types and variables, working with numeric data, working with string data, Python functions, Boolean expressions, selection structure, iteration structure, Illustrative Programs, Exercises

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢ https://www.youtube.com/watch?v=riL_xn6BKD8

Unit II

Define and use functions and modules, working with recursion, Basic skills for working with lists, work with a list of lists, work with tuples, work with dates and times, get started with dictionaries, Illustrative programs, Exercises.

➢ **Pedagogy:** ➢Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢https://www.youtube.com/watch?v=fXRxHrDhQuI

Unit III

An introduction to file I/O, use text files, use CSV files, use binary files, Handle a single exception, handle multiple exceptions, Illustrative programs, Exercises Exits

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢ https://www.programiz.com/python-programming/file-operation

Unit IV

Object Oriented Programming, An introduction to classes and objects, define a class, work with object composition, work with encapsulation, and work with inheritance, override object methods, Illustrative programs, Exercises

➢ **Pedagogy:** ➢Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢https://java-programming.mooc.fi/part-4/1-introduction-to-object-oriented-programming

Unit V

An introduction to relational databases, SQL statements for data manipulation, Using SQLite Manager to work with a database, Using Python to work with a database, Creating a GUI that handles an event, working with components, Illustrative programs, Exercises

- ➢ **Pedagogy:** ➢Chalk and talk, Power Point presentation, Videos
- ➢ **Link:** ➢https://www.youtube.com/watch?v=J9OkCVfr_ZY

Text books
1. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
2. Mark Lutz ,"Learning Python", O Reily, 4th Edition, 2009, ISBN: 978-0-596-15806-4
3. Tim Hall and J-P Stacey ,"Python 3 for Absolute Beginners" , 2009, SBN:9781430216322

Reference Books
1. Mark Lutz ,Programming Python, O Reily, 4th Edition, 2010, ISBN 9780596158118
2. Magnus Lie Hetland , "Beginning Python: From Novice to Professional", 2nd Edition, 2009, ISBN:9781590599822

Course Outcomes
At the end of the course, the student will be able to
1. Acquire programming skills in core Python. (PO-3)
2. Implement Object Oriented Skills in Python. (PO-1,3)
3. Develop the skill of designing Graphical user Interfaces in Python. (PO-1)
4. Write database applications in Python. (PO-1,3)
5. Independently create GUI based applications. (PO-3)

BLOCKCHAIN TECHNOLOGY

Course Code: MIEE243	Credits:4:0:0
Prerequisite: Nil	Contact Hours: 56
Course Coordinators: Dr. M. Shilpa	

Course Contents

Unit I

Introduction: Concept of blockchain, Nodes, cryptocurrency, token, distribution, modern encryption, blocks to hashes, Ledgers, public witness

Blockchain Principles and Qualities: Blockchain qualities, basic principles, three main types of blockchains, popular platforms

- ➢ **Pedagogy:**
- ➢ **Link :**
  - ➢ Chalk and talk, Power Point presentation, Videos
  - ➢ https://www.legal.io/articles/5170590/Blockchain-101

Unit II

Blockchain Networks: History of blockchain networks, top challenges, deeper dive into Bitcoin, major Bitcoin contributors, hyperledger, Ripple, Waves Platform – a Russian blockchain

- ➢ **Pedagogy:**
- ➢ **Link:**
  - ➢ Chalk and talk, Power Point presentation, Videos
  - ➢ https://www.makeuseof.com/problems-with-blockchain-technology/

Unit III

Blockchain for Data Management: Big Data, cloud computing technology, cloud-based blockchain, monetizing big data, challenges for blockchain in data analytics, blockchain and Ricardian contracts

- ➢ **Pedagogy:**
- ➢ **Link:**
  - ➢Chalk and talk, Power Point presentation, Videos
  - ➢https://www.youtube.com/watch?v=20gDImYbVcU

Unit IV

Implementing Blockchain: Identifying opportunities and threats, determining use cases and impact on processes, people and partners, conceptual model for implementation, transformation success

- ➢ **Pedagogy:**
- ➢ **Link:**
  - ➢ Chalk and talk, Power Point presentation, Videos
  - ➢ https://connect.comptia.org/content/guides/blockchain-concept-to-implementation

Unit V

New Business Applications: Decentralized sharing economy, neighborhood micro-grids, data-sharing marketplace, machine to machine transactions, smart cities, digital medicine, value based healthcare, energy sector, payroll service

Blockchain Security issues: Rise of cyber security threats, blockchain risks, cyber security risks, blockchain risk management

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.youtube.com/watch?v=dl8Hl91siM8

Textbooks
1. Tiana Laurence, Introduction to Blockchain Technology, Van Haren Publishing, 1st edition, 2019.
2. Mohsen Attaran, Angappa Gunasekaran, Applications of Blockchain Technology in Business: Challenges and Opportunities, Springer, 2019

References
1. Alan T. Norman, Blockchain Technology Explained, CreateSpace Independent Publishing Platform, 2017
2. Ahmed Banafa, Blockchain Technology and Applications River Publishers, 2020, ISBN: 8770221065, 9788770221061
3. Peter Lipovyanov, Blockchain for Business 2019: A user-friendly introduction to blockchain, Packt Publishing, 2019

Course outcomes
At the end of the course, student will be able to
1. Identify the type of blockchain required for the business (PO- 4)
2. Analyze and select a blockchain network (PO- 3,4)
3. Understand the significance of blockchain for data management. (PO- 4)
4. Analyze the challenges in implementing blockchain for a business (PO- 3)
5. Identify new business applications of blockchain and address the related security issues (PO- 5)

DATA WAREHOUSING AND MINING

Subject Code : MIEE44	Credits : 4 : 0 : 0
Prerequisites : Nil	Course Hours: 56
Course Coordinator : Hamritha.S	

Course Content

Unit I

DW methodology - DW architectures - The DW development processes: Logical and physical DW

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢ https://www.youtube.com/watch?v=patBYUGwsHE

Unit II

DW data modeling - ETL, Data access, Data quality - DM - Query tools

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://www.javatpoint.com/data-warehouse

Unit III

State-of-the-art in DM tools and technologies

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢

Unit IV

DM and Business intelligence – From findings to application

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://datasemantics.co/business-intelligence-and-data-mining/

Unit V

From research to a mature technology – technological artifact - DW, DM and beyond.

