DEPARTMENT OF INDUSTRIAL ENGINEERING

ANNA UNIVERSITY, CHENNAI

VISION :

To emerge as a Centre of excellence in the field of Industrial Engineering where the world class practices of teaching, learning and research synergize.

MISSION :

- Development of state of the art curriculum to meet the dynamic industry needs.
- Knowledge dissemination through student centric teaching learning process.
- Enriching laboratories with modern facilities
- Research contribution in the field of Industrial Engineering
- Maintaining continuous interaction with industry
- Cultivate the spirit of Entrepreneurship.

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ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.E. INDUSTRIAL ENGINEERING
REGULATIONS 2023
CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I.	To get competency in creating, implementing, improving and managing the financially viable/sustainable integrated socio-technical systems.
II.	To solve the real world industrial problems and can apply problem-solving skills to obtain optimal valid realistic solutions.
III.	To build and lead cross-functional teams, demonstrate professional leadership upholding to follow the ethical values.
IV.	To pursue research and engage themselves in life-long learning and growth in the field of Industrial Engineering with professional and ethical responsibility in the context of technological changes.
V.	To become an entrepreneur and be part of a supply chain or make and sell products in the open market.

2. PROGRAMME OUTCOMES(POs) & PROGRAMME SPECIFIC OUTCOMES (PSOs):

PO#	Program Outcomes
1	An ability to independently **carry out research/investigation** and development work to solve practical problems, write and present a technical report.
2	Students will have a solid formulation in the Industrial Engineering and Operations Research models and supporting quantitative methods by having a firm grasp of the **mathematical theory necessary to understand and build such models**.
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level **higher than the requirements in the appropriate bachelor program**

PSO#	Program Specific Outcomes
1	**Formulate and analyze problems in complex manufacturing and service systems** by comprehending and applying the basic tools of Industrial Engineering such as **modeling and optimization, stochastic, statistics**.
2	**Design and Develop appropriate analytical solution strategies** for problems in integrated production and service systems involving human capital, materials, information, equipment and energy.
3	**Implement solution, strategies** on a computer platform for decision - support purposes by employing effective **computational and experimental tools.**

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3. PEO/PO Mapping:

PEO	POs			PSOs		
	1	2	3	1	2	3
I.			3		2	2
II.	3	3	2	2		2
III.			2	2	3	
IV.	3		2	3		3
v.	1	1	1	1	1	1

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PROGRAM ARTICULATION MATRIX OF PG INDUSTRIAL ENGINEERING

Year	Semester	COURSE NAME	PO1	PO2	PO3	PSO1	PSO2	PSO3
Year - I	Semester I	Statistical Methods and Design of Experiments	2	2.8	3	1	1	3
		Research Methodology and IPR	3	3	2	-	-	-
		Work System Design and Ergonomics	2	2	2.5		2	
		Operations Management	1	3	3	3	3	
		Quality Engineering	1	2	2	2	1	
		Optimization Techniques	1	2	2	2	1	
		Work System Design and Ergonomics Laboratory	1	2	2	2	1	
	Semester II	Supply Chain Systems and Management	2.6	3	1	1	1.5	1
		Reliability Engineering Models	1.2	2	1.3	1.25	1.5	2
		Discrete System Simulation	3	2.5	1.3	1.25	1.5	2
		Data Analytics	1.5	2	2	2		
		Professional Elective I						
		Professional Elective II						
		Simulation Laboratory		3		3		
		Technical Seminar						
Year -II	Semester III	Professional Elective III						
		Professional Elective IV						
		Professional Elective V						
		Professional Elective VI						
		Data Analytics Laboratory	**2**	**2.5**	**3**	**1.6**	**2**	**1.3**
		Project Work I	2	3	1	1.6	-	2
		Project Work II	2	3	1	1.6	-	2

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ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

M.E. INDUSTRIAL ENGINEERING

REGULATIONS – 2023

CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IL3151	Statistical Methods and Design of Experiments	FC	4	0	0	4	4
2.	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
3.	IL3101	Work System Design and Ergonomics	PCC	3	0	0	3	3
4.	IL3152	Operations Management	PCC	3	0	0	3	3
5.	QE3151	Quality Engineering	PCC	3	0	0	3	3
6.	IL3102	Optimization Techniques	PCC	3	0	2	5	4
PRACTICALS								
7.	IL3111	Work System Design and Ergonomics Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**1**	**6**	**25**	**22**

SEMESTER II

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	IL3251	Supply Chain Systems and Management	PCC	3	0	0	3	3
2.	IL3252	Reliability Engineering Models	PCC	3	0	0	3	3
3.	IL3201	Discrete System Simulation	PCC	3	0	0	3	3
4.	IL3253	Data Analytics	PCC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Professional Elective II	PEC	3	0	0	3	3
PRACTICALS								
7.	IL3211	Simulation Laboratory	PCC	0	0	4	4	2
8.	IL3212	Technical Seminar	EEC	0	0	2	2	1
			TOTAL	**18**	**0**	**6**	**24**	**21**

SEMESTER III

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.		Professional Elective III	PEC	3	0	0	3	3
2.		Professional Elective IV	PEC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
4.		Professional Elective VI	PEC	3	0	0	3	3
PRACTICALS								
5.	IL3361	Data Analytics Laboratory	PCC	0	0	4	4	2
6.	IL3311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**16**	**28**	**20**

SEMESTER IV

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
PRACTICALS								
1.	IL3411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 75

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IL3151	Statistical Methods and Design of Experiments	4	0	0	4	I

PROFESSIONAL CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IL3101	Work System Design and Ergonomics	3	0	0	3	I
2.	IL3152	Operations Management	3	0	0	3	I
3.	QE3151	Quality Engineering	3	0	0	3	I
4.	IL3102	Optimization Techniques	3	0	2	4	I
5.	IL3111	Work System Design and Ergonomics Laboratory	0	0	4	2	I
6.	IL3251	Supply Chain Systems and Management	3	0	0	3	II
7.	IL3201	Discrete System Simulation	3	0	0	3	II

8.	IL3252	Reliability Engineering Models	3	0	0	3	II
9.	IL3253	Data Analytics	3	0	0	3	II
10.	IL3211	Simulation Laboratory	0	0	4	2	II
11.	IL3361	Data Analytics Laboratory	0	0	4	2	III
					TOTAL CREDITS	31	

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM3151	Research Methodology and IPR	2	1	0	3	I
					TOTAL CREDITS	**3**	

PROFESSIONAL ELECTIVE COURSES

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
1.	IL3051	Applied Object Oriented Programming	PEC	3	0	0	3	3
2.	QE3051	Quality Management	PEC	3	0	0	3	3
3.	IL3052	Management Accounting and Financial Management	PEC	3	0	0	3	3
4.	IL3053	Engineering Economics and Cost Estimation	PEC	3	0	0	3	3
5.	QE3252	Software Quality Engineering	PEC	3	0	0	3	3
6.	IL3054	Industrial Automation and Robotics	PEC	3	0	0	3	3
7.	IL3001	Intelligent and modern manufacturing management systems	PEC	3	0	0	3	3
8.	IL3055	Design Thinking	PEC	3	0	0	3	3
9.	QE3251	Lean Six Sigma	PEC	3	0	0	3	3
10.	IL3056	Advanced Optimization Techniques	PEC	3	0	0	3	3
11.	IL3002	Manufacturing Systems Modeling and Analysis	PEC	3	0	0	3	3
12.	IL3003	Modern Measurement Methods	PEC	3	0	0	3	3
13.	IL3057	Engineering Project Management	PEC	3	0	0	3	3
14.	IL3058	Industrial Scheduling Algorithms	PEC	3	0	0	3	3
15.	IL3059	Industrial Facilities Design	PEC	3	0	0	3	3

16.	IL3060	Decision Support Systems	PEC	3	0	0	3	3
17.	IL3004	Advances in Human factors engineering	PEC	3	0	0	3	3
18.	IL3061	Maintainability Engineering	PEC	3	0	0	3	3
19.	IL3005	Industrial safety Engineering	PEC	3	0	0	3	3
20.	IL3062	Product design and Value Engineering	PEC	3	0	0	3	3
21.	IL3063	Logistics and Distribution Management	PEC	3	0	0	3	3
22.	IL3064	Artificial Intelligence and Machine Learning	PEC	3	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IL3212	Technical Seminar	0	0	2	1	II
2.	IL3311	Project Work I	0	0	12	6	III
3.	IL3411	Project Work II	0	0	24	12	IV
TOTAL CREDITS						**19**	

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SUMMARY

	Name of the Programme: M.E. INDUSTRIAL ENGINEERING					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	4				**4**
2.	PCC	15	14	2		**31**
3.	RMC	3				**3**
4.	PEC		6	12		**18**
5.	EEC		1	6	12	**19**
	TOTAL CREDIT	**22**	**21**	**20**	**12**	**75**

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IL3151 STATISTICAL METHODS AND DESIGN OF EXPERIMENTS **L T P C**
4 0 0 4

COURSE OBJECTIVES:

1. To explain the basic probability and statistics concepts
2. To familiarize Hypothesis Testing and ANOVA to compute significance of factors and reach conclusions about effect of factors involved.
3. To develop factorial and fractional factorial designs for product and process optimization
4. To describe experimental design for engineering applications using orthogonal arrays and to use signal to noise ratios to illustrate robust design concepts in process optimization.
5. To impart knowledge on Response Surface Methods and Shainin design of experiments

UNIT I INTRODUCTION TO PROBABILITY AND STATISTICS 12

Basic Probability: Experiment, definition of probability, conditional probability, independent events, Bayes' rule, Bernoulli trials, Random variables, discrete random variable, , continuous random variable, Two dimensional random variables and their distribution functions, Independent random variables. Standard distributions - Binomial, Multinomial, Poisson, Uniform, exponential, Weibull, Gamma, Beta, Normal- Evaluation of statistical parameters for these distributions-Applications of these distributions- Chebyshev's theorem and central limit theorem - Basic Statistics - Linear Correlation, correlation coefficient, rank correlation coefficient, linear regression model, Bounds on probability, Chebyshev's Inequality.

UNIT II HYPOTHESIS TESTING AND SINGLE FACTOR EXPERIMENTS 12

Hypothesis- Types- Steps in Hypothesis Testing, Test of significance: Large sample test for single proportion, Difference of proportions, Single mean, Difference of means, and Difference of standard deviations. Test of significance for small samples: t- Test for single mean, difference of means, t-test for correlation coefficients-Chi-square test for goodness of fit and independence of attributes. Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, ANCOVA, steps in experimentation, Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests. Multivariate analysis of variance (MANOVA) – One way MANOVA

UNIT III MULTIFACTOR EXPERIMENTS 12

Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F- tests. 2^K factorial Experiments, Blocking and confounding in 2^K designs. Two level Fractional factorial design, nested designs, Split plot design- Factorial MANOVA with 2 factors- Response Surface Methods

UNIT IV TAGUCHI METHODS 12

Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design-control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response optimization

UNIT V RESPONSE SURFACE METHODS AND SHAININ DESIGN OF EXPERIMENT 12

Response Surface Designs- Designs for Fitting First-order Model -Central Composite Design (CCD)-Box–Behnken Designs - Analysis of Data from RSM Designs - Analysis of First-order Design - Analysis of Second-order Design. Basis of Shainin System -Problem Solving Algorithm-Procedure-Problem Identification Tools- Shainin Tools: Multivary analysis, Product

Process Search, Component search, Paired Comparison, Modified component search, Best vs. Current comparison.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Explain principles and concepts of design of experiments and quality engineering.
CO2 Illustrate quality engineering and robust design concepts.
CO3. Develop factorial, fractional factorial and orthogonal array designs for product and process optimization
CO4. Conduct experiments and analyse data for product and process improvements
CO5. Explain principles and concepts of response surface methodology.

REFERENCES:

1. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI,1 st Edition, 2011.
2. Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, Eighth edition, 2012.
3. NicoloBelavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.
4. Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.
5. Krishnaiah.K, Applied Statistical Quality Control and Improvement, PHI, 2014.
6. Montgomery, D.C., Design and Analysis of Experiments, Minitab Manual, John Wiley and Sons, Seventh edition, 2010.

CO's - PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	**2**	**3**	**1**	**2**	**3**
1	2	3	-	-	-	-
2	3	3	-	3	3	2
3	-	3	3	-	-	3
4	3	3	3	3	3	3
5	3	3	3	3	3	3
Avg.	**2.75**	**3**	**3**	**3**	**3**	**2.75**

RM3151 RESEARCH METHODOLOGY AND IPR L T P C
2 1 0 3

OBJECTIVES:

To impart knowledge on

- Formulation of research problems, design of experiment, collection of data, interpretation and presentation of result
- Intellectual property rights, patenting and licensing

UNIT I RESEARCH PROBLEM FORMULATION 9

Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap

UNIT II RESEARCH DESIGN AND DATA COLLECTION 9

Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING 9

Sampling, sampling error, measures of central tendency and variation,; test of hypothesis- concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, Copy rights, applicability of these IPR; , IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance.

UNIT V PATENTS 9

Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student can

CO1: Describe different types of research; identify, review and define the research problem
CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data
CO3: Explain the process of data analysis; interpret and present the result in suitable form
CO4: Explain about Intellectual property rights, types and procedures
CO5: Execute patent filing and licensing

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,

3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

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IL3101	WORK SYSTEM DESIGN AND ERGONOMICS	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1. To impart knowledge in the area of method study
2. To train the students in stop watch time study
3. To summarize time standards using predetermined motion time systems
4. To explain the Anthropometry measures and its use in the work place design
5. To articulate the effect of environmental factors on human performance

UNIT I METHOD STUDY **9**

Work design and Productivity – Productivity measurement - Total work content, Developing methods – operation analysis, motion & micro motion study, graphic tools.

UNIT II WORK MEASUREMENT **9**

Stop watch time study, Performance rating, allowances, standard data-machining times for basic operations, learning effect.

UNIT III APPLIED WORK MEASUREMENT **9**

Methods time measurement (MTM), Introduction to MOST standards, Work sampling, organization and methods (O & M), Wage incentive plans.

UNIT IV PHYSICAL ERGONOMICS **9**

Physical work load and energy expenditure, Anthropometry – measures – design procedure, Work postures-sitting, standing - measurement – ergonomic implications. Design of displays and controls .

UNIT V ENVIRONMENTAL FACTORS **9**

Sources & effects of Noise, Vibration, lighting, temperature, humidity & atmosphere. Measures for monitoring control & mitigation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Understand the purpose of method study and its method.
CO2. Understand the work measurement methods.
CO3. Know about Work sampling
CO4. Know the better working postures for better working.
CO5. Know about the environmental factors which affect the working condition.

REFERENCES:

1. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., Seventh Edition, 2002
2. Barnes, R.M. Motion and Time Study, John Wiley, 2002.
3. Bridger, R. S. "Introduction to Ergonomics", 3rd ed. CRC Press, New York and London,2008
4. MeCormik, J., Human Factors Engineering and Design, McGraw Hill, 1992
5. Introduction to work study, ILO, 3rd edition, Oxford & IBH publishing,2001
6. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006.

CO's - PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
1	2	-	2	-	2	-
2	2	-	2	-	-	-
3	-	2	-	-	2	-
4	-	-	3	-	-	-
5	-	-	3	-	-	-
Avg.	2	2	2.5	-	2	-

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IL3152	OPERATIONS MANAGEMENT	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1. To describe different operations management strategies for competitive advantage.
2. To know various techniques in forecasting the future Demand with accuracy.
3. To learn planning of production schedule and apply techniques like Aggregate plan, MRP, MRP II, DRP and ERP.
4. To learn how to determine the lot size and EOQ using the inventory systems. Also to learn how to classify the inventories for a better control.
5. To calculate the plant capacity and exercise control on production. Also to learn JIT implementation and control procedures.

UNIT I UNDERSTANDING OPERATIONS AND ITS DESIGN 9

Introduction to Operations Management, Manufacturing trends in India, Systems Perspective, Functions of Operations Management, Challenges and current priories for operations management; Operations Strategy- Corporate Strategy-Environmental Scanning -Developing Core Competencies -Developing Core Processes-Developing Global Strategies-Market Analysis-Market Segmentation-Competitive Priorities and Capabilities- Order Winners and Qualifiers-Identifying Gaps between Competitive Priorities and Capabilities - Addressing the Trends and Challenges in Operations Management –Global Competition -Comparative Cost Advantages- The Internet of Things- Need for Sustainable thinking for Operations Managers- Concerns and Barriers.

UNIT II DEMAND FORECASTING 9

Forecasting as a planning tool, need for forecast, forecasting time horizon, Design of forecasting system, Developing the forecasting Logic, Sources of data, Models for forecasting, Explorative Methods using Time Series - Moving averages, The exponential smoothing method, Extracting the components of time series, Estimating the trend using linear regression and Extracting the seasonal component; Causal Methods of forecasting, Accuracy of Forecasts and the Forecasting System.

UNIT III PRODUCTION PLANNING 9

Aggregate Production Planning and Master Production Scheduling; Resources Planning – Dependent demand attributes, the basic building blocks of a planning frame work, MRP logic, Using the MRP system, Capacity Requirements (CRP), Distribution Requirement Planning (DRP), and Resources Planning; Manufacturing Resources Planning (MRP II), Enterprise Resource Planning (ERP) and Resources Planning in Services.

UNIT IV INVENTORY PLANNING AND CONTROL 9

Inventory planning for independent Demand items, Types of inventory, Inventory Costs, Inventory Control for Deterministic Demand items, Handling Uncertainty in Demand, Inventory Control Systems, Selective Control of Inventory, Inventory Planning for Single - Period Demand and other issues in Inventory Planning and Control.

UNIT V CAPACITY ANALYSIS AND OPERATIONAL CONTROL 9

Defining capacity, Measures of capacity, The time horizon in capacity planning, The capacity planning framework, Alternatives for capacity augmentation, Decision tree for capacity planning; Operational control – Input - Output Control, Operational Control issues in mass production systems and Operations planning and control based on the theory of constraints; Elements of JIT Manufacturing and Production planning and Control in JIT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Identify different operations management strategies for competitive advantage.

CO2. Apply various techniques in forecasting the future Demand with accuracy.

CO3. Plan the production schedule and apply techniques like Aggregate plan, MRP, MRP II, DRP and ERP.

CO4. Determine the lot size and EOQ using the inventory systems. Also will be able to classify the inventories for a better control.

CO5. Plan the capacity and exercise control on production. Also understand JIT implementation and control.

REFERENCES:

1. Lee J. Krajewski, Manoj K. Malhotra, Larry P. Ritzman, "Operations Management: Strategy and Analysis", Pearson, 2018
2. Mahadevan,B. Operations Management- Theory & Practice, Pearson Education, 2018.
3. Panneerselvam,R. Production and operations management, PHI, 2012
4. SeetharamaL.Narasimhan, Dennis W.McLeavey, Peter J.Billington,"Production Planning and Inventory Control" , PHI, 2002

CO's - PO's & PSO's MAPPING

	PO's			PSO's		
CO's	**1**	**2**	**3**	**1**	**2**	**3**
CO1	1	3	3	3	3	-
CO2	1	3	3	3	3	-
CO3	1	3	3	3	3	-
CO4	1	3	3	3	3	-
CO5	1	3	3	3	3	-
Avg	1	3	3	3	3	-

QE3151	QUALITY ENGINEERING	L T P C
		3 0 0 3

COURSEOBJECTIVES:

1. To develop a clear knowledge in the basics of various quality concepts.
2. To Facilitate the students in understanding the application of control charts and its techniques.
3. To develop the special control procedures for service and process-oriented industries.
4. To analyze and understand the process capability study.
5. To develop the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION **9**

Quality Dimensions – Quality definitions – Inspection - Quality control – Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function

UNIT II QUALITY CONTROL CHARTS **9**

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES **9**

Warning and modified control limits, control chart for individual measurements, multi-vari chart, X chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICAL PROCESS CONTROL **9**

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V ACCEPTANCE SAMPLING **9**

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1.	Control the quality of processes using control charts for variables in manufacturing industries.
CO2.	Control the occurrence of defective product and the defects in manufacturing companies.
CO3.	Control the occurrence of defects in services.
CO4.	Analyzing and understanding the process capability study
CO5.	Developing the acceptance sampling procedures for incoming raw material.

REFERENCES:

1 Douglus C. Montgomery, “Introduction to Statistical Quality Control”, Wiley-India, Eighth Edition, 2019

2 Krishnaiah K.,” Applied Statistical Quality Control and Improvement”, PHI, 2014.

3 AmitavaMitra, “Fundamentals of Quality Control and Improvement”, Wiley, Fourth Edition, 2015.

4 Dale H. Besterfield, Quality Control, Pearson Education Asia, 10 th Edition, 2018.
5 Eugene L. Grant and Richard S. Leaven Worth, “Statistical Quality Control”, McGraw-Hill Education, Seventh Edition, 2000.

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s			PSO’s		
	1	**2**	**3**	**1**	**2**	**3**
1	-	3	3	3	-	2
2	-	3	3	3	-	2
3	-	3	3	3	-	2
4	3	2	3	-	-	2
5	3	2	3	-	3	-
Avg	3	2.6	3	3	3	2

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IL3102	OPTIMIZATION TECHNIQUES	L T P C
		3 0 2 4

COURSE OBJECTIVES:

1. To provide knowledge of optimization techniques and approaches.
2. To enable students to formulate real-world problems as mathematical programming models.
3. To develop students' mathematical, computational, and communication skills required for the practical application of Operations Research.
4. To build and solve the network problems
5. To understand issues in project management and manage project activities effectively
6. To gain knowledge and skills in solving decision-making and game theory models

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method. Solutions to LPP using simplex algorithm – Two phase method – Big M method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Revised simplex method - primal dual relationships – Dual simplex algorithm – Sensitivity analysis – changes in RHS value – changes in Coefficient of constraint – Adding new constraint – Adding new variable.

UNIT III NETWORK ANALYSIS 9

Transportation problems: Northwest corner rule, least cost method, Vogel's approximation method - stepping stone method - MODI method – Unbalanced transportation – Assignment problem – Hungarian algorithm. TSP- Solving using Hungarian Algorithm- Applications of TSP to other engineering problems. Minimum spanning tree problem, shortest path problem, Maximal flow problem-Maximal-flow minimum cut theorem - Maximal flow algorithm

UNIT IV PROJECT MANAGEMENT 9

Project Management- CPM- PERT- Crashing of Networks – Resource Leveling strategies- critical chain method- Resource Smoothing.

UNIT V DECISION THEORY AND GAME THEORY 9

Decision Theory- Decision under certainty-Decision under Risk-Decision under uncertainty – Decision Tree- Game theory – Two person zero sum games – Graphical solution Algebraic solution – Linear Programming solution.

TOTAL: 45 PERIODS

LABORATORY EXPERIMENTS

The following problems are solved using Operation Research software packages and 'C++' programming language.

1. LP problems and Sensitive Analysis
2. Solving LPP using Excel
3. Transportation problems
4. Assignment problems
5. Maximal Flow problems
6. Minimal Spanning Tree problems
7. Shortest route problems
8. Project Management problems
9. Two players zero sum game

TOTAL: 30 PERIODS

SOFTWARE REQUIRED

MS EXCEL
TORA & LINDO/GOOGLE OR TOOLS
Dev C++

COURSE OUTCOMES:

The students will be able to

CO1. Convert an abstract real-world problem to an optimization model.
CO2. Perform sensitivity analysis for an optimization problem
CO3. Build and solve network models and handle issues in Project Management
CO4. Identify critical activities and expedite project effectively.
CO5. Make decision under risk and uncertainty

REFERENCES:

1. Hamdy A Taha, "Operations Research – An Introduction", Pearson, 2017.
2. Philips, Ravindran and Solberg, "Operations Research principle and practise", John Wiley, 2007.
3. Ronald L Rardin, "Optimisation in Operations Research", Pearson, 2018.
4. Panneerselvam R, "Operations Research", PHI, 2009
5. Srinivasan G., "Operations Research Principles and Applications", PHI, 2017

CO's - PO's & PSO's MAPPING

CO	PO			PSO's		
	1	1	1	1	2	3
CO1	1	2	-	-	-	-
CO2	-	-	-	-	1	-
CO3	-	-	2	-	-	-
CO4	-	-	-	2	-	-
CO5	-	-	-	-	1	-
AVG	1	2	2	2	1	-

IL3111 WORK SYSTEM DESIGN AND ERGONOMICS LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES:

1. To develop the graphical tools of method study.
2. To prioritize the alternate, modify and propose the new methods.
3. To infer the work measurement tools.
4. To relate the software products in work measurement and set time standards.
5. To collaborate the students in physical fitness test.

LIST OF EXPERIMENTS

1. Graphic tools for method study.
2. Performance rating exercise.
3. Stop watch time study.
4. Peg board experiment.
5. Work sampling.
6. MTM practice.
7. Study of physical performance using tread mill and Ergo cycle.
8. Physical fitness testing of individuals.
9. Experiments using sound level and lux meters.
10. Experiments using Ergonomics software

TOTAL: 30 PERIODS

LABORATORY EQUIPMENTS REQUIREMENTS

1. Time study Trainer.
2. Peg board.
3. Stop watches.
4. Tread mill.
5. Ergo cycle.

Any one Ergonomics software

COURSE OUTCOMES:

The students will be able to

CO1: Apply the method study tools to record the existing methodology.
CO2: Design a better work place using method study tools.
CO3: Set time standards using work measurement techniques.
CO4: Develop time standards using software's
CO5: Conduct experiments for physical fitness using appropriate equipment.

CO's - PO's & PSO's MAPPING

CO	PO			PSO's		
	1	2	3	1	2	3
CO1	1	2	-	-	-	-
CO2	-	-	-	-	1	-
CO3	-	-	2	-	-	-
CO4	-	-	-	2	-	-
CO5	-	-	-	-	1	-
AVG.	1	2	2	2	1	-

IL3251 SUPPLY CHAIN SYSTEMS AND MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To describe the role and drivers of and supply chain management in achieving competitiveness.
2. To explain about Supply Chain Network Design.
3. To illustrate about the issues related to inventory in Supply Chain.
4. To appraise about transportation and sourcing in Supply Chain.
5. To application of Information Technology and Emerging Concepts in Supply Chain.

UNIT I INTRODUCTION TO SUPPLY CHAIN MANAGEMENT 9

Definition and Objective of Supply Chain, The importance of Supply Chain Decisions, Decision Phases in a Supply Chain, Process View of Supply Chains. Competitive and Supply Chain Strategies, Achieving Strategic fit, Expanding Strategic Scope. Drivers of Supply Chain Performance, Frame work for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing, Infrastructure, International Logistics

UNIT II DISTRIBUTION NETWORK DESIGN IN SUPPLY CHAIN 9

The Role of Distribution in the Supply Chains, Factors influencing Distribution Network design, Design Options for a Distribution Network, Online sales and the Distribution network, Distribution Networks in practice. Factors influencing network design decisions, Framework for Network design decisions, The impact of uncertainty on network design, The impact of Globalization on Supply Chain networks, Risk Management in Global Supply Chains, Discounted cash flow analysis, Evaluating Network Design Decisions

UNIT III INVENTORY IN SUPPLY CHAIN 9

The Role of Cycle inventory in a Supply Chain, Economies of Scale to Exploit Fixed costs, Managing Multi-echelon Cycle Inventory. The Role of Safety Inventory in a Supply Chain, Determining appropriate level of Safety inventory, Impact of supply Uncertainty on Safety inventory, Impact of aggregation on safety inventory, impact of replenishment policies on safety inventory, Managing Safety Inventory in a Multi-echelon Supply Chain, The Role of IT in inventory management.