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://community.fs.com/blog/an-overview-of-dwdm-technology-and-dwdm-system-components.html

Text books

1. Berry, M.J.A. and Linoff G.S. (2004). Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management (paperback), 2nd Edition. ISBN: 0-471-47064-3, Wiley

Reference Books

1. Sperley, Eric. (1999) the Enterprise Data Warehouse: The Planning, Building & Implementation Volume I: 1st Edition. ISBN 0139058451, Prentice Hall.

Course Outcomes

At the end of the course, the student will be able to

1. Identify the data ware housing and methodologies and architecture .(PO-3)
2. Understand data modelling and data mining quarry tools (PO-3)
3. Application of state of the arts in mining tools and technologies. (PO-3)
4. Aware of business intelligence from findings to applications. (PO-4)
5. Apply various data modelling techniques to any given business process. (PO-4)

ELECTIVE – F

EVALUATION OF SUPPLY CHAIN MANAGEMENT	
Course Code: MIEE251	Credits:4:0:0
Pre-requisites : Nil	Contact Hours: 56
Course coordinator: Dr. Niranjan C A	

Course Contents

Unit I

Understanding the Supply Chain: Historical perspective; Objective of Supply Chain; The Importance of supply Chain Decisions; Decisions Phases in a Supply Chain; Process Views of a Supply Chain; Examples of Supply Chains. Competitive and supply Chain Strategies; Supply Chain Performance: Achieving Strategic Fit and Scope: Obstacles to Achieving Strategic Fit ; Achieving Strategic Fit; Expanding Strategic Scope; Obstacles to Achieving Strategic Fit. Supply Chain Drivers and Metrics. **Drivers of Supply chain performance**

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://nptel.ac.in/courses/110106045

Unit II

Designing Distribution Networks and Applications to e-Business: The role of Distribution in Supply Chain; Factors influencing Distribution Network Design; Design Options for a Distribution Network; Indian Distribution Channels; Distribution Networks in Practice. Network Design in the Supply Chain: The Role of Network Design in the Supply Chain; Factors Influencing Network design decisions; A framework for Network design decisions; Models for Facility Location and Capacity Allocation; The role of information Technology in Network Design; Making Network Design Decisions in Practice; The impact of Uncertainty on Network Design.

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://nptel.ac.in/courses/110105122

Unit III

Conceptualization of Supply Chain Performance: Supply Chain Performance Definition of Performance, Goal of Performance Measurement, Performance Indicators, Performance Improvement Goals in the Supply Chain, Evolution of Supply Chain Performance, Supply Chain Performance Attributes (Metrics), Performance and Measurement Categories, Supply Chain Performance Measurement Models, Performance Benefits.

Supply Chain Performance Factors in the Manufacturing Industry: Overview, Factors Associated with Performance in the Manufacturing Industry, Supply Chain Risk, Definition of Risk and Risk Management, Risk Assessment Methodologies,

Types of Supply Chain Risk, Manufacturing Practices, Toyota Production System and Competitiveness Enterprises, Regional Aspects of the Supply Chain: Overview.

➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
➤ **Link:**   ➤ https://onlinecourses.nptel.ac.in/noc21_mg45/preview

Unit IV

Supply Chain Evaluation and Methodologies: Analysis of Performance Factors, Multivariate Analysis Methods, Introduction, Multiple Linear Regression **Designing Global Supply Chain Networks**: The impact of Globalization on Supply Chain Networks; The Off shoring Decision: Total Cost; Risk Management in Global Supply Chains; the Basic Aspects of Evaluating Global Supply Chain Design; Evaluating Network Design Decisions Using Decision Trees; Making Global Supply Chain Design Decisions Under uncertainty in Practice; Uncertainty in Global Supply Chain operations –An Indian Experience

➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
➤ **Link:**   ➤ https://nptel.ac.in/courses/110108056

Unit V

Impact of Competitiveness on the Supply Chain Performance: Methodology, **Exploratory Analysis of the Data:** Introduction and Generalities, Sample Description, Descriptive Analysis of Risk Factors, Descriptive Analysis of Regional Factors, Descriptive Analysis of Manufacturing Practices, Descriptive Analysis of Supply Chain Performance, Exploratory Factor Analysis Risks Factors, Regional Factors, Manufacturing Practices Supply Chain Performance, Conclusions.

➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
➤ **Link:**   ➤ https://archive.nptel.ac.in/courses/110/105/110105141/

Text book:
1. Evaluation of Supply Chain Performance- Avelar-Sosa, Liliana, Garcia Alcaraz, Jorge Luis, Maldonado-Macías, Aide Aracely
2. Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies – David Simchi-Levi (McGraw Hill, 2008)

References
1. Supply Chain Management: Strategy, Planning, and Operation **–** Sunil Chopra (Pearson, 2015)
2. Operations and Supply Chain Management - Robert Jacobs (McGraw Hill, 2013)

Course Outcomes

At the end of the course, the student will be able to

1. Understand the fundamentals of supply chain management and inventory management. (PO-1)
2. Execute Supply Chain Evaluation in the Export-Oriented Manufacturing Industry. (PO-3)
3. Understand the Conceptualization of Supply Chain Performance. (PO-3)
4. Examining Supply Chain Methodologies. (PO-3)
5. Analyzing Impact of Competitiveness on the Supply Chain Performance. (PO-3)

INNOVATION AND TECHNOLOGY MANAGEMENT

Course Code: MIEE252	Credits:4:0:0
Pre-requisites :Nil	Contact Hours: 56
Course coordinators : Dr. M Rajesh/Sri Sudheer D. Kulkarni	