UNIT IV TRANSPORTATION AND SOURCING IN SUPPLY CHAIN 9

The role of transportation in a Supply chain, Modes of transportation and their performance characteristics, Transportation infrastructure and policies, Design options for a transportation network, Trade-offs in transportation design, Tailored transportation, The role of IT in transportation, Problems. Sourcing Decisions In A Supply Chain: The role of sourcing in a supply chain, in-house or outsource, Third-and Fourth-party logistics providers, Total cost of Ownership, Supplier selection, Auctions and Negotiations, Sharing Risk and Reward in the supply chain.

UNIT V INFORMATION TECHNOLOGY IN SUPPLY CHAIN 9

The role of IT in a supply chain, The supply chain IT framework, The supply chain macro processes, Lack of Supply Chain co-ordination and the Bullwhip effect, managerial levers to achieve coordination, continuous replenishment and vendor-managed inventories, collaborative planning, forecasting and replenishment (CPFR).

TOTAL:45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Understand supply chain concepts, systemic and strategic role of SCM in global competitive environment.

CO2. Evaluate alternative supply and distribution network structures using optimization models.

CO3. Develop optimal inventory policies in the supply chain context.

CO4. Develop optimal sourcing and Transportation decisions in the supply chain.

CO5. Select appropriate information technology frameworks for managing supply chain processes.

REFERENCES:

1. Sunil Chopra, Peter Meindl and D.V. Kalra, “Supply Chain Management: Strategy, Planning, and Operation", Pearson Education, 2016.
2. Sarika Kulkarni & Ashok Sharma, Supply Chain Management – Creating Linkages for Faster Business Turnaround, 1st Edition, TATA Mc Graw Hill, 2004.
3. David Simchi Levi, Philip Kaminsky, Edith Simchi Levi & Ravi Shankar, Designing & Managing the Supply Chain – Concepts Strategies and Case Studies, McGraw-Hill higher education, 3rd Edition, 2008.
4. Jeremy F Shapiro, Modelling the Supply Chain, 2nd Edition, Cengage Learning,2009.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s			PSO’s		
	1	**2**	**3**	**1**	**2**	**3**
1	1	2	1			
2	3	3	1	1	1	1
3	3	3	1	1	1	1
4	3	3	1	1	1	1
5	3	3	1	1	3	1
Avg.	**2.6**	**3**	**1**	**1**	**1.5**	**1**

IL3252 RELIABILITY ENGINEERING MODELS L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To gain basic understanding on Reliability studies
2. To impart knowledge on the failure data analysis
3. To gain understanding of reliability prediction methods of various structures
4. To impart knowledge on reliability testing and monitoring methods
5. To provide understanding of maintainability/availability/replacement models

UNIT I RELIABILITY CONCEPT 9

Reliability definitions – Quality vs. Reliability - Reliability measures – f(t), F(t) , R(t) functions – Central tendency of failure time distributions – Design life - Mortality graph - A priori and A posteriori probabilities of failure – Component Mortality – Exponential relia/bility function – Useful life.

UNIT II LIFE DATA ANALYSIS 9

Failure data taxonomy – Empirical methods for Ungrouped, Grouped, Complete, Censored data – Failure time distributions - Survival graphs – Bartlett's Test – Kolmogorov Smirnov Test – Chi square goodness of fit Test – Hazard Plotting: Exponential, Weibull distributions: Smith's improved estimate.

UNIT III SYSTEM RELIABILITY EVALUATION 9

Series and Parallel structures – Parallel Redundancy – m/n System – Standby System – Complex structures: Baye's decomposition method: Different structures - Cut and Ties sets Method – Fault Tree Analysis – Human Reliability.

UNIT IV RELIABILITY MANAGEMENT 9

Life Testing: Failure terminated test – Time terminated test – Determination of Upper and Lower MTBFs – Sequential Reliability Testing – Reliability Allocation – Reliability Growth Monitoring: Duane Model - Replacement decisions: Deterministic and Stochastic models – Economic life.

UNIT V MAINTAINABILITY AND AVAILABILITY 9

Analysis of Downtime – Repair time distributions: Exponential, Lognormal – Maintainability measures – Maintainability prediction – Design for optimum maintainability – Spare parts control - Availability measures: Inherent, Achieved, Operational, Point and Interval Availability – System Availability – Optimal Inspection models: Minimize downtime, maximize profit.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the fundamental theory in Reliability Engineering
CO2: Analyse the failure time data and determine the fitness of the data into theoretical distributions
CO3: Estimate system reliability of standard/complex configurations
CO4: Apply reliability allocation, growth monitoring and life testing models
CO5: Demonstrate Maintainability and Availability of system

.

REFERENCES:

1. Patrick D.T. O'Connor and Andre Kleyner, "Practical Reliability Engineering", Fifth Edition, John Wiley & Sons, New York, 2012.
2. Andrew K.S.Jardine and Albert H.C.Tsang, "Maintenance, Replacement and Reliability: Theory and Applications", Taylor & Francis, 2013.
3. Charles Ebeling, "An Introduction to Reliability and Maintainability Engineering", Tata McGraw Hill, 2007

CO's - PO's & PSO's MAPPING

CO	PO			PSO's		
	1	**2**	**3**	**1**	**2**	**3**
CO1	1	1	-	-	-	2
CO2	1	2	-	1	1	-
CO3	2	3	3	2	1	-
CO4	1	2	1	1	2	-
CO5	1	2	1	1	2	-
AVG	**1.2**	**2**	**1.3**	**1.25**	**1.5**	**2**

Attested

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IL3201	DISCRETE SYSTEM SIMULATION	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1. To gain knowledge on solving different waiting line models.
2. To gain knowledge about generation of the random numbers using different algorithms and Enable to generate random variates.
3. To learn how to test the random number and random variates.
4. To enable to design of Monte Carlo simulation experiment.
5. To solve different simulation problems using various simulation softwares.

UNIT I QUEUING THEORY **9**

Queuing theory terminology – Single server, multi server- limited and unlimited queue capacity limited and unlimited population –limited and infinite queue length.

UNIT II GENERATION OF RANDOM NUMBERS and RANDOM VARIATES **9**

Systems – Modelling – Types – Systems components – Simulation basics- Random numbers – Methods of generation : Manual, table, algorithms – mid square, multiplier, constant multiplier, additive and multiplicative congruential algorithms- Random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc

UNIT III TESTING OF RANDOM NUMBERS AND RANDOM VARIATES **9**

Testing of Random numbers and Random variates – Chi square test - KS test - Run test - Poker test - Gap test - Autocorrelation test Input Data Modeling.

UNIT IV MONTE CARLO SIMULATION and DESIGN OF SIMULATION EXPERIMENTS **9**

Monte Carlo Simulation method - Random walk problem - Inventory problem - Queuing problem - Production problem - Replacement problem - Steps on Design of Simulation Experiments

UNIT V SIMULATION LANGUAGES & CASE STUDIES **9**

Development of simulation models using of simulation language for systems like Queuing, Inventory, Replacement, and Production etc

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- **CO1.** Acquire capability in applying and using of queuing models for day today problem.
- **CO2.** Learned to generate random numbers and variates.
- **CO3.** Understand the statistical stability of random number and random variates.
- **CO4.** Solve real time problem using Monte Carlo simulation.
- **CO5.** Learned to use simulation language to simulate and analyze systems.

REFERENCE:

1. David Kelton, Rondall P Sadowski and David T Sturrock, “Simulation with Arena”, McGraw Hill, 2004.
2. Law A M and Kelton W D, Simulation Modelling and analysis, Tata McGraw Hill, 2003.
3. Jerry Banks, John S Corson, Barry.L. Nelson, David M.Nicol and P.Shahabudeen, Discrete Event Systems Simulation, Pearson education, Fifth edition, 2009.
4. Thomas J Schriber, “Simulation Using GPSS”, John Wiley, 2002**.**

CO's - PO's & PSO's MAPPING

CO	PO			PSO's		
	1	2	3	1	2	3
CO1	3	-	-	-	-	2
CO2	3	-	-	1	1	-
CO3	3	2	3	2	1	-
CO4	3	3	1	1	2	-
CO5	3	-	1	1	2	-
AVG	3	2.5	1.3	1.25	1.5	2

Attested

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IL3253	DATA ANALYTICS	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1 To extract the knowledge on the applications of multivariate statistical analysis.
2 To understand the simple regression, multiple regression and correlation procedures.
3 To apply the factor analysis in real life applications and principal component analysis effectively for data exploration and data dimension reduction.
4 To classify and implement the discriminant analysis to various cases.
5 To find groupings and associations using cluster analysis.

UNIT I MULTIVARIATE METHODS 9

Review of basic matrix operations and random vectors, Properties of Eigen values and Eigen vectors. An overview of multivariate methods - Basic Multivariate Statistics - Mean, Variance, Covariance and Correlation, Multivariate normal distribution.

UNIT II REGRESSIONANALYSIS 9

Inferences about population parameters - Simple Regression, and Correlation – Estimation using the regression line, correlation analysis, Multiple Regression– Logistic Regression - Canonical Correlation Analysis - Multivariate analysis of variance (MANOVA) – Conjoint Analysis – Choice based conjoint (CBC), Adaptive CBC.

UNIT III FACTOR ANALYSIS 9

Principal components analysis – Objectives, estimation of principal components, testing for independence of variables, Factor analysis model – Method of estimation – Factor rotation – Factor Scores - EFA - CFA - Path analysis and Path Diagrams, Software tools for development – SEM and ISM.

UNIT IV DISCRIMINANT ANALYSIS 9

Discriminant analysis – Classification with two multi-Variate normal populations- Evaluating classification function – Classification with several populations – Fishers Method for Discriminating among several Populations.

UNIT V CLUSTER ANALYSIS 9

Cluster analysis – Clustering methods, Hierarchical clustering methods – Single Linkage, Complete Linkage, Average Linkage, Ward's Hierarchical Clustering Method, Non-Hierarchical Clustering methods - K-means Method, Validation and profiling of clusters – Multi-Dimensional Scaling.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Predict the values of one or more variables on the basis of observations on the other variables.
CO2 Synthesize the specific statistical hypotheses, in terms of the parameters of multivariate populations.
CO3 Construct data reduction or structural simplification as simply as possible without sacrificing valuable information and will make interpretation easier.
CO4 Apply to sort and group the "similar" objects or variables are created, based upon measured characteristics.
CO5 Prepare to understand appropriate use of clustering methods.

REFERENCES:

1 Dallas E Johnson, Applied Multivariate methods for data analysis, Duxbury Press(1998).

2 Brian S. Everitt and Graham Dunn, Applied Multivariate Analysis, Second edition, Arnold press, (2001).

3 Joseph F. Hair, Jr. William C. Black Barry J. Babin, Rolph E. Anderson, Multivariate Data Analysis, Pearson Edition, (2010).

4 Richard I Levin, Statistics for Management, PHI (2000).

CO's - PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
CO1	2	-	-	-	-	-
CO2	-	2	-	-	-	-
CO3	-	-	2	-	-	-
CO4	-	-	-	2	-	-
CO5	1	-	-		-	-
AVG.	1.5	2	2	2	-	-

Attested

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IL3211 **SIMULATION LABORATORY** **L T P C**

0 0 4 2

COURSE OBJECTIVES:

1. Knowledge to generate random numbers and random Variate using C++.
2. To learn how to test random Variate and random number using C++.
3. To learn how to solve different Monte Carlo simulation problem.
4. To learn how to use simulation language.

The following experiments using C++/Python/ Optimization package

Experiment 1. Random Number Generation Mid Square, Constant Multiplier, Congruential
Experiment 2. Random variates Generation Exponential, Poisson, Normal, Binomial
Experiment 3. Testing of Random variates using Chi-Square, KS, Run, Poker test
Experiment 4. Monte Carlo Simulation: Random Walk Problem
Experiment 5. Monte Carlo Simulation: News Vendor Problem
Experiment 6. Single Server Queuing Model
Experiment 7. Multi Server Queuing Model

The following experiments using any simulation package

Experiment 8. Production problem
Experiment 9. Warehouse problem
Experiment 10. Health care problem

TOTAL: 60 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Learn to generate random numbers and random Variate using C++.
CO2. Learn to test statistical stability of random Variate and random number using C++.
CO3. Learn to solve various Monte Carlo simulation problem using C++.
CO4. Learn to Simulate various problems using Simulation languages.

CO's - PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
1	2	3	1	2	-	2
2	2	3	1	1	-	-
3	2	3	1	-	-	-
4	-	3	1	2	-	2
5	2	3	1	-	-	2
Avg	2	3	1	1.6	-	2

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IL3212	TECHNICAL SEMINAR	L T P C
		0 0 2 1

COURSE OBJECTIVES:

1. To develop technical article reading and understanding skill.
2. To improve communication and presentation skill of students
3. To develop technical report Writing

GUIDELINES:

- The students are expected to make a presentation on the state of research on a particular topic based on current journal publications.
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the student.
- Students are encouraged to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

COURSE OUTCOMES:

The students will be able to

- Select the method, analysis and optimize the given problem for the given field applications.

TOTAL: 30 PERIODS

IL3361	DATA ANALYTICS LABORATORY	L T P C
		0 0 4 2

COURSE OBJECTIVES:

1. To get hands on training and exposure on descriptive and Inferential statistics, Hypothesis testing, Regression and Correlation Analysis.
2. To get hands on training and exposure on Factor Analysis, Discriminant Analysis and Cluster Analysis.
3. To get hands on training and exposure to techniques on Single factor experiments, Factorial experiments and 2k design.
4. To get hands on training and exposure on design and Analysis of Taguchi's DOE
5. To get hands on training on Response Surface Methodology and MANOVA.

LABORATORY EXPERIMENTS

Students will perform analysis of data in the following topics using Python and Data Analysis package

1. Statistical analysis: Descriptive Statistics • Inferential statistics
2. Testing of Hypothesis
3. Linear Regression and Correlation
4. Discriminant analysis
5. Control charts
6. Process capability
7. Single Factor Experiments
8. Factorial experiments
9. 2^k Design
10. Analysis of Variance (ANOVA)
11. Taguchi Design of Experiments
12. Factor analysis
13. Cluster Analysis
14. Response Surface Method
15. MANOVA

TOTAL:60 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1: Compute descriptive and inferential statistics, Hypothesis testing, Regression and Correlation Analysis for a given data

CO2: Perform Factor Analysis, Discriminant Analysis, Cluster Analysis and develop Process control.