Course Contents

Unit I

Innovation: Concepts, Types of innovation, Linear, Cyclic and Network models of innovation, Global industrial competition: Changes in World industry, Dominant trends and issues in World business, Relationship between Business strategy and technology strategy, To Innovate or Not to Innovate. Innovation Planning Process, Factors that aid Innovation Planning, Dynamics of innovation process.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :** ➢ https://youtu.be/6L_ipFvVtWE

Unit II

Strategies for Innovation: New R&D strategies, Core competencies and business strategy, Building innovation culture in organizations, Key Initial Questions for Implementation, Organizational roles for innovation, Facilitators and impediments of innovation, Strategic issues in innovation management, developing a Climate for Innovation, Management of technological innovation, Case study.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢ https://youtu.be/OFAJM-wl3HM

Unit III

The concept of technology: Introduction, concept and meaning of technology, the nature of technology change, life cycle. Economics of technology: Introduction, meaning, engineering economics, concept of optimum size, corporate technological strategy, business mission, competitive technology, technology crisis, Technology Forecasting, technological convergence.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢ https://youtu.be/lxtaDlHZtg4

Unit IV

The adoption of new manufacturing technology: Introduction, strategy, challenges and opportunities, yield of technology forecasting, realization of new technology, concept of R& D, effectiveness of R& D, Analysis for technology strategy: Introduction, technology assessment, forecasting, techniques.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :** ➢ https://youtu.be/ubRAaOMytww

Unit V

Project management for new technology: Introduction, project preparation, risks, project planning, cost management, technology: an instrument of competition, technology competition analysis (TCA), technology leadership, adoption of new technology, change management, work structure. Stages of factory automation, FMS, CIM, CAD/CAM, IMS, Case Study.

- ➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :** ➢ https://youtu.be/3zqwlr8sp2Y

Text Books
1. P.N.Rastogi, Management of Technology and Innovation, Sage Publications, New Delhi, 1995.
2. Paul Lowe - The Management of Technology, perception & opportunities, Chapman & Hall, London, 1995.

Reference Books
1. M. White and G.D. Bruton, The Management of Technology and Innovation, Cengage learning, 2007
2. Frederick Betz - Strategic Management of Technology, Mc Graw Hill inc 1993

Course Outcomes:
At the end of the course, student will be able to
1. Understand the global industrial competition to adopt the new technology to build the relationship bridge between business strategy and technology strategy. (PO: 5,7)(PSO: 2,3)
2. Apply the various innovation concepts and models in organization to their strategic issues in innovation management. (PO: 5,6) (PSO: 2,3)
3. Analyze the trends in Innovation Management, engineering economics strategies to build innovation culture to strengthen the activities of employees. (PO: 4,7) (PSO: 2,3)
4. Evaluate, adapt and select new manufacturing technologies. (PO: 7,8) (PSO: 2,3)
5. Develop skills to setting up a small business enterprise and implement projects for new technologies. (PO: 9,11) (PSO: 2,3)

SYSTEMS ENGINEERING	
Course Code: MIEE253	Credits:4:0:0
Prerequisites :Nil	Contact Hours: 56
Course coordinator : Dr. M Shilpa	

Course Contents

Unit I

Overview of the systems engineering domain; definitions key to systems engineering; the system life cycle, and the product development life cycle. Phase gate approach to product development enabled by application of systems engineering principles. Concept Exploration and the four types of systems requirements that must be extracted from the customer's statement of want and needs. Dual nature of validation, and its differences from verification.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢ https://www.coursera.org/lecture/mbse/introduction-to-systems-engineering-1OGnu

Unit II

Requirement analysis, requirements development, and how these relate to planning for systems integration, verification and validation. Functional analysis, interface analysis, requirement allocation, traceability, and use of commercial tools to enable effective application of SE principles in an integrated team environment.

Development of a master compliance matrix, a test and evaluation master plan, and use of technical performance measures in defining system performance.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢ https://acqnotes.com/acqnote/tasks/step-5-verify-validate-requirements

Unit III

Use of trade study methods for system definition. Applying these methods in concept exploration and system definition. Modeling, simulation and systems analysis enable analysis of alternatives in concept exploration.

Applying specialty-engineering disciplines by the system engineer throughout the product development life cycle, and the system life cycle. Gaining practical experience in the use of reliability, system safety and human factors engineering.

➢ **Pedagogy:** ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:** ➢ https://www.youtube.com/watch?v=AlnYvHJ-GPM

Unit IV

Engineering Design: preliminary design, detailed design, integration and test, system validation, full rate production. Explore the ideas behind concurrent engineering,

design for six sigma and total quality development as they apply to the systems engineering roles, responsibilities, and the development of high quality products in any market, industry or sector. Explore the fundamentals of how an integrated product and process development system can enhance the application of systems engineering principles and what an engineer should look for in a company's "people, methods, tools/processes, and environment (PMTE)".

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Link :**   ➤ https://www.coursera.org/lecture/systems-engineering/module-6-part-1-fx09i
  - ➤ https://www.coursera.org/lecture/systems-engineering/module-6-part-2-MwwXi

Unit-V

Design and Specification Design:—usability, survival, damage tolerance, safety, reconfigure ability, stealth, self-defence, self-healing, replacement, test, production, integration, installation, preplanned improvement. Development Interface control, adjusting design for integration, configuration management, compatibility management

- ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
- ➤ **Link :**   ➤ https://www.javatpoint.com/software-configuration-management

Textbook:
1. Benjamin S. Blanchard and Wolter J. Fabrycky, Systems Engineering and Analysis, 5th ed., Prentice Hall International Series in Industrial and Systems Engineering, (Upper Saddle River, NJ), 2006. ISBN-13: 978-0-13-221735-4

Reference Books
1. Alexander Kossiakoff, William N. Sweet, Samuel J. Seymour, Steven M. Biemer Systems Engineering Principles and Practice, wiley series 2nd edition- 2011
2. Dahai Liu, Systems Engineering: Design Principles and Models CRC Press- 2016
3. Derek K. Hitchins, Systems Engineering: A 21st Century Systems Methodology John Wiley & son's - 2008

Course Outcomes

At the end of the course, the student will be able to

1. Define systems engineering, the system life cycle phases, and the product development life cycle phases.(PO-1,3)
2. Write 'good' requirements and explain the characteristics of: a 'good' requirement, a suitable requirement management process, and enabling tools. (PO-3)
3. Describe and apply a general methodology for trade study and analysis of alternatives. (PO-3)
4. Describe how integrated product teams and specialty engineering are used to achieve effective product development. (PO-4,5)
5. Analyze Specification Design for technical project management and systems engineering principles(PO-3,5)

ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM

Course Code: MIEE254	Credit:4:0:0
Prerequisites : Nil	Contact Hours: 56
Course coordinator: Dr. R.Shobha	

Course Contents

Unit I

Introduction to Artificial Intelligence: Historical Backdrop, What is intelligence? Turing Test, Intelligent Decisions, Intelligent agent and model of world, symbolic reasoning in AI, model of cognitive agent

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://www.youtube.com/watch?v=SSE4M0gcmvE

Unit II

Communication and Integration: Multiple agents, interacting agents, models of other agents, modal logic of knowledge

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.youtube.com/watch?v=zGOGzbHz0SA

Unit III

State Space Search: Introduction, Generate and Test, Simple search 1, Depth First Search, Breadth first search, Comparison of DFS and BFS

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.youtube.com/watch?v=pcKY4hjDrxk

Unit IV

Heuristic Search: Heuristic functions, Best First Search, Hill Climbing, Local Maxima, Solution Space search, variable neighborhood descent, Beam search, peak to peak method

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.youtube.com/watch?v=5F9YzkpnaRw

Unit V

Expert Systems: Introduction, representing and using domain knowledge, Expert system shells, Explanation, Knowledge acquisition

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ https://www.javatpoint.com/expert-systems-in-artificial-intelligence

Textbooks
1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education Pvt. Ltd., 2013
2. Elaine Rich, Kevin Knight, Shivashankar B Nair, "Artificial Intelligence" 3rd edition, Tata McGraw Hill Publication, New Delhi.

Reference books
1. Nils J. Nilsson, Nils Johan Nilsson, Artificial Intelligence: A New Synthesis, MK Publishers, California, 2000
2. Stuart Jonathan Russell, Peter Norvig, John Canny, Artificial intelligence, Prentice Hall, 2003

Course Outcomes
At the end of the course, the student will be able to
1. Identify intelligent decisions taken up by AI and understand symbolic reasoning in AI (PO-2)
2. Establish communication and integration models among the AI agents (PO-1)
3. Conduct different searches under State Space Search (PO-1)
4. Analyze different searches under heuristic functions (PO-2)
5. Identify how expert systems work and how they acquire knowledge. (PO-3)

SYSTEMS SIMULATION AND MODELING LAB	
Course Code: MIEL26	Credits: 0:0:1
Prerequisites: Nil	Course Hours: 14 Sessions
Course coordinator: Dr. Siddhartha Kar	

List of Experiments

1. Introduction to and Understanding the Simulation Packages
2. Building simulation Models for Banking service (With Basic templates)
3. Building simulation Models for Banking service (With Common templates)
4. Building simulation Model for Mortgage application problem (With Basic templates)
5. Building simulation Model for Mortgage application problem (With Common templates)
6. Building simulation Model for food processing problem
7. Building simulation Model for post office animation
8. Building simulation models for manufacturing operations (Electronic assembly – With Basic templates)
9. Building simulation models for manufacturing operations (Electronic assembly – With Common templates)
10. Building simulation models for manufacturing operations with transport System
11. Building simulation models for manufacturing operations with layout
12. Simulation of hospital emergency room (Basic Templates)
13. Evaluation of two alternative designs of retail outlet stores (Basic Templates)
14. Identifying probability distributions for given data
15. Statistical Analysis of Simulation models (input analysis)
16. Statistical Analysis of Simulation models (output analysis)

Note: At least 13 experiments from the above list have to be conducted during the semester

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ Simulation Experiments using ARENA:
    https://www.youtube.com/watch?v=r-SGj4Xo9lI
    - ➢ An Introduction to ARENA:
    https://www.youtube.com/watch?v=UycXwNTYlHE

Textbooks

1. Law, A. M., and W. D. Kelton, Simulation Modeling and Analysis. Tata McGraw Hill, 2007

Reference books

1. Averill M. Law, Michael G. McComas, SIMULATION OF MANUFACTURING SYSTEMS, Proceedings of the 1997 Winter Simulation Conference ed. S. Andradóttir, K. J. Healy, D. H. Withers, and B. L. Nelson, 1997
2. Banks, J., J. S. Carson, and B. L. Nelson. 1996. Discrete event system simulation. 2nd edition,. Upper Saddle River, New Jersey: Prentice-Hall.
3. Law, A. M. 1997. How to select simulation software. Tucson, Arizona: Averill M. Law & Associates.