CO3: Perform DOE (Single, Factorial and 2k design) for a given data software.

CO4: Perform Taguchi Design

CO5: Perform Response Surface Methodology and MANOVA for a given data

CO's- PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
1	2	3	1	2	-	2
2	2	3	1	1	-	-
3	2	3	1	-	-	-
4	-	3	1	2	-	2
5	2	3	1	-	-	2
Avg	2	3	1	1.6	-	2

IL3311 **PROJECT WORK I** **L T P C**

0 0 12 6

COURSE OBJECTIVE:

1. To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
2. To understand the literature study
3. To develop the methodology to solve the identified problem
4. To Conceptualizing a project design
5. To train the students in preparing project reports and to face reviews and viva-voce examination

SYLLABUS:

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work.

TOTAL: 180 PERIODS

COURSE OUTCOME:

- Understand the current need of the society through detailed review of literature.
- Analyze the methodology of literature reviews to solve the identified problem.
- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

CO's- PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	**2**	**3**	**1**	**2**	**3**
1	2	3	1	2	-	2
2	2	-	1	1	-	-
3	2	3	1	-	-	-
4	-	3	1	2	-	2
5	-	3	1	-	-	2
Avg	2	3	1	1.6	-	2

IL3411 **PROJECT WORK II** **L T P C**

0 0 24 12

COURSE OBJECTIVE:

1. To solve the identified problem based on the formulated methodology.
2. To constructing an instrument for data collection.
3. To writing a project proposal.
4. To processing and displaying the data.
5. To develop skills to analyze and discuss the test results, and make conclusions

SYLLABUS:

The student shall continue (or take up a new) the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department.

TOTAL: 180 PERIODS

COURSE OUTCOME:

- Understand the constructing an instrument for data collection
- Writing a project proposal and displaying the data
- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

CO's- PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	**2**	**3**	**1**	**2**	**3**
1	2	3	1	2	-	2
2	2	3	1	1	-	-
3	2	3	1	-	-	-
4	-	3	1	2	-	2
5	2	3	1	-	-	2
Avg	2	3	1	1.6	-	2

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IL3051	APPLIED OBJECT ORIENTED PROGRAMMING	L T P C
		3 0 0 3

COURSEOBJECTIVES:

1. To understand the basic syntax of c++ programs and to write simple programs
2. To understand OOP concepts and use those concepts in programming
3. To create class in C++ Program
4. To derive a class from base class in c++ program
5. To apply C++ concepts in Industrial Problems

UNIT I C++ Basics **9**

Expression and statements, operators, precedence, type conversion, control statements, loops, Arrays structures, functions, argument passing, reference argument, overloaded function. Writing Simple programs - Understanding the Syntax - Troubleshooting Methods.

UNIT II FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING **9**

Elements of OOP, classes, subjects, messaging, inheritance, polymorphism, OOP paradigm versus procedural paradigm, object-oriented design. Use OOPs concepts to write programs for small IE problems.

UNIT III C++ CLASS **9**

Definition, class objects, member functions, class argument, operator overloading, user defined conversions. Application Programs using Classes

UNIT IV CLASS DERIVATION **9**

Derivation specification, public and private base classes, standard conversions under derivation, class scope, initialization and assignment under derivation. Write Programs that are derived from base class.

UNIT V CONSTRUCTORS, DESTRUCTORS AND FILE HANDLING **9**

Constructors - Copy Constructor – Destructors -Default Constructors - Private Destructor-Exception Handling - Catching Base and Derived Classes as Exceptions-Catch block and type conversion - Exception Handling and Object Destruction-File Handling through C++ Classes- Read/Write Class Objects from/to File in C++

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

- **CO1.** Create and execute simple C++ programs.
- **CO2.** Use object oriented programming Concepts in programming.
- **CO3.** Create class in C++ program.
- **CO4.** Derive a class from the basic class.
- **CO5.** Create and execute program for solving the industrial problems.

REFERENCES:

1. E.Balagurusamy, Object oriented programming with C ++,Tata Mc Graw Hill, 2020
2. NabajyotiBarkakati,Object Oriented Programming in C++, Prentice Hall of India, 2001
3. Robert Lafore, “Object oriented programming in C++”, Sam Publishing, 2002
4. R.S.Salaria, Mastering Object Oriented Programming with C++, Khanna Publishers, 2016
5. Stanley B Lippman, Josee Lajoie, C++ Primer, Addison – Wesley Pub. Co., 2017

CO's - PO's & PSO's MAPPING

	POs			PSO's		
CO's	**1**	**2**	**3**	**1**	**2**	**3**
CO1	2	3	1	2	-	2
CO2	2	3	1	1	-	-
CO3	2	3	1	-	-	-
CO4	-	3	1	2	-	2
CO5	2	3	1	-	-	2
Avg	2	3	1	1.6	-	2

Attested

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QE3051	QUALITY MANAGEMENT	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1. To Summarize the Overview of Quality
2. To Illustrate the essentials of Quality
3. To Understand and apply Selected Quality Improvement techniques
4. To gain knowledge on research and development (R&D) certification standards
5. To Develop comprehensive knowledge of Quality Management Systems and awards

UNIT I INTRODUCTION 9

History of Quality – Objectives and Importance of Quality Management – Contributions of Quality Gurus- Quality Information System – Strategy Development and Deployment –Need for Quality Approach to Strategy – Definition of Quality and its types –Distinction between product quality and service quality – TQM Framework- Barriers to TQM– Benefits of TQM.

UNIT II ESSENTIALS OF QUALITY MANAGEMENT 9

Leadership-Desirable Qualities of a Leader-Role of Leaders in Quality improvement; Customer focus – Steps of developing customer focus – Customer and management–Factors affecting customer satisfaction–Importance of customer retention – Employee Involvement - Motivation-Empowerment-Teams-Rewards and Recognition-Performance appraisal-Quality circles.

UNIT III QUALITY IMPROVEMENT TECHNIQUES 9

Continuousprocessimprovement-TheJuranTrilogy-Improvementstrategies-ThePDSACycle-Kaizen-Six Sigma-Bench Marking–Cost of Quality–Quality Function Deployment (QFD) –The role of Information Technology in Quality improvement.

UNIT IV RESEARCH AND DEVELOPMENT STANDARDS 9

Industrial Automation and Control Systems Security (IEC 62443) -(ISO 31000:2018) Risk Management - Association of Clinical Research Professionals (ACRP) - National Institute of Standards and Technology (NIST) - Good Laboratory Practice (GLP) - Good Clinical Practice (GCP) - ISO/IEC 17025:2017 - General Requirements for the Competence of Testing and Calibration Laboratories - Research Excellence Framework (REF) – Intellectual Property (IP) standards.

UNIT V QUALITY MANAGEMENT SYSTEMS AND AWARD 9

ISO 9000 Series – ISO 9001: 2015 – ISO 9000 Vs Baldrige Award – Malcolm Baldrige National Quality Award- Rajiv Gandhi National Quality Award - Quality 5 STAR rating system-ISO 13485:2016 - Medical Devices Quality Management System – ENVIRONMENTAL MANAGEMENT SYSTEM (EMS):Introduction—ISO 14000 Series Standards (ISO 14001, 14004, 14031, 19011) —IATF 16949 Automotive Quality Management System – Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Recognition of the importance of Quality
CO2. Acquiring Essentials of Quality
CO3. Application of Quality Improvement tools
CO4. Research and Development standards
CO5. Comprehensive Quality Management System

REFERENCES:

1. DaleH.Besterfiled,CarolB.Michna, GlenH.Besterfield, Mary B.Sacre, Hemant Urdh wareshe and Rashm iUrdhwareshe, “Total Quality Management”, Pearson Education Asia,Revised Third Edition,IndianReprint,Sixth Impression,2013
2. K.Krishnaiah,“Applied Statistical Quality Control and Improvement”, PHI Learning, New Delhi–2014
3. Panneerselvam. RandSiva Sankaran. P,” Quality Management”, PHI Learning, New Delhi–2014
4. Summers,C.S., Quality Management: Creating and Sustaining Organization effectiveness Prentice– Hall of India, New Delhi,2005.
5. Dinesh Kumar Khamari, Quality Management System Manual IATF 16949: 2016., 2020.
6. Research and Development Evaluation in the Aerospace and Defense Industry & quot; by Matthew Z. Liberatore and Brian J. Lunday
7. ISO 13485:2016 - A Complete Guide to Quality Management in the Medical Device Industry" by Itay Abuhav
8. Good Laboratory Practice: A Question & Answer Reference Guide" by David S. Loseke
9. ISO 9001:2015 for Small Businesses & quot; by Ray Tricker

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s			PSO’s		
	1	**2**	**3**	**1**	**2**	**3**
1	-	3	-	-	-	-
2	-	-	-	-	-	3
3	3	-	-	-	3	-
4	-	2	-	-	3	2
5	-	-	3	-		3
Avg	3	2.5	3	**-**	3	2.6

1-low, 2-medium, 3-high, ‘-“- no correlation

IL3052 MANAGEMENT ACCOUNTING AND FINANCIAL MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

1. Understanding the Basics of accounting and recording of transactions
2. Evaluating P&L statements, Balance sheets and other accounting statements.
3. Learn and apply the various cost accounting methods.
4. Study the various cost control procedures.
5. Sketch and prepare a budget and make investment decisions.

UNIT I INTRODUCTION 9

Basics of accounting – Management Accounting – Financial accounting – cost accounting – comparison of financial accounting, cost accounting and management accounting – generally accepted accounting principles – Accounting standards – Accounting cycle-Recording of transactions: journalizing, ledger posting, preparation of Trial Balance- Introduction to Financial Institution.

UNIT II FINANCIAL ACCOUNTING 9

Preparation of Companies Financial Statements - Salient features of Balance Sheet and Profit and Loss statement, cash flow and Fund flow Analysis (Elementary), ratio analysis.

UNIT III COST ACCOUNTING 9

Cost accounting systems: Job Costing, process costing, allocation of overheads, Activity based costing, variance analysis–marginal costing–Break even analysis.

UNIT IV BUDGETING 9

Requirements for a sound budget, fixed budget – preparation of sales and production budget, flexible budgets, zero based budgets and budgetary control.

UNIT V FINANCIAL MANAGEMENT 9

Investment decisions – Investment appraisal techniques – payback period method, accounting rate of return, net present value method, internal rate of return and profitability index method-cost of capital.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Analyse the financial transaction and prepare the Trail Balance

CO2. Evaluate the financial statements.

CO3. Ability to apply the management and cost accounting techniques for decision making.

CO4. Construct andanalyse a various types of budget

CO5. Examine investment decision based on capital budgeting techniques.

REFERENCES:

1. Narayanaswamy R 2014, Finanacial Accounting – A Managerial Perspective, 5th Ed, Prentice Hall of India.
2. Bhattacharyya, Asish K. Principles And Practice Of Cost Accounting, 3rd Edition, 2004.
3. I M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11th Edition, 2018.
4. M.Y. Khan & P.K. Jain, Management Accounting, Tata McGraw Hill, 8 thedtion, 2018.
5. Maheshwari SN, Maheshwari SK& Maheshwari SK An Introduction to Accountancy, 12th Ed,Vikas Pub. House. 2022.
6. Horne, J.C. Van and Wackowich. Fundamentals of Financial Management. Pearson Education, 12th Edition, 2008.

CO's - PO's & PSO's MAPPING

	PO's			PSO's		
CO's	**1**	**2**	**3**	**1**	**2**	**3**
CO1	-	3	-	-	-	-
CO2	-	-	-	-	-	3
CO3	3	-	-	-	3	-
CO4	-	2	-	-	3	3
CO5	-	-	3	-		3
Avg	3	2.5	3	-	3	3

IL3053 ENGINEERING ECONOMICS AND COST ESTIMATION L T P C

3 0 0 3

COURSEOBJECTIVES:

1. To understand the concept of Engineering Economics and apply in the real word.
2. To gain knowledge in the field of value engineering to enable the students to estimate the costing factors
3. To understand the concept of cash flow and its methods of comparison
4. To acquire knowledge in the field of cost estimation
5. To enable the students to estimate the cost of various manufacturing processes.

UNIT I INTRODUCTION TO MANAGERIAL ECONOMICS AND DEMAND ANALYSIS 9

Definition of Managerial Economics - Nature and scope of Managerial Economics - Managerial Economics and other disciplines. Objectives of the firm - Factors influencing Managerial decisions - Basic concepts of Managerial Economics. Demand Analysis – Defining demand, Types of demand and Determinants of demand, Elasticity of demand and demand forecasting**.**

UNIT II PRODUCTION AND COST ANALYSIS 9

Production Analysis – Production function, Returns to a factor, Returns to scale, ISO quants and Least cost combination of inputs. Cost Analysis – Cost concepts, Determinants of cost, Short-run cost-output Relationship, Long-run cost output relationship, Economies and Diseconomies of scale and Estimating cost – Output Relationship.

UNIT III PRICING 9

Determinants of price – Pricing under different objectives – Pricing under different market structures – Price discrimination – Pricing of Joint products – Pricing methods in practice.

UNIT IV ESTIMATION OF MATERIAL AND LABOUR COSTS 9

Introduction to Estimation and Costing – Elements of costs – Allocation of overheads – Estimation of Material cost – Estimation of Labour cost, Indirect Expenses and Depreciation

UNIT V ESTIMATION OF OPERATIONAL COST 9

Estimation in Machine shop – Estimation in Forging shop –Estimation in welding shop.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. know about method to Perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.

CO2. Calculate payback period and capitalized cost on one or more economic alternatives.