Course Outcomes

At the end of the course' the student will be able to

1. Create Simulation Model for various real time scenarios (Manufacturing, Servicing Industry, Health Care, Retail Sectors) using Arena. (PO-3)
2. Analyze the simulation output and suggest improvement (PO- 3,5)
3. Evaluate alternative system designs using Arena Software (PO-3)

QUALITY ENGINEERING LAB

Course Code: MIEL27	Credits:0:0 :1
Pre-requisite: Nil	Contact Sessions :14 Sessions
Course coordinators: Dr. G S Prakash / Dr. M. Rajesh	

List of Experiments

1. Construction of Xbar- R chart using SPC software
2. Construction of Xbar- R chart using SYSTAT software
3. Construction of Xbar- R chart using Multifunctional Vernier height gauge
4. Construction of Xbar- R chart using SQC display unit
5. Process capability analysis using Normal Probability Paper method
6. Process capability analysis using Multifunctional Vernier height gauge
7. Process capability analysis using SPC software
8. Process capability analysis using SYSTAT software
9. Process capability analysis using SQC display unit
10. Construction of attribute control chart using SYSTAT software (P- chart , nP- chart, c-chart, u-chart) at least 2 attribute control charts to be constructed
11. Conduction of single sampling plan experiment

Note: Any 10 experiments from the above list of experiments to be conducted in a semester and the same should be indicated in the lesson plan.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link :**   ➢ https://nptel.ac.in/courses/110105088

Text Books

1. Montgomery -Introduction to Statistical Quality Control, John Wiley and Sons -2007.
2. Grant and Leavenworth -Statistical Quality Control,McGraw-Hill.-2008
3. Juran and Gryna-Quality Planning and Analysis, 3rd edition,TMH.4thEdision-2001
4. NVR Naidu, KM Babu, and G Rajendra-Total Quality Management, New Age International Pvt.Ltd-2006

References

1. Dale H. Besterfield-Quality control, Prentice-Hall International; 1998.-HardCover- 2003
2. Kesavan R -Total Quality Management, IK International, NewDelhi-2007

Course outcomes

At the end of the course, student will be able to

1. Construct quality control charts and assess the capability of the process. (PO-1,3,4)
2. Conduct experiments using principles of design of experiments and analyze the results(PO- 1,3,4)
3. Design the sampling plan and determine producer's and consumer's risks (PO- 3,4)
4. Conduct experiments on Six Sigma and variability studies and analyze the results(PO- 3, 4, 5)

III SEMESTER

QUANTITATIVE TECHNIQUES IN DECISION MAKING

Course Code: MIE31	Credits:3:1:0
Pre-requisites: Nill	Contact hours: 42 Theory+ 14 Tutorial Session
Course coordinators: Dr. G S Prakash/Dr. Sridhar B S	

Course Contents

Unit I

Introduction to Decision Making and Quantitative Techniques: Complexity of Reallife problems, Models, Types of models for decision support, Model building process, Solution procedures, Advantages and limitations, Role of Human Judgment to make decisions.

Linear Programming: Introduction, Formulation and Graphical Solution, Simplex Method, Big-M method

➢ **Pedagogy:**   ➢ Black board teaching, Power Point Presentation
➢ **Links:**   ➢ https://www.youtube.com/watch?v=gMGwB4VBhE0
                             ➢ https://www.youtube.com/watch?v=j0rEFrBgPRs
                             ➢ https://www.youtube.com/watch?v=8RhOmy1Hg_8

Unit II

Specially structured linear program: Transportation problems and assignment problems

Sensitivity Analysis – Algebraic Method in linear programs

➢ **Pedagogy:**   ➢ Black board teaching, Power Point Presentation
➢ **Links:**   ➢ https://www.youtube.com/watch?v=iIRmTbcTN-g
                             ➢ https://www.youtube.com/watch?v=SYbvaLW6LLs
                             ➢ https://www.youtube.com/watch?v=-w2z3MVTcQA
                             ➢ https://www.youtube.com/watch?v=nkvS1URM20g

Unit III

Integer programming – Introduction, Cutting plane method (Gomory cut)

Goal Programming: Introduction, formulation of goal programing problems.

Replacement: Introduction, Replacement of items that deteriorate with time, when money value is not counted and counted, Replacement of items that fail completely, Group Replacement.

➢ **Pedagogy:**   ➢ Black board teaching, Power Point Presentation
➢ **Links:**   ➢ https://www.youtube.com/watch?v=BifxJCwwthg
                             ➢ https://www.youtube.com/watch?v=vKVkOpNDZ2s
                             ➢ https://www.youtube.com/watch?v=sF8D9htih4Y

Unit IV

Network models: PERT and CPM, crashing (Simple Problems), Maximum Flow Problems, Shortest Route Problems,

Introduction, general characteristics, Kendall-Lee notation, performance measures, Single-server model, multiple server model – M/M/K: ∞/FCFS

- ➤ **Pedagogy:**   ➤ Black board teaching, Power Point Presentation
- ➤ **Links:**   ➤ https://www.youtube.com/watch?v=vUMGvpsb8dc
                            ➤ https://www.youtube.com/watch?v=WrAf6zdteXI

Unit V

Optimization Heuristics: (No analytical treatment) Genetic Algorithm – Introduction, characteristics, mapping GA to natural evolution, methodology, advantages, applications Particle Swarm Optimization –

Introduction, mapping to social behavior of some of the animals, methodology Simulated Annealing – Introduction, mapping to physical annealing process, methodology Ant Colony Optimization – Introduction, mapping to ant's foraging behavior, methodology Analytical Hierarchical Processing – Introduction to multi-criteria decision making, methodology

- ➤ **Pedagogy:**   ➤ Black board teaching, Power Point Presentation
- ➤ **Links:**   ➤ https://www.youtube.com/watch?v=PGjnv6OC73M
                            ➤ https://www.youtube.com/watch?v=y7rEGCsymzs
                            ➤ https://www.youtube.com/watch?v=O_UAVLcJ6e8

Text Book

1. Taha, Hamdy A. Introduction to Operations Research, PHI Pvt Ltd., New Delhi 2003.
2. Omid Bozorg-Haddad, Mohammad Solgi, Hugo A. Loáiciga, Meta-heuristic and Evolutionary Algorithms for Engineering Optimization, John Wiley and Sons, 2017

Reference books

1. M P Gupta and R B Khanna, Quantitative Techniques for Decision Making, PHI, 2011.
2. Anderson, Sweeney and Williams, quantitative Methods for business, Lengage Learning, 2006.
3. Ravindran, Philips and Solberg, Operations research Principles and Practice, John Wiley and Sons, 1987.
4. Kaushik Kumar, Divya Zindani, J. Paulo Davim Meta Heuristic - Optimizing Engineering Problems through Heuristic Techniques, CRC Press, 2019

Course Outcomes

At the end of the course, the student will be able to

1. Use human judgment to make informed decisions and formulate and solve linear programming problems in real life situations (PO-3)
2. Arrive at optimum solutions for transportation problems and conduct sensitivity analysis to aid in decision making (PO-3)
3. Obtain solutions to integer programming problems and formulate the multi objective problems as goal programming problems. (PO-3)
4. Arrive at optimum solutions for network problems and analyze queuing systems. (PO-5)
5. Identify and apply the right heuristic for solving optimization problems (PO-3,5)

PROJECT MANAGEMENT FOR BUSINESS, ENGINEERING AND TECHNOLOGY

Course Code: MIEE321	Credits:4:0:0
Pre-requisites : Nil	Contact Hours: 56
Course coordinators: Dr. M R Shivakumar / Sudheer D Kulkarni	

Course Contents

Unit I

Philosophy and concepts: Functions and views of management, Project view Point and traditional management, Evaluation of project management, Where is project management appropriate, Management by project: A common approach, different forms of project management, Project environments, Project management by industrial settings, Project management in the industrial setting, Project management in the service sector, Project and program management in government and the public sector.

Systems thinking- definition of system, systems concepts and principles, Human organizations, Systems approach, Systems engineering, Relevancy of the systems approach to project management.

> ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos
> ➤ **Links:**   ➤ https://www.youtube.com/watch?v=betmDj4t25s
>   ➤ https://www.youtube.com/watch?v=BE34Gu_swXQ

Unit II

Systems development cycle: Systems life cycle, System development cycle, Phase A: Conception, Project feasibility, project charter, the project proposal, project contracting. Phase B: Definition.

Systems and Procedures for planning and control: Planning steps, the project master plan, Scope and statement of work, work definition, Project organization and responsibilities, Scheduling, Planning and scheduling charts, Line of balance, procurement management.

> ➤ **Pedagogy:**   ➤ Chalk and talk, Power Point presentation, Videos

> ➤ **Links:**   ➤ https://www.youtube.com/watch?v=-GwBNwZOPUs
>   ➤ https://www.youtube.com/watch?v=uWPIsaYpY7U

Unit III

Project time planning and Networks: Network diagrams, the critical path, Gantt and calendar schedules, Management schedule reserve, precedence diagramming method, Scheduling with resource constraints, Criticism of network methods.

Advanced project network analyses and Scheduling: CPM and time –cost tradeoff, variability of activity duration, PERT, Theory of constraints and critical chain method,

Allocating resources and multiple project scheduling, Theory of constraints methods for allocating resources to multiple projects.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Links:**   ➢ https://www.youtube.com/watch?v=ACjTnkTT7v4

    ➢ https://www.youtube.com/watch?v=ZxQ2QChBVVc

Unit IV

Cost estimation and Budgeting: Cost estimating, Cost escalating, Cost estimating and the systems development cycle, Life cycle costs, Cost estimating process, Elements of budgets and estimates, Project cost accounting systems, Budgeting using control (cost) accounts, Cost summaries, Cost schedules and forecasts.

Project quality management: The concepts of quality, the processes of project quality management, Techniques for quality assurance during system development, Processes and techniques for quality control.

Managing risks in projects: Risk concepts, Risk identification, Risk assessment, risk response planning, risk tracking and response, Project management is risk management.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Links:**   ➢ https://www.youtube.com/watch?v=YQ2Wi3Jh3X0
    ➢ https://www.youtube.com/watch?v=_toWE9DpsCU
    ➢ https://www.youtube.com/watch?v=xXV_gjtXMSk

Unit V

Project Execution and Control: Phase C: Execution, Design stage, Production and /Build stage, The control process, Project monitoring, Internal and external project control, Traditional cost control, Cost- accounting systems for project control, Work package and control accounts, Project control emphasis, Performance analysis, Forecasting "To complete" and "At completion", Monitoring performance indexes and variances, Controlling changes, Contract administration, Control problems.

Project evaluation, Communication, implementation and closeout: project evaluation, Communication plan, Project review meetings, Reporting, Project management information systems, Web-enabled project management, PMIS in the project life cycle, Informal communication, Implementation stage, project terminating and closeout, Closing contract, Project summary evaluation, After project-Phase-D: operation.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Links:**   ➢ https://www.youtube.com/watch?v=dXYMZDaPkUE
    ➢ https://www.youtube.com/watch?v=Pwd7ddSDgZQ

Text books
1. John M Nicholas and Herman Steyn- Project management for Business, Engineering and Technology, Elsevier India Private Ltd. -2011.
2. James P Lewis – Project planning scheduling and control, Tata McGraw Hill-2001.

References
1. Harold Kerzner -Project management - A Systems approach to planning, scheduling and controlling, CBS Publishers and distributors, 2004.
2. David I Clelnad -Project Management –Strategic design and Implementation, McGraw Hill, 1999.