CO3. know about method to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives

CO4. Prepare the cost estimation report for any project

CO5. Learn about cost accounting, replacement analysis

REFERENCE:

1. A.RamachandraAryasri and V.V.Ramana Murthy, “Engineering Economics and Financial Accounting”, McGraw Hill Education (India), New Delhi, 2004
2. R.Paneerselvam, “Engineering Economics”, PHI, 2013
3. V.L.Mote, Samuel Paul and G.S.Gupta, “ Managerial Economics – concepts and cases”, McGraw Hill Education (India), 2017.
4. Yogesh Maheshwari, “Managerial Economics”, Third edition, PHI 2012
5. T.R.Banga and S.C.Sharma, “Mechanical Estimating and Costing”, 16th Edition, Khanna Publishers, 2012.

CO’s - PO’s & PSO’s MAPPING

CO	PO’s			PSO’s		
	1	2	3	1	2	3
CO1	-	3	-	-	-	-
CO2	-	-	-	-	-	3
CO3	3	-	-	-	3	-
CO4	-	2	-	-	3	2
CO5	-	-	3	-		3
AVG	3	2.5	3	-	3	2.6

Attested

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QE3252 **SOFTWARE QUALITY ENGINEERING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

1. To study the basic principles and concepts of software quality
2. To effective designing, analyzing and developing the software engineering activities
3. To gain knowledge on software quality assurance and risk management
4. To analyze the principles and applications of software quality management tools
5. To gain knowledge about software quality standards

UNIT I SOFTWARE QUALITY **9**

Definition of Software Quality, Quality Planning, Quality system – Quality Control Vs Quality Assurance – Product life cycle – Project life cycle models- Agile-Scrum

UNIT II SOFTWARE ENGINEERING ACTIVITIES **9**

Estimation, Software requirements gathering, Analysis, Architecture, Design, development

UNIT III SUPPORTING ACTIVITIES **9**

Metrics, Reviews –Software Configuration Management **(**SCM) – Software quality assurance and risk management.

UNIT IV SOFTWARE TESTING & MAINTENANCE **9**

Definition and Objectives software testing strategies- Software test Classifications- White & Black box testing process-Test case design-Automated Testing-Alpha and Beta site Testing programs. Activities - Maintenance Phase – Issues - Configuration management- Skillsets, Estimative, Geographically Distributed Teams – Metrics - Maintenance Phase

UNIT V QUALITY ASSURANCE MODELS **9**

Software Quality Standards, ISO systems– CMM, Capability Maturity Model Integration (CMMI) – P-CMM – Case study_ Industry Specific Quality Models(Hippa.Sas)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Understand the basic principles and concepts in software quality
CO2. Effectively design, analyze and develop software engineering activities
CO3. Gain knowledge on software quality assurance and risk management
CO4. Understand the principles and applications of software quality management tools
CO5. Gain knowledge about software quality standards

REFERENCES:

1. Dunn Robert M., Software Quality: Concepts and Plans, Englewood clifts, Prentice Hall Inc., 2003.
2. Metrics and Models in Software Quality Engineering, Stephen, Stephen H. Kan, Pearson education, 2006, Low price edition.
3. Norman E – Fenton and Share Lawrence P flieger, Software metrics , International Thomson Computer press , 1997.
4. Ramesh Gopalswamy, Managing global Projects ; Tata McGraw Hill, 2002
5. Software Engineering: A Practitioners Approach, 5th Edition Roger S. Pressman McGraw – Hill International Edition, 6th Edition, 2006.

CO's- PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	2	-	-	2
2	2	2	1	-	-	1
3	-	-	2	-	-	1
4	-	-	-	3	-	-
5	-	-	-	2	-	-
Avg	2.5	2	1.6	2.5	-	1.3

1-low, 2-medium, 3-high, '-"- no correlation

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IL3054	INDUSTRIAL AUTOMATION AND ROBOTICS	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1. To understand industrial automation principles and strategies.
2. To evaluate the material handling system used in the automated industries.
3. To understand the working of industrial robots and its sensors.
4. To gain knowledge in the kinematics of robotic manipulators.
5. To gain knowledge in the dynamics of robotic manipulators.

UNIT I INTRODUCTION **9**

Definition, automation principles and strategies - scope of automation - socioeconomic consideration, low cost automation - Production concepts and automation strategies - Fixed Automation: Automated Flow lines, Methods of Work part Transport. Transfer Mechanism - Continuous transfer, intermittent transfer - Indexing mechanism Automation for Machining Operations, Design and Fabrication Considerations. Analysis of Automated Flow Lines: General Terminology and Analysis.

UNIT II MATERIAL HANDLING SYSTEM **9**

Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, rail guided vehicles, conveyor systems - advanced material handling systems - automated guided vehicle systems - automated storage and retrieval systems(ASRS), Work-in-process Storage - Interfacing Handling and Storage with Manufacturing.

UNIT III ROBOTS AND SENSORS **9**

Introduction - Definition, Classification, Robot Components, Degree of Freedom, Mobile robots, Robot Characteristics, Robot Workspace, Robot programming - Application of Robots - Various Sensors and their Classification - Use of Sensors and Sensor Based System in Robotics - Machine Vision System - Description, Sensing – Digitizing - Image Processing and Analysis and Application of Machine Vision System - Robotic Assembly Sensors and Intelligent Sensors.

UNIT IV KINEMATICS OF ROBOTIC MANIPULATORS **9**

General Mathematical Preliminaries on Vectors & Matrices - Direct Kinematics problem - Geometry Based Direct kinematics problem - Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems - Composite Rotation matrix - Homogenous Transformations - Robotic Manipulator Joint Co-Ordinate System - Euler Angle & Euler Transformations - Roll-Pitch-Yaw (RPY) Transformation - DH Representation & Displacement - Matrices for Standard Configurations - Jacobian Transformation in Robotic Manipulation - Trajectory Interpolators.

UNIT V DYNAMICS OF ROBOTIC MANIPULATORS **9**

Definitions - Generalized Robotic Coordinates - Jacobian for a two link Manipulator - Euler Equations and The Lagrangian Equations of motion - Application of Lagrange – Euler (LE) - Dynamic Modeling of Robotic Manipulators - Velocity of Joints, Kinetic Energy (T) of Arm, Potential Energy (V) of Robotic Arm, The Lagrange L, Two Link Robotic Dynamics with Distributed Mass.

TOTAL: 45 PERIOD

COURSE OUTCOMES:

The students will be able to

CO1. Describe the industrial automation principles and strategies.
CO2. Evaluate the material handling system for automation.
CO3. Distinguish between different sensors for different applications.
CO4. Demonstrate the Kinematics of Robotic Manipulators.
CO5. Demonstrate the Dynamics of Robotic Manipulators.

REFERENCE:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. Richaerd D Klafter, Thomas Achmielewski and MickaelNegin, "Robotic Engineering – An integrated Approach" Prentice Hall India, New Delhi, 2001.
3. Deb S R and Deb S, Robotics Technology and Flexible Automation, Tata McGraw Hill Education Pvt. Ltd, 2010.
4. Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, 2015.

CO's - PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
1	-	-	3	-	-	-
2	-	-	3	3	-	-
3	-	-	2	-	-	-
4	-	-	2	2	-	-
5	-	-	2	2	-	-
Avg.	-	-	2.4	2.33	-	-

IL3001 INTELLIGENT AND MODERN MANUFACTURING MANAGEMENT SYSTEMS **L T P C**

3 0 0 3

UNIT I INDUSTRY 4.0 9

The Various Industrial Revolutions, Need – Reason for Adopting Industry 4.0, Definition, Goals and Design Principles – Interoperability, Virtualization, Decentralization, Real-time Capability, Service Orientation, Modularity. Individualization, Volatility, Energy and resource efficiency. Road to Industry 4.0 - Internet of Things (IoT), Architecture of IoT, Technologies for IoT & Industrial Internet of Things (IIoT), Internet of Services, Standardization, Cyber-Physical Systems, Smart Manufacturing, Network via Ethernet/ WiFi for high-speed data transmission, Mobile technologies. Present Scenario - Opportunities and Challenges – Lack of resources, Availability of skilled workers, Broadband infrastructure, Policies, Future of Works and Skills in the Industry 4.0 Era, Disruption as manufacturing's greatest modern challenge.

UNIT II BIG DATA 9

Big Data for Digital Manufacturing - Evolution, Essential of Big Data in Industry 4.0, Big Data Merits, Data transparency, Business Intelligence, Acquisition of Data, Data storage – Cloud computing, Traceability, RadioFrequency Identification (RFID), GPS, Data transformation, Big Data Characteristics, Data as a new resource for organizations, Data driven applications, Harnessing and sharing knowledge in organizations, Data analytics - Descriptive Analytics, Diagnostic analytics, Predictive Analytics, Prescriptive analytics, Cyber Security.

UNIT III AR/VR AND DIGITAL TWINS TECHNOLOGIES 9

Basics of Augmented and Virtual Technologies, Operating software tools for AR/VR in Industry-Maintenance, Assembly, Collaborative operations, Training, and other applications.
Concept of Digital Twins- Business value of implementing Digital Twins – Factors to be considered for implementation-Information technology infrastructure -Opportunities and challenges of implementation-Future of Digital Twins technology within industry and across manufacturing - case studies.

UNIT IV SMART FACTORIES AND BLOCKCHAIN 9

Introduction to Smart Factories- Additive Manufacturing technologies, Cloud Manufacturing - Advantages, impact on environment, Applications – Automotive, Aerospace, Electronics, Biotechnology, Design case studies. Introduction to Blockchain Technology and its Importance - Basic Crypto Primitives: Cryptographic Hash & Digital Signature -Evolution -Elements -Models - Decentralized Identity Management- Interoperability – Applications.

UNIT V CYBER SECURITY 9

Essential components of cyber security - Cyber security threat landscape - Cyber crime and its types Basic - Remedial and mitigation measures - Reporting of Cyber crime - Cyber Law Basic - Data privacy and security - E-Commerce, Digital payments and its security -Cyber security of digital devices -Tools and technology for cyber security - Cyber security plan and crisis management - Security controls -Risk based assessment, audit and compliance - Cyber security best practices and do's and don'ts - Platforms to report and combat cyber crime

TOTAL: 45 PERIODS

REFERENCES:

1. Industry 4.0: Managing The Digital Transformation, Alp Ustundag, Emre Cevikcan, 2017, Springer, ISBN: 978-3-319-57869-9, ISBN: 978-3-319-57870-5
2. The Concept Industry 4.0 - An Empirical Analysis of Technologies and Applications in Production Logistics, Christoph Jan Bartodziej, 2017, Springer Gabler, ISBN: 978-3-658-16501-7 ISBN: 978-3- 658-16502-4
3. Industry 4.0 - The Industrial Internet of Things, Alasdair Gilchrist, 2016, APRESS, ISBN-13 978-1- 4842-2046-7 ISBN: 13 978-1-4842-2047-4
4. Digitizing the Industry – Internet of Things connecting the Physical, Digital and Virtual Worlds, Ovidiu Vermesan, 2016, River Publishers, ISBN: 978-87-93379-81-7 ISBN 978-87-93379-82-4

CO's - PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
CO1	-	-	3	-	-	-
CO 2	-	-	3	3	-	-
CO 3	-	-	2	-	-	-
CO 4	-	-	2	2	-	-
CO 5	-	-	2	2	-	-
Avg.	-	-	2.4	2.33	-	-

Attested

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IL3055	DESIGN THINKING	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1. To explain the concept of design thinking for product and service development
2. To explain the fundamental concept of innovation and design thinking
3. To discuss the methods of implementing design thinking in the real world.
4. To acquire the skills to create technical drawings for design ideas.
5. To participate in a design thinking workshop to gain training and practical experience in applying design thinking principles.

UNIT I UNDERSTANDING DESIGN THINKING **9**

Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – Minimum Viable Products (MVP) or Prototyping

UNIT II TOOLS FOR DESIGN THINKING **9**

Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design

UNIT III DESIGN THINKING IN IT DESIGN **9**

Thinking to Business Process modelling – Agile in Virtual collaboration environment – Scenario based Prototyping

UNIT IV DESIGN THINKING FOR STRATEGIC INNOVATIONS **9**

Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.

UNIT V DESIGN THINKING WORKSHOP **9**

Design Thinking Workshop Empathize, Design, Ideate, Prototype and Test

TOTAL:45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Appreciate various design process procedure
CO2. Generate and develop design ideas through different technique
CO3. Identify the significance of reverse Engineering to Understand products
CO4. Draw technical drawing for design ideas
CO5. To get training in design thinking workshop

REFERENCES:

1. Daniel Ling “Complete Design Thinking Guide for Successful Professionals”, Emerge Creatives Group LLP, Print ISBN: 978-981-09-5564-9.
2. A.K. Chitale and R.C. Gupta, “ Product Design and Manufacturing”, Prentice Hall
3. Michael Lewrick, Patrick Link, Larry Leifer, “The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems”, John Wiley & Sons, 2020.
4. John.R.Karsnitz, Stephen O’Brien and John P. Hutchinson, “Engineering Design”, Cengage learning (International edition) Second Edition, 2013.

5. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
6. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
7. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.
8. Yousef Haik and Tamer M.Shahin, “Engineering Design Process”, Cengage Learning, Second Edition, 2011.
9. Jeanne Liedtka , Andrew King , Kevin Bennett” Solving Problems with Design Thinking - Ten Stories of What Works “,Columbia Business School Publishing,2013 .

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s			PSO’s		
	1	**2**	**3**	**1**	**2**	**3**
1	2	-	3	2	2	2
2	2	3	3	-	2	2
3	2	-	3	2	2	2
4	2	3	3	2	-	-
5	2	-	3	-	-	-
Avg	**2**	**3**	**3**	**2**	**2**	**2**

Attested

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QE3251	LEAN SIX SIGMA	L T P C
		3 0 0 3

COURSE OBJECTIVES

1. To understand Lean production principles, eliminate waste, and improve efficiency through case studies.
2. To learn steps for Value Stream Mapping, apply Lean metrics, and implement improvements in value streams.
3. To explore Six Sigma's relationship with Lean Manufacturing, cultural changes, quality assessment, and cost implications.
4. To gain knowledge of various Six Sigma tools and techniques for problem-solving and project management.
5. To evaluate Six Sigma quality economics, focus on continuous improvement using Lean principles, Kaizen, and 5S methodologies.