Course Outcomes
At the end of the course, the student will be able to
1. Understand the philosophy and concepts of systems engineering.(PO-1, 5)
2. Analyze the system development and procedure for planning and control.(PO-:2, 5)
3. Estimate project time planning.(PO-3, 5)
4. Develop estimate and budgeting, controlling quality and managing risks of a project.(PO-3, 5)
5. Apply technique for execution, control, evaluation, communication, implementation of a project. (PO-3, 5)

INDUSTRY 4.0	
Course Code: MIEE322	Credits: 4:0:0
Prerequisites: Nil	Contact Hours: 56
Course Coordinators: Dr. R Shobha/Dr. Siddhartha Kar	

Course Contents

Unit I

Fourth Industrial Revolution – Introduction, Current Practices, Challenges and Opportunities, Qualifications and skills for Industry 4.0

> ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos

> ➢ **Link:**   ➢ Industry 4.0: The Fourth Revolution:
> https://www.youtube.com/watch?v=wgWRLu8p90M

Unit II

Enabling Technologies - Management of new technologies, functional aspects, drivers of industry 4.0, main idea of industry 4.0, end-to-end digital transformations, and introduction to block chain technology

> ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos

> ➢ **Link:**   ➢ Sustainability Assessment of Manufacturing Industry:
> https://www.youtube.com/watch?v=eKiepu2D-XQ

Unit III

Cyber-physical Systems - Introduction, Internet of Things and Services, Intelligent Objects vs. Intelligent Systems

> ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos

> ➢ **Links:**   ➢ Cyber-Physical Systems and Next-Generation
> Sensors:
> https://www.youtube.com/watch?v=8wBQMbOntNc
> ➢ Basics of Industrial IoT:
> https://www.youtube.com/watch?v=JN8uv-qryRY

Unit IV

Technological requirements - hardware based technologies, Software based technologies, Artificial Intelligence, autonomy of action, advanced data analytics

> ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos

> ➢ **Links:**   ➢ Artificial Intelligence:
> https://www.youtube.com/watch?v=zsE9EH0oJSk
> ➢ Big Data and Advanced Analysis:
> https://www.youtube.com/watch?v=cTZVK7CK1gs

Unit V

Human Capital in Industry 4.0 – Future competencies for Industry 4.0, Education in smart manufacturing, National knowledge management, Rewarding human capital.

- ➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
- ➢ **Link:**   ➢ Smart Factories:
  https://www.youtube.com/watch?v=De8MQWbhu3k

Text Books:
1) Bartodziej CJ. 2017. The Concept Industry 4.0 - An Empirical Analysis of Technologies and Applications in Production Logistics, Springer Gabler, ISBN: 978-3-658-16501-7
2) Petrillo A, Cioffi R and Felice FD. 2018. Digital Transformation in Smart Manufacturing, IntechOpen, London, ISBN: 978-953-51-3841-9

References:
1) Diego Galar Pascual, Pasquale Daponte, Uday Kumar, Handbook of Industry 4.0 and Smart Systems, CRC Press, Taylor and Francis Group, 2019
2) Narendra Jadhav, New Age Technology and Industrial Revolution 4.0, Konark Publishers Pvt. Ltd., 2019

Course outcomes

At the end of the course, student will be able to
1) Analyze the challenges and opportunities of Industry 4.0 (PO-1,3 & PSO-1)
2) Identify the right enabling technologies to transform into Industry 4.0 (PO-5 & PSO-2)
3) Analyze the interface between humans and computers in industries and services. (PO-1, 3 & PSO-2)
4) Identify and suggest the technological requirements for Industry 4.0. (PO-1,3&PSO-1)
5) Analyze the role of human capital for future competencies of Industry 4.0 (PO-8 & PSO-1)

SOFTWARE ENGINEERING	
Course Code: MIEE323	Credits:4:0:0
Prerequisites :Nil	Contact Hours: 56
Course Coordinators: Dr. M Rajesh / Hamritha S	

Course Contents

Unit I

The Product and the Process: The product - Evolving role of Software, Characteristics, Components, and Applications. The Process - Software process, Models - Linear, sequential, Prototype, RAD, Process Technology, Software Development Life cycle.

Software Project Management Concepts: The Management Specification, People, Problem, Process.

➢ Pedagogy: ➢ Chalk and talk, Power Point presentation, Videos

➢ Link :   ➢ https://www.youtube.com/watch?v=Z-THUjekmIc

Unit II

Software Project Planning: Objectives, Scope, Resources, Project estimation, Decomposition Techniques, Empirical Estimation Models, Make-buy decision, automated estimation tools.

Risk Management: Reactive v/s Proactive Risk Strategies, Software Risks, Risk identification, Risk projection, Monitoring.

➢ Pedagogy: ➢ Chalk and talk, Power Point presentation, Videos

➢ Link :   ➢ https://www.youtube.com/watch?v=TYBVAvWkG6M

Unit III

Software Project Scheduling and Tracking: Basic concepts, defining a task set selection, Defining Scheduling, Project Plan.

Software Quality Assurance/Quality Control: Quality assurance concept, Cost impact of software defects, Technical review, statistical Quality assurance, software reliability, ISO 9000 Quality standards.

➢ Pedagogy: ➢ Chalk and talk, Power Point presentation, Videos

➢ Link :   ➢ https://www.youtube.com/watch?v=yjykeur4FUA

Unit IV

System Analysis Concept and Principles: Requirement analysis, Principles, software prototyping, specifications, Data Modeling, Functional Modeling and Information Flow, Structured Analysis, Data Dictionary.

System Design Concepts and Principles: Design Process Concept, Modular design, Documentation Design Methods, Data Design, Interface Design, Procedural Design,

Design for Real Time Systems, Considerations in Real Time systems, Analysis and Simulation of Real Time Systems.

➢ Pedagogy: ➢ Chalk and talk, Power Point presentation, Videos

➢ Link :   ➢ https://www.youtube.com/watch?v=95nIM9vZSAQ

Unit V

Dependability and security specification: safety specification, reliability specification, formal specification.

Security Engineering: Security management, Design for Security, System survivability,

Dependability and security assurance: static analysis, reliability testing, security testing, process assurance, safety and dependable cases.

➢ Pedagogy: ➢ Chalk and talk, Power Point presentation, Videos

➢ Link: ➢ https://www.youtube.com/watch?v=jHOxpcINJZc

Text Book

1. Roger S. Pressman -Software Engineering: A Practitioner's Approach, Software Engg. Series, McGraw-Hill International Editions, 4th Ed.

Reference

1. Somerville -Software Engineering, Adison Wesley publications, 9th edition, 2012, ISBN 978-81-317-6216-5

Course outcomes

At the end of the course, student will be able to

1. Appreciate Software concepts and understand the significance of software development life cycle. (PO- 1,2 &PSO1)

2. Identify and classify key project planning steps. (PO- 2 &PSO 2)

3. Track and evaluate software quality control process. (PO-5 &PSO 2)

4. Demonstrate data modeling and functional modeling. (PO-4 &PSO 1)

5. Design security specification and handle security engineering. (PO-3 &PSO3)

COMPUTATIONAL METHODS FOR QUEUING NETWORKS	
Course Code: MIEE324	Credits:4:0:0
Prerequisites :Nil	Contact Hours: 56
Course Coordinators: Dr. G S Prakash / Dr. M.Shilpa	

Course Contents

Unit I

Introduction -Modelling Automated Manufacturing Systems - Performance Modeling Tools. Markov Chain Models - Memoryless Random Variables - Stochastic Processes in Manufacturing - Discrete Time Markov Chain Models - Continuous Time Markov Chain Models - - Absorbing States and Modeling of Deadlocks - Semi-Markov Processes in Manufacturing

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link:**   ➢ https://www.youtube.com/watch?v=v-3TmN4HhLc

Unit II

Queuing Models - Queues: Notation and Examples - The M/M/1 Queue - The M/M/m Queue - Batch Arrival Queuing Systems - Queues with General Distributions - Queues with Breakdowns

➢ **Pedagogy:**   ➢Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢https://www.youtube.com/watch?v=SqSUJ0UYWMQ

Unit III

Queuing Networks - Open Queuing Networks - Closed Queuing Networks - Product Form Queuing Networks - Queuing Networks with Blocking. Analysis of Queues - Approximate Analysis of Queuing Systems - Analysis of a Flexible Machine Centre - Per formability Analysis

➢ **Pedagogy**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢ https://www.youtube.com/watch?v=e5e31ZLytO0

Unit IV

Petri Net Models - Classical Petri Nets - Stochastic Petri Nets - Generalized Stochastic Petri Nets - Deadlock Analysis using Petri Nets - Extended Classes of Petri Nets - Integrated Petri Net - Queuing Network Models

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢ https://www.youtube.com/watch?v=XpZEbHyHA2o

Unit V

Applications - Automated Manufacturing Systems - Performance Measures - Computer Controlled Machines - Material handling Systems - Plant Layout- Flexible Manufacturing Systems - Computer Control Systems - Modeling of Kanban Systems

➢ **Pedagogy:**   ➢ Chalk and talk, Power Point presentation, Videos
➢ **Link :**   ➢ https://archive.nptel.ac.in/courses/110/106/110106044/

Text books

1. Viswanadham N, Narahari Y, Performance Modeling of Automated Manufacturing Systems, Prentice Hall of India Pvt Ltd, 2005

Reference Books

1. Computer systems performance evaluation and prediction, Paul J Fortier, 2006

Course Outcomes

At the end of the course, the student will be able to

1. Analyze discrete time and continuous time marker chain models in manufacturing. (PO-3)
2. Analyze different types of queues along with their breakdowns. (PO-3)
3. Conduct perform ability analysis for different types of queue networks. (PO-3)
4. Identify the type of Petri Net models and analyze the same. (PO-3)
5. Analyze the queues in manufacturing, material handling systems. (PO-3, 4)

INTERNSHIP/INDUSTRIAL TRAINING	
Course Code: MIEI33	Credits:0:0:4
Pre requisite: Nil	Course duration: 1 Month
Course Coordinator: Dr. R Shobha	

Course Contents

Students have to undergo industrial training in the form of Internship for one month in reputed industries.

Assessment and Evaluation

Note: Students have to undergo one month internship in an industry. The student has to compulsorily submit a report and the evaluation will be done by a committee constituted by the HOD. Each student must give a presentation for about 30 minutes, comprising of:

- Company Profile
- Recording of information/observations
- Short comings noticed during the internship
- Application of industrial engineering techniques
- Conclusions

Course outcomes

At the end of the course, the student will be able to

1. Identify the products of the company and its customers and draw the appropriate plant layout of the industry (PO-1)
2. Construct the process map for some of the important products of the industry (PO-1,2)
3. Identify some of the problems present in the industry and apply industrial engineering techniques to provide suitable suggestions to overcome them (PO-2,3)

Course Code: MIEP34   Credits:0:0:4
Prerequisites : Nil
Course Coordinator: Dr. R Shobha

Course Contents

The Project preparatory work will be evaluated based on:

> ➢ Company Information
> ➢ Appreciating the different aspects of the business
> ➢ Narrowing down to the specific problem
> ➢ Its importance and relevance / significance
> ➢ Project problem definition
> ➢ Scope – In Scope, Out of Scope
> ➢ Assumptions
> ➢ Project Plan

Course Outcomes
At the end of the course, the student will be able to
1. Identify engineering problems area. (PO-1,2)

2. Define project methodology/approach. (PO-2,3)

3. Evaluate various engineering tools / techniques. (PO-4, 5)

PROJECT WORK - II

Subject Code : MIEP41   Credits :0:0:20
Pre-requisites : Project work I
Course Coordinator: Dr. R Shobha

Course Contents

Final Project work will be evaluated based on

> ➢ Project problem definition
> ➢ Scope – In Scope, Out of Scope
> ➢ Assumptions
> ➢ Literature Survey
> ➢ Project Plan
> ➢ Project Preparatory Work and
> ➢ Data Gathering
> ➢ Inferences
> ➢ IE Concepts and Methodology used
> ➢ Implementation Methodology
> ➢ Analysis and Interpretation
> ➢ Recommendations
> ➢ Results
> ➢ Original Contribution of the project
> ➢ Project Report Depth and Quality
> ➢ Project Presentation

Course Outcomes
At the end of the course, the student will be able to
1. Collect and Interpret engineering data. (PO-1)
2. Implement engineering tools / techniques. (PO-2)
3. Validate the results obtained. (PO-3, 4)
4. Prepare a technical report. (PO-2)