UNIT I LEAN MANUFACTURING 9

Evolution of Mass production, Traditional versus Mass production, Evolution of Toyota (Lean) Production System, Business Dynamics of Lean production, Principles of Lean production – Value, Value stream, Flow, Pull, Perfection- 3Ms – Muda, Mura, Muri, 7 Wastes in Manufacturing, Lean Tools to eliminate Muda - 5S, Standardised work, TPM, SMED, Jidoka – Poka Yoke, JIT, Heijunka, Kanban, One piece production, Case studies.

UNIT II VALUE STREAM MAPPING 9

Need for Value Stream mapping; Steps involved in Value stream mapping – Choose value stream – PQ and PR analysis, Current State map, Lean Metrics, Future State Map, Kaizen plans; Lean implementation - Cultural change, Hoshin planning; Lean in the Supply chain.

UNIT III SIX SIGMA 9

Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ)

UNIT IV SIX SIGMA SCOPE OF TOOLS AND TECHNIQUES 9

Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

UNIT V EVALUATION AND CONTINUOUS IMPROVEMENT METHODS 9

Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Demonstrate understanding of Lean production principles, waste identification, and efficiency improvement.

CO2. Apply Value Stream Mapping steps and Lean metrics to enhance organizational performance.

CO3. Analyze the relationship between Six Sigma and Lean Manufacturing, evaluate cultural changes, quality levels, and cost implications.

CO4. Acquire knowledge of Six Sigma tools and techniques for effective problem-solving and project management.

CO5. Evaluate Six Sigma quality economics and demonstrate commitment to continuous improvement through Lean principles, Kaizen, 5S methodologies, and customer focus.

REFERENCES:

1. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000
3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma:A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000
5. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 2003

CO's- PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	**2**	**3**	**1**	**2**	**3**
1	-	3	3	-	-	2
2	-	3	3	-	-	2
3	2	3	3	-	-	2
4	3	-	3	2	3	2
5	2	-	3	2	3	2
Avg	**2.33**	**3**	**3**	**2**	**3**	**2**

1-low, 2-medium, 3-high, '-"- no correlation

IL3056	ADVANCED OPTIMIZATION TECHNIQUES	L T P C
		3 0 0 3

COURSEOBJECTIVES:

1. To impart knowledge to model and solve Integer programming problems.
2. To model and solve problems using dynamic programming.
3. To solve single- and multiple-variable unconstrained and constrained nonlinear.
4. To solve non-linear problem using KKT condition, quadratic programming and separable programming.
5. To apply meta heuristics for solving engineering problems

UNIT I INTEGER PROGRAMMING AND GOAL PROGRAMMING 9

Branch and Bound technique –cutting plane algorithm method - Traveling Salesman Problem - Branch and Bound Algorithms for TSP - Heuristics for TSP. Goal programming – Goal programming formulation - Goal programming algorithms – The weights method – Pre-emptive method

UNIT II DYNAMIC PROGRAMMING 9

Characteristics of Dynamic Programming Problems - Deterministic Dynamic Programming - Forward and Backward recursive recursion – selected dynamic programming application – investment model – inventory model – replacement model –reliability model – stage coach problem.

UNIT III NONLINEAR PROGRAMMING I 9

Types of Nonlinear Programming Problems - One-Variable Unconstrained Optimization - Multivariable Unconstrained Optimization

UNIT IV NONLINEAR PROGRAMMING II 9

Lagrangian multiplier - Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization - Quadratic Programming - Separable Programming - Convex Programming – Non-convex Programming

UNIT V META-HEURISTICS 9

Combinatorial optimization- NP Hard- Classification of Meta-Heuristic algorithms- Genetic Algorithm- Ant Colony Optimization- Simulated Annealing- Case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Solve integer programming problems using appropriate methods
CO2. Solve various dynamic programming problems.
CO3. Apply methods to solve nonlinear unconstrained problems
CO4. Apply methods to solve nonlinear constrained problems.
CO5. Identify, apply and solve suitable meta-heuristic technique to solve engineering optimization problems.

REFERENCES:

1. Hamdy A Taha, “Operations Research – An Introduction”, Pearson, 2017.
2. Philips, Ravindran and Solberg, “Operations Research principles and practices”, John Wiley, 2007
3. Ronald L Rardin, “Optimisation in Operations Research”, Pearson, 2018
4. Deb. K, “Optimization for Engineering Design: Algorithms and Examples”, PHI, 2012
5. Panneerselvam R, “Operations Research”, PHI, 2009
6. Srinivasan G., “Operations Research Principles and Applications”, PHI, 2017.
7. Singiresu S. Rao, “Engineering Optimization: Theory and Practice”, WILEY, 2019

CO's - PO's & PSO's MAPPING

CO	PO's			PSO's		
	1	2	3	1	2	3
CO1	2	3	3	2	-	-
CO2	2	3	3	2	-	3
CO3	2	3	3	-	3	-
CO4	2	3	3	-	3	2
CO5	2	3	3	-	-	3
AVG	2	3	3	2	3	2.6

Attested

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IL3002 MANUFACTURING SYSTEMS MODELING AND ANALYSIS L T P C

3 0 0 3

COURSEOBJECTIVES:

1. To understand various measure the performance of manufacturing system
2. To Know how to apply DTMC model to a Manufacturing systems
3. To Know how to apply CTMC model to a Manufacturing system
4. To understand Queuing networks and to model queuing network for a Manufacturing system
5. To understand and apply the Peterinet model to a Manufacturing system

UNIT I MANUFACTURING SYSTEMS- PERFORMANCE MEASURES 9

Manufacturing systems- Types, Concepts. Performance measures- types. Manufacturing Models Types. Factory Models- Single Workstation Factory Models-Developing Rate Balance Equations- Assembly Lines- Transfer Lines

UNIT II DISCRETE TIME MARKOV CHAINS 9

Introduction to Markov Chains, DTMC, Properties of DTMC, Sojourn Times in DTMC Models, Applications of DTMC Models in Manufacturing Systems

UNIT III CONTINUOUS TIME MARKOV CHAINS 9

Introduction to CTMC, Properties of CTMC, Sojourn Times in CTMC Models, Applications of CTMC Models in Manufacturing Systems

UNIT IV QUEUING MODELS 9

Birth and death process, performance measures in queuing models, open queuing networks and closed queuing networks- applications in manufacturing systems

UNIT V PETRINET MODELS 9

Introduction to Petri-net models-Representational powers of Petri-Nets- Reachability graphs, Markings, Applications of Petri-Nets models in manufacturing systems- Timed and Colored Petri-Nets

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Identify and measure the performance of manufacturing system
CO2. Apply the DTMC model to a Manufacturing systems
CO3. Apply the CTMC model to a Manufacturing system
CO4. Apply the Queuing network model to a Manufacturing system
CO5. Apply the Peterinet model to a Manufacturing system

REFERENCES:

1. Viswanadham, N., &Narahari, Y., Performance modeling of automated manufacturing systems, Prentice Hall, 1992
2. Ronald G. Askin Charles R. Stand ridge, Modelling and analysis of manufacturing systems, John Wiley and son's .Inc, 1993.
3. Guy L. Curry., Richard M. Feldman "Manufacturing Systems Modeling and Analysis", Springer, 2011

CO's - PO's & PSO's MAPPING

	POs			PSO's		
CO's	**1**	**2**	**3**	**1**	**2**	**3**
CO1	2	2	-	-	-	-
CO2	2	2	3	3	3	-
CO3	2	2	3	3	3	-
CO4	2	2	3	3	3	-
CO5	2	2	3	3	3	2
Avg	2	2	3	3	3	2

Attested

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IL3003	MODERN MEASUREMENT METHODS	L T P C
		3 0 0 3

COURSEOBJECTIVES:

1. To summarize the techniques used for testing mechanical properties.
2. To describe the ultrasonication process used in casting and its principles.
3. To discuss tribological behaviour and wear reduction techniques.
4. To acquire knowledge about surface characteristics and video measurement technologies.
5. To outline the various forms of corrosion and testing techniques.

UNIT I QUANTIFICATION OF MATERIAL PROPERTIES 9

Introduction to mechanical behaviour, standards, and procedure for the measurement of mechanical properties. Measurement of Hardness, tensile properties, fatigue properties. Shear strength and Toughness Test. Measurement of Creep life characteristics. Effect of heat treatment on mechanical properties.

UNIT II MEASUREMENT OF ULTRASONICATION 9

Introduction to ultrasonication process, principles, process parameters. Effect on the hardness, effect on the tensile behavior and microstructure. Effect on the wear behavior of ultrasonicated casted materials.

UNIT III FRCITION AND WEAR MEASUREMENT METHODS 9

Introduction to tribology: friction, wear and lubrication. Measurement of friction and wear: types, methods, standards, equipment, parameters, thermal wear imaging, data and image acquisition. Wear reduction methods: Surface modification and property enhancement methods.

UNIT IV MODERN SURFACE MEASUREMENT METHODS 9

Ideal surface, surface structure and 2D and 3D surface roughness parameters. Roughness measurement equipment. Introduction to 3D surface metrology- Parameters. Video measurement systems: Introduction and principles, measurement of wear depth, scratch dimensions, kerf taper angle. Nanoscale surface measurements: Atomic Force Microscope (AFM), Scanning Election Microscope (SEM), High-Resolution Scanning Election Microscope (HR-SEM)

UNIT V CORROSION MEASUREMENT TECHNIQUES 9

Definition, types, standards and principles. Corrosion test procedures and equipment: Salt spray test, immersion test, electrochemical test and tribo-corrosion test, Cyclic Corrosion Test (CCT) , High-Temperature Corrosion Test, Stress Corrosion Cracking (SCC) Test. Corrosion rate measurements.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1	Experiment with mechanical testing methods and the corresponding measurement techniques.
CO2	Relate the fundamental principles of ultrasonication and determine the effects of ultrasonication methods.
CO3	Describe the key principles of friction and wear behaviour in various methods, and discuss techniques for wear reduction.
CO4	Outline the material's surface characteristics and highlight the video measurement methods usage for surface analysis.
CO5	Assess the corrosion characteristics of various materials and the techniques applied to measure the corrosion.

REFERENCES:

1. Hein eloper and Rosenthal, Principles of Metal Casting, Tata McGraw Hill, 2000.
2. C. Mathew Mate and Robert W. Carpick, “Tribology on the Small Scale: A Modern Textbook on Friction, Lubrication, and Wear”, 2019.
3. “Techniques for Corrosion Monitoring”, Woodhead Publishing Series in Metals and Surface Engineering, 2nd edition - December 1, 2020.
4. A. K. Bhargava, and C. P. Sharma “Mechanical Behaviour and Testing of Materials”, 2011.
5. Mahi Sahoo, and Sudhari (Sam) Sahu, “Principles of Metal Casting”, 3rd edition, 2014.
6. Emanuele Trucco, and Alessandro Verri, “Introductory Techniques for 3D Computer Vision”, 1st Edition, 2009.
7. Krishan Kant Sharma, “Tribology (Friction, Wear, lubrication and bearing)”, 2016.
8. Pierre R. Roberge, “Corrosion Basics: An Introduction”, 2nd edition, 2006.

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s			PSO’s		
	1	2	3	1	2	3
1	3	2	-	-	-	-
2	3	-	2	-	-	-
3	3	2	2	3	2	3
4	3	2	2	2	2	-
5	3	-	2	3	-	3
Avg	3	2	2	2.67	2	3

IL3057	ENGINEERING PROJECT MANAGEMENT	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1. To know various models used in project selection.
2. To understand the project planning, and demand analysis.
3. To understand the financial analysis of the project.
4. To apply network techniques for project scheduling and resource allocation.
5. To recognize the values of project audit.

UNIT I INTRODUCTION **9**

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

UNIT II PROJECT PLANNING AND DEMAND ANALYSIS **9**

Work breakdown structure, Systems integration, Interface coordination - Market and demand analysis - market survey - demand forecasting methods - Technical analysis – manufacturing process, materials-product mix, plant location - project charts and layouts.

UNIT III FINANCIAL ANALYSIS **9**

Financial analysis – cash flows for project appraisal- Investment evaluation using capital budgeting techniques - net present value, profitability index internal rate of return, payback period, accounting rate of return - cost versus time, straight-line approximation of variation of cost with reduction in time for activities, direct and indirect costs.

UNIT IV PROJECT SCHEDULING **9**

Scheduling: Gantt chart, milestone chart, Network Techniques PERT and CPM, Crashing a project, Resource loading, leveling, and allocation – GERT - Q-GERT.

UNIT V PROJECT AUDITING **9**

Construction and use of audit report, Project audit life cycle, Essentials of audit and evaluation, Varieties of project termination, the termination process, The Final Report – A project history.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Understand various models used in project selection.
CO2. Acquire knowledge in project planning, and demand analysis.
CO3. Understand the financial analysis of the project.
CO4. Prepare project scheduling and resource allocation.
CO5. Understand the values of project audit.

REFERENCE:

1. Kerzner Harold, "Project Management - A Systems Approach to Planning, Scheduling and Controlling", CBS Publishers Delhi, Second edition (2002).
2. Jack R. Meredith, and Samuel J. Mantel Jr, Project Management – A Managerial Approach, John Wiley and Sons, 10th edition, 2017.
3. Weist Jerome D and Ferdinand K. Levy, "A Management Guide to PERT/CPM with GERT/PDM/DCPM and other networks", Prentice-Hall of India New Delhi, Second edition (2003).
4. Parsanna Chandra, "Project Planning, Analysis, Selection, Implementation and Review", Tata McGraw Hill, Fourth Edition (2002).

5. Srinath L.S., "PERT & CPM Principles and Applications", Affiliated East- West Press Pvt. Ltd., New Delhi, Third Edition (1993).
6. Panneerselvam .R, Senthil Kumar .P, Project Management, PHI, 2009.

CO's - PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
1	-	-	-	-	-	-
2	2	-	-	3	-	-
3	2	-	-	3	-	-
4	3	-	-	3	3	-
5	-	-	-	-	-	-
Avg.	2.33	-	-	3	3	-

Attested

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IL3058 INDUSTRIAL SCHEDULING ALGORITHMS L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To gain the basic concepts of Sequencing and Scheduling theory.
2. To impart knowledge on the Applications of Single Machine Sequencing Algorithms
3. To gain understanding of Parallel Machine Scheduling Algorithms
4. To impart knowledge on Flow Shop Scheduling and its algorithms
5. To provide knowledge on Job Shop Scheduling and its algorithms

UNIT I SCHEDULING BASICS 9

Scheduling Background – Sequencing and Scheduling – Performance measures: Flow time – Tardiness – Weighted flow time - Priority rules: SPT, EDD, WSPT - Scheduling Theorems – Scheduling constraints – Pure Sequencing model.

UNIT II SINGLE MACHINE MODEL 9

Characteristics - Smith's rule – Hogdson's algorithm – Wilkerson Irwin algorithm – Neighbourhood Search method – Branch and Bound algorithm – Dynamic Programming method – Non simultaneous arrivals – Dependent jobs sequencing – Sequence dependent setup times.

UNIT III PARALLEL MACHINE MODEL 9

Characteristics - Preemptive jobs: McNaughton's algorithm – Non preemptive jobs: Heuristic approaches – Minimizing weighted mean flow time: H_1 and H_m heuristics – Dependent jobs: Hu's heuristic – Muntz Coffman heuristic.

UNIT IV FLOW SHOP MODEL 9

Characteristics – Johnson's Algorithm – Extension to 3 machine problem – nxm FSP: Campbell Dudek Smith algorithm – Palmer's algorithm – Gupta's algorithm – Start/Stop lags – Mitten's algorithm – Ignall Schrage algorithm – Dispatch Index heuristic.

UNIT V JOB SHOP MODEL 9

Characteristics – Graphical representation – Feasible schedule identification (Network diagram) – Semi active schedule - Active schedule – Single pass approach – Non delay schedule – Heuristic schedule generation – Dynamic job shop scheduling – Open shop – Meta heuristics applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the fundamental theory in Sequencing and Scheduling.
CO2: Determine the sequence that minimizes a performance measure in single machine problems
CO3: Design a Parallel Machine schedule to minimize performance measures
CO4: Apply heuristics/algorithms to design a Flow shop
CO5: Demonstrate the use of heuristics for Job shop scheduling

REFERENCES:

1. Kenneth R.Baker, "Introduction to Sequencing and Scheduling", John Wiley & Sons, New York, 2000.
2. Richard W.Conway, William L.Maxwell and Louis W.Miller, "Theory of Scheduling", Dover Publications, 2003.
3. Kenneth R.Baker, Dan Trietsch, " Principles of Sequencing and Scheduling", John Wiley & Sons, New York, 2019.

CO's - PO's & PSO's MAPPING

	PO's			PSO's		
CO's	**1**	**2**	**3**	**1**	**2**	**3**
CO1	2	2				
CO2	2	2	3	3	3	
CO3	2	2	3	3	3	
CO4	2	2	3	3	3	
CO5	2	2	3	3	3	2
Avg	2	2	3	3	3	2

Attested

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IL3059 **INDUSTRIAL FACILITIES DESIGN** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

1. To understand the basic principles in facilities planning and plant location
2. To gain knowledge on the basic principles in facility layout design decisions through proper analysis
3. To analyze various modern trends while designing a layout using computerized algorithms
4. To understand the basic principles of group technology and develop knowledge in line balancing concepts to implement improved system
5. To understand basic principles in designing, measuring and analyzing material flow to improve the efficiency of the system

UNIT I PLANT LOCATION **9**

Plant location analysis – factors, costs, location decisions – Single facility location models, Multi facility location models - Mini-sum model - Mini-max model - Gravity location models, Brown & Gibbs model - Multi Criteria location problems - P median model - Developing facilities planning strategies- Examples of inadequate planning

UNIT II FACILITIES LAYOUT DESIGN **9**

Facilities requirement, need for layout study – types of layout - Factors affecting plant layout - P-Q chart - Systematic layout planning - Information gathering, Flow & Activity analysis, Relationship diagram, Space Constraint – OSHA, ADA regulations in facility design

UNIT III LAYOUT PLANNING ALGORITHMS **9**

Computerized layout planning procedure – ALDEP, CORELAP, CRAFT – Trends in computerized layout - Layout software

UNIT IV GROUP TECHNOLOGY & LINE BALANCING **9**

Group technology – OPTIZ classification system - Production Flow analysis , Rank Order Clustering I & II - Product oriented layout- assumptions and types, Assembly line balancing – Objectives, Line balancing techniques – LCR, KWM, RPW, COMSOAL - Introduction to Multi-model assembly line - Mixed model assembly line balancing

UNIT V MATERIALS HANDLING **9**

Concept of material handling – Principles - Material handling system design – Models for material handling system design- Classification of material handling equipments, AGV – types, Conveyors – types of conveyors – Palletizers – Warehouse material handling devices - Equipment selection & specification, Packaging – Types & Functions

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Interpret appropriate location models for various facility types
CO2. Examine different type of design and analyze various facility layouts
CO3. Analyze and apply various computerized techniques while designing a layout
CO4. Predict a strategy to level the workload across all the workstations
CO5. Estimate smooth and cost effective system in the material handling process

REFERENCES:

1. Tompkins, J.A. and White J A et al., “Facilities planning”, Fourth edition, John Wiley & Sons, 2010.
2. SundereshS.Heragu, “Facilities Design”, Fourth edition, CRC Press, 2016.

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3. Krajewski. J and Ritzman, “Operations management – Strategy and Analysis”, Addison – Wesley publishing company, 5th edition, 1999.
4. Pannerselvam.R, “Production and Operations Management”, PHI, 2017.
5. Richard Francis. L. and John A. White, “Facilities Layout and location - an analytical approach”, Second edition, PHI., 2002.
6. James, Apple, “Material Handling System Design”, Ronald Press, 1980.

CO’s - PO’s & PSO’s MAPPING

CO’s	PO’s			PSO’s		
	1	2	3	1	2	3
1	-	2	2	3	3	-
2	-	1	-	2	-	-
3	-	3	1	3	2	3
4	-	3	2	3	3	-
5	-	2	1	2	3	-
Avg.	-	2.2	1.5	2.6	2.75	3

Attested

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IL3060 DECISION SUPPORT SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

1 To understand the fundamental terms, concepts and theories associated with the phases of Decision Support Systems.
2 To evaluate the various mathematical models, data warehousing and data mining.
3 To discuss and develop skills in the analysis, design and implementation of group support systems and knowledge management systems.
4 To analyze the expert system as a subsystem of DSS
5 To create the knowledge representation method and implement support systems.

UNIT I DECISION MAKING INTRODUCTION 9

Management Support System - Managerial decision making, System modeling and support - preview of the modeling process - phases of decision-making process - DSS Architecture, Analysis, Design, Requirements, and Validation

UNIT II MODELING AND ANALYSIS 9

DSS components - Modelling and Analysis - Database Organization and Structures, Data Warehousing, Data Marts, Business Intelligence/ Analytics, Online Analytical Processing, Data Mining - DSS development - Software tools for Development - AHP.

UNIT III KNOWLEDGE MANAGEMENT 9

Group support systems- Enterprise DSS- supply chain and DSS - Knowledge management methods - Organizational Learning and Transformation, technologies and tools.

UNIT IV KNOWLEDGE REPRESENTATION 9

Artificial intelligence and expert systems - Concepts, structure, types - Knowledge Engineering - Principle and Methods - Difficulties, methods, selection, verification and validation - Advanced Intelligent Systems.

UNIT V SUPPORT SYSTEM IMPLEMENTATION 9

Representation in logic and schemas, semantic networks, production rules and frames, inference techniques, intelligent system development, implementation and integration of management support systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Choose decisions in the semi structured and unstructured problem situations.
CO2 Illustrate the data warehousing and data mining principles in basic applications.
CO3 Develop a knowledge management system with simple tools and techniques.
CO4 Construct intelligent based DSS and gain knowledge on AI expert systems.
CO5 Express logical and analytical thinking in making decisions.

REFERENCES:

1 Efraim Turban and Jay E Aronson, “Decision Support and Business Intelligent Systems”, PHI, Eighth edition, 2010.
2 Gupta, J.N.D., Forgionne, G.A., and Manuel, M.T., Intelligent Decision-making Support Systems: Foundations, Applications and Challenges, Springer, 2006
3 Iantovics, B., and Kountchev, R., Advanced Intelligent Computational Technologies and Decision Support Systems, Springer, 2014
4 Kumer. K., Zindani, D. and Davim, J.P., Digital Manufacturing and Assembly Systems in Industry 4.0, CRC Press, 2019
5 Tweedale, J.W., Neves-Silva, R., Jain, L.C., Phillips-Wren, G., Watada, J., and Howlett, R.J., Intelligent Decision Technology Support in Practice, Springer, 2016
6 Valencia-Garcia, R, Paredes-Valverde, M.A., Salas-Zarate, M.P. and Alor-Hernandez, Giner., Exploring Intelligent Decision Support Systems, Springer, 2018

CO's- PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
1	-		1	-	-	-
2	-	2	-	-	-	-
3	2	-	-	2	1	-
4	-	-	2	-	1	-
5	-	-	2	-	2	-
Avg.	2	2	1.6	2	2	-

Attested

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IL3004 ADVANCES IN HUMAN FACTORS ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To use Knowledge of basic human science and Engineering science to improve physiological performance
2. To illustrate an ergonomic analysis and ergonomic recommendations for modern work environment problems
3. To design the Equipment by apply skills associated with ergonomic measurement methods
4. To use ergonomic principles to design workplaces for the improvement of human performance
5. To modify the work place based on Environment factors

UNIT I PHYSIOLOGICAL PERFORMANCE 9

Metabolism –Stress and fatigue - Physical work capacity - Physiological factors affecting work activity – Measurement of energy expenditure – Quantitative work load analysis – Work and rest schedules – Physical fitness tests.

UNIT II WORK SPACE DESIGN 9

Problems of body size, Anthropometry measures- Work posture– Design for standing and seated workers - Design of repetitive tasks - Design of manual handling tasks- Hand tool design.

UNIT III DESIGN OF EQUIPMENT 9

Ergonomic factors to be considered in the design of displays and control, design for maintainability, design of human computer interaction.

UNIT IV COGNITIVE ERGONOMICS 9

Information Theory, Information processing, signal detection theory, Human response and human errors, cognitive task analysis.

UNIT V ENVIRONMENT ERGONOMICS 9

Indoor room environment Heat, cold and the design of the physical environment–Illumination design – Noise and Vibration

COURSE OUTCOMES:

The students will be able to

CO1: Know the Knowledge of basics of human science and Engineering science to improve physiological performance

CO2: Conduct an ergonomic analysis and ergonomic recommendations for modern work environment problems

CO3: Design the Equipment by apply skills associated with ergonomic measurement methods

CO4: Apply ergonomic principles to design workplaces for the improvement of human performance

CO5: Improve the work place based on Environment factor

CO's - PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
1	3	-	2	-	3	-
2	2	-	-	-	-	-
3	-	-	3	-	-	-
4	-	-	2	-	-	-
5	-	-	3	-	3	-
Avg.	2.5	-	2.5	-	3	-

Attested

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IL3061	MAINTAINABILITY ENGINEERING	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1. To understand basic maintenance concepts and latest trends
2. To know various maintenance policies for maximizing the profit.
3. To diagnose and analyse maintenance problems.
4. To know effective spare parts management strategies
5. To learn strategies for improving the overall Equipment Effectiveness.

UNIT I MAINTENANCE CONCEPT **9**

Maintenance definition – Maintenance objectives - Maintenance challenges – Tero Technology Maintenance costs - Scope of maintenance department. –Latest Trends in Maintenance- Computerized Maintenance Management Software (CMMS)- Role of IoT in Maintenance- Digital Twins in Maintenance.

UNIT II MAINTENANCE MODELS **9**

Proactive/reactive maintenance - Maintenance policies – Imperfect maintenance Preventive / breakdown maintenance – Optimal PM schedule and product characteristics – Inspection decisions - Maximizing profit - Minimizing downtime – Replacement decisions.

UNIT III MAINTENANCE QUALITY **9**

Five zero concept – FMEA- FMECA – Root cause analysis – Repair time distribution – Analysis of downtime – Maintainability prediction – Design for maintainability – Reliability Centered Maintenance.

UNIT IV MAINTENANCE MANAGEMENT **9**

Human factors – Maintenance staffing - Learning curves – Simulation – Optimal size of service facility – Optimal repair effort – Spare parts management – Maintenance planning – Maintenance scheduling.

UNIT V TOTAL PRODUCTIVE MAINTENANCE **9**

TPM philosophy – Chronic and sporadic losses – Equipment defects – Six major losses – Overall equipment effectiveness –TPM pillars –Autonomous maintenance.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Describe basic maintenance concepts and latest trends in maintenance
CO2. Extract maintenance policies for maximizing the profit.
CO3. Diagnosis of maintenance problems.
CO4. Improve uptime of machines by effective spare parts management.
CO5. Improve the overall Equipment Effectiveness.

REFERENCES:

1. Andrew K.S.Jardine& Albert H.C. Tsang, “Maintenance, Replacement and Reliability-Theory and Applications” Taylor and Francis, 2021.
2. Mishra R C and Pathak K., “Maintenance Engineering and Management”, PHI,2012
3. BikasBadhury& S.K.Basu, “Tero Technology: Reliability Engineering and Maintenance Management”, Asian Books, 2008.
4. Seichi Nakajima, “Total Productive Maintenance”, Productivity Press, 1993.
5. Matthew P. Stephens, “Productivity and Reliability-Based Maintenance Management”, Purdue University Press, 2010

CO’s - PO’s & PSO’s MAPPING

	PO’s			PSO’s		
CO’s	**1**	**2**	**3**	**1**	**2**	**3**
CO1	1	-	1	-	2	-
CO2	1	-	1	-	2	-
CO3	1	-	1	-	2	-
CO4	1	-	1	-	2	-
CO5	1	-	1	-	2	-
Avg	1	-	1	-	2	-

Attested

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IL3005 INDUSTRIAL SAFETY ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

1 To understand unsafe conditions and recognize unsafe alerts.
2 To interpret the rules and regulations for safety operations.
3 To evaluate the health and hygiene of industries.
4 To apply the safety system analysis to prevent accidents.
5 To understand the regulatory bodies and to collaborate and modify processes procedures for safety.

UNIT I INTRODUCTION 9

Need for safety - Safety and productivity - Accident, Injury, Unsafe act, Unsafe Condition - Dangerous Occurrence - Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions. Risk and Hazard - Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT II CHEMICAL HAZARDS AND ENVIRONMENTAL CONTROL 9

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology. Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, Industrial Lighting, Ventilation and Heat control - Personal Protection.

UNIT III INDUSTRIAL HYGIENE AND OCCUPATIONAL HEALTH 9

Industrial Hygiene - Importance of hygiene in industry, domestic hygiene and industrial hygiene - Air sampling, the concept of threshold limits, personal monitoring - risk management at work places, emergency control measures - Industrial physiology, classification of workload, work capacity and man-job alignment, fatigue and rest allowances, physiological list in occupational health assessment – Occupational Hazard – Occupational Health audit and survey.

UNIT IV HAZARD ANALYSIS 9

System Safety Analysis – Material Safety Data Sheets (MSDS) - Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis, and Risk Assessment – methodology, criticality analysis, corrective action and follow-up.

UNIT V SAFETY REGULATIONS 9

Explosions – Disaster management – catastrophe control, hazard control - Safety Laws and Regulations – Relevant Provisions of Factories Act and Rules, Indian Electricity Act and Rules, Explosive Act and Rules, Gas Cylinders Rules – Safety Regulatory Authorities – Functions and processes of regulatory body of safety - Product safety – case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Identify and prevent chemical, environmental, mechanical, fire hazard.
CO2 Collect, analyze and interpret the accidents data based on various safety techniques.
CO3 Develop proper safety hygiene's on industries and its employees.
CO4 Construct to perform hazard analysis.
CO5 Express to design the system with environmental consciousness by implementing safety regulation.

REFERENCES:

1 David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
2 Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005.
3 Safety Manual, “EDEL Engineering Consultancy”, 2000.
4 John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.
5 R.K Jain (2000) Industrial Safety, Health and Environment management systems, Khanna Publications.
6 Krishnan, N.V. (1997). Safety management in Industry. Jaico Publishing House, New Delhi.

CO’s- PO’s MAPPING

CO’s	PO’s			PSO’s		
	1	2	3	1	2	3
1	2	2	-	-	-	2
2	2	1	2	-	1	1
3	2	2	2	-	1	1
4	2	2	2	-	1	1
5	2	2	2	1	1	1
AVg.	2	1.8	2	0.5	1	1.2

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IL3062 **PRODUCT DESIGN AND VALUE ENGINEERING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

1. Relate product development integrated with value engineering.
2. Summarize the development of new products through conceptualization, design and development phases.
3. Relate various aspects of product development with industrial design and manufacturing.
4. Describe the value of a product using tools and techniques.
5. Design products which are suitable for the needs of the society.

UNIT I VALUE ENGINEERING BASICS **9**

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity in Value Engineering.

UNIT II VALUE ENGINEERING JOB PLAN AND PROCESS **9**

Seven phases of job plan, Functional Analysis and System Technique - Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

UNIT III IDENTIFYING CUSTOMER NEEDS AND PRODUCT SPECIFICATIONS **9**

Product Development process – front end process-Product development organizations. Gather raw data – Interpret raw data- organize the needs into a hierarchy –Relative importance of the needs. Specifications – Refining specifications-Quality Function Deployment (QFD)-Product Costing.

UNIT IV CONCEPT GENERATION, SELECTION AND PRODUCT ARCHITECTURE **9**

The activities of concept generation, Clarify the problem – Search internally – Search externally – Explore systematically. Concept Screening – Concept scoring-Concept testing. Product architecture – Implication of architecture –Establishing the architecture – Related system level design issues. Design for Manufacture, Assembly, Maintenance and Environment

UNIT V INDUSTRIAL DESIGN, PROTOTYPING AND ECONOMICS **9**

Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design. Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes. Product development economics: Elements of economic analysis, sensitive analysis

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Understand the basic concept of product development.

CO2. Design and develop new products in a systematic manner considering the concept of value engineering.

CO3. Understand customer requirements.

CO4. Understand product architecture.

CO5. Gain knowledge and create the prototype models.

REFERENCE:

1. Charles Gevirtz, “Developing New products with TQM”, McGraw Hill, International Editions, 1994.
2. Rosenthal S, “Effective Product Design and Development”, Irwin, 1992.
3. A K Chitale and R C Gupta , “ Product Design and Manufacturing”, PHI, New Delhi, 2003
4. Karal, T.Ulrich Steven D.Eppinger, “Product Design and Development”, McGraw Hill, International Editions, 2003.
5. Mudge, Arthur E. “Value Engineering”- A systematic approach, McGraw Hill, New York, 2000.

CO’s - PO’s & PSO’s MAPPING

CO’s	PO’s			PSO’s		
	1	2	3	1	2	3
CO1	2	2	-	-	-	2
CO 2	2	1	2	-	1	1
CO 3	2	2	2	-	1	1
CO 4	2	2	2	-	1	1
CO 5	2	2	2	1	1	1
Avg.	2	1.8	2	0.5	1	1.2

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IL3063 LOGISTICS AND DISTRIBUTION MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To develop an understanding of the role of logistics in a market-oriented society Examine the major functions of logistics
2. To provide insight into Transportation Mode Selection and its cost structures
3. To impart knowledge on Packaging and Containerization
4. To familiarize Warehousing functions, types, Internal Operations

UNIT I LOGISTICS MANAGEMENT 9

Definition, Evolution, Importance. The concepts of logistics. Logistics relationships. Functional applications – Logistics Organization - Logistics in different industries -Logistics Activities: – functions, objectives, solution. Third party and fourth party logistics - Reverse Logistics - Global Logistics. Legal types - Modes of transportation –Transport mode selection –methods - Transportation Functionality and Principles; Multimodal Transport: Modal Characteristics; Modal Comparisons; Legal Classifications; International Air Transport; Air Cargo Tariff Structure; Freight: Definition, Rate; Freight Structure and Practice, Transport costs – rate profiles–transport regulations– intra and interstate transport of goods. Transport Industry in India- International Transport – Rail ways, Road transport, Ports – Transport Security - Trends in Modern Transport

UNIT II PACKAGING AND CONTAINERIZATION 9

Transportation and Packaging. Packaging and Packing: Labels, Functions of Packaging, Designs, Kinds of Packaging; Packing for Transportation and Marking: Types of Boxes, Container, Procedure, Cost, Types of Marking, Features of Marking. Containerization: Genesis, Concept, Classification, Benefits and Constraints; Inland Container Depot (ICD): Roles and Functions, CFS, Export Clearance at ICD; CONCOR; ICDs under CONCOR; Chartering: Kinds of Charter, Charter Party, and Arbitration

UNIT III WAREHOUSE FUNCTIONS AND TYPES 9

Warehouse –objectives- Functions Activities-Types- Own Warehouses- Hired Warehouses- Private Warehouses- Public Warehouses- Government Warehouses- Bonded Warehouses- Co-operative Warehouses- Distribution Warehouses- Fulfilment/ Consolidation Warehouses Warehouses Providing Value Added Services- Cross Docking and Trans-loading Warehouses- Break Bulk Warehouses- Storage Warehouses- Refrigerated Warehouses Characteristics of ideal warehouses- Warehouse Layout- Principles and Facilities Types.

UNIT IV WAREHOUSE OPERATIONS 9

Internal Operations: Measures and metrics of warehouse operations- Logistics in the warehouse- Localization of materials in a warehouse- Identification and classification of Materials and products in the warehouse- Managing the material/products turns in warehouse (FIFO/LIFO) – Problems and issues in shipment processes. Warehousing Equipment: Material Handling equipment and Systems Safety Matting, Industrial Safety Equipment- Storage types and storage unit management- Material Storage Systems - benefits – methods- Industrial Shelving, Industrial Storage Bins - Industrial Storage Cabinets - Spill Containment Systems-Industrial Waste Disposal

UNIT V EXPORT & IMPORT PROCEDURES 9

Export & Import – Introduction, Definitions. Evolution of Export & Import. Foreign Trade-Institutional Framework and Basics-Documentation and Steps, Export–Import Strategies and Practice, Export Marketing, Business Risk Management and Coverage, Export Incentive Schemes Export Procedures and Documents, Customs Clearance of Import and Export Cargo, Methods and Instruments of Payment and Pricing Inco terms, Methods of Financing Exporters

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Understand the principles of logistics management
CO2. Understand the logistics role in the economy and the organization
CO3. Gain knowledge about warehouse functions and types
CO4. Understand warehouse operations
CO5. Familiarise about Export & Import Procedures in Logistics and Distribution

REFERENCES:

1 Kapoor Satish K &KansalPurva.(2003)Basics of Distribution Management: A Logistical Approach :Prentice Hall of India
2 Agrawal D K. (2007). Distribution and Logistics Management: A Strategic Marketing Approach :Macmillan publishers India.
3 Alan Ruston, Phil Crouches & Peter Baker. (2014)The Handbook of Logistics and Distribution Management. New Delhi: kogan page India.
4 Bowersox. (2000). Logistical Management: Mc-Graw Hill.

CO's - PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
1	3	-	2	-	3	-
2	2	-	-	-	-	-
3	-	-	3	-	-	-
4	-	-	2	-	-	-
5	-	-	3	-	3	-
Avg.	2.5	-	2.5	-	3	-

IL3064 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To understand the concepts of supervised and unsupervised learning.
2. To analyze models such as support vector machines, kernel SVM, Naive Bayes, decision tree classifier, random forest classifier, logistic regression, K-means clustering
3. To implement and work with state-of-art tools in machine learning

UNIT I INTRODUCTION TO MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE 9

Human Learning, Types of Human Learning, Machine Learning-Types of Machine Learning - Supervised learning, Unsupervised learning, Reinforcement learning, Comparison – supervised, unsupervised, and reinforcement learning, Problems Not To Be Solved Using Machine Learning, Applications of Machine Learning, State-of-The-Art Languages/Tools In Machine Learning, Issues in Machine Learning. Preparing to Model: Introduction, Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing

UNIT II MODELLING , EVALUATION AND FEATURE ENGINEERING 9

Modelling and Evaluation: Introduction, Selecting a Model, Training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Supervised learning – classification, Supervised learning – regression, Unsupervised learning – clustering, Improving Performance of a Model. Basics of Feature Engineering, Feature Transformation, Feature construction, Feature extraction, Feature Subset Selection, Issues in high-dimensional data, Key drivers of feature selection – feature relevance and redundancy, Measures of feature relevance and redundancy, Overall feature selection process, Feature Selection Approaches.

UNIT III BAYESIAN METHODS 9

Bayesian Concept Learning: Introduction, Importance, Bayes' Theorem and Concept Learning, Brute-force Bayesian algorithm, Concept of consistent learners, Bayes optimal classifier, Naïve Bayes classifier, Applications of Naïve Bayes classifier, Handling Continuous Numeric Features in Naïve Bayes Classifier, Bayesian Belief Network, Independence and conditional independence, Use of the Bayesian Belief network in machine learning.

UNIT IV SUPERVISED LEARNING- CLASSIFICATION AND REGRESSION 9

Classification- Introduction, Example of Supervised Learning, Classification Model, Classification Learning Steps, Common Classification Algorithms, k-Nearest Neighbour (KNN), Decision tree, Random forest model, Support vector machines. Regression-Introduction, Example of Regression, Common Regression Algorithms, Simple linear regression, Multiple linear regression, Assumptions in Regression Analysis, Main Problems in Regression Analysis, Improving Accuracy of the Linear Regression Model, Polynomial Regression Model, Logistic Regression, Maximum Likelihood Estimation

UNIT V UNSUPERVISED LEARNING 9

Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering, Clustering as a machine learning task, Different types of clustering techniques, Partitioning methods, K-Medoids: a representative object-based technique, Hierarchical clustering, Density-based methods – DBSCAN, Finding Pattern using Association Rule, Definition of common terms, Association rule, The apriori algorithm for association rule learning, Build the apriori principle rules.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Explore and apply the fundamentals of machine learning techniques.

CO2. Understand different techniques of data pre processing.

CO3. Analyze the strength and weakness of different machine learning models to solve real world problems.

CO4. Implement and apply different supervised and unsupervised machine learning algorithms.

REFERENCES:

1. Machine Learning, Amit Kumar Das, SaikatDutt, Subramanian Chandramouli, Pearson Education India, April 2018 ISBN: 9789389588132.
2. Introduction to Machine Learning, EthemAlpaydin, 2nd Edition, 2010, PHI Publication, ISBN978-81-203-4160-9.
3. Practical data science with R, Zumel, N., & Mount J, Manning Publications, 2014, ISBN 9781617291562
4. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma, O'Reilly Publications, 2016 Edition, ISBN-13: 978-1491925614.
5. Pattern Recognition and Machine Learning, Christopher M Bishop, Springer, February 2006, ISBN-10: 0-387-31073-8, ISBN-13: 978-0387-31073-2.
6. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, Springer, Second Edition, April 2017, ISBN 978-0-387-84858-7

CO's- PO's & PSO's MAPPING

CO's	PO's			PSO's		
	1	2	3	1	2	3
1	3	-	-	-	-	-
2	-	3	3	-	2	-
3	3	-	3	-	2	3
4	3	-	3	-	2	3
5	-	-	3	-	2	3
Avg	3	3	3	-	2	3

1-low, 2-medium, 3-high, '-"- no correlation