ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS - 2019

CHOICE BASED CREDIT SYSTEM

M.E. MANUFACTURING SYSTEMS AND MANAGEMENT (FULL - TIME)

THE VISION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

We, at the Department of Mechanical Engineering, Anna University shall strive hard to impart knowledge and state-of-the-art training to our students and expose them to broad areas of Mechanical Engineering, namely Design, Manufacturing, Energy, Thermal Sciences and currently related interdisciplinary areas, so that they can later practice their profession at home or abroad keeping in mind the needs and concern of the society they represent, safeguarding values, ethics and be instrumental in bringing about an overall technological development.

THE MISSION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

1. To deliver knowledge in Mechanical Engineering and Materials Science and Engineering with high educational standards so that the outgoing students are employable and globally competitive.
2. To produce graduate and post graduate engineers with core competency as well as relevant software skills and social responsibility.
3. To be dynamic in imparting knowledge to students depending upon the changing national and International needs

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M.E. MANUFACTURING SYSTEMS AND MANAGEMENT (FULL - TIME)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

Master of Manufacturing Systems and Management curriculum is designed

I. To prepare students to excel in research and to succeed in the areas of manufacturing systems engineering and manufacturing management.
II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve manufacturing systems engineering related problems
III. To train students with scientific and engineering knowledge so as to comprehend, analyze, design and solve the real time problems.
IV. To inculcate students with professional and ethical attitude, effective communication skills, teamwork skills and multidisciplinary approach.
V. To develop student with an academic excellence, leadership qualities, leading to life-long learning for a successful professional career

PROGRAMME OUTCOMES (POs):

After going through the two years of study, our Manufacturing systems and Management Graduates will exhibit ability to:

PO#	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply knowledge of mathematics, basic science and engineering science.
2	Problem analysis	Identify, formulate and solve engineering problems.
3	Design/development of solutions	Design a system or process to improve its performance, satisfyingitsconstraints.
4	Conduct investigations of complex problems	Conduct experiments & collect, analyze and interpret the data.
5	Modern tool usage	Apply various tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct themselves to uphold the professional and social obligations.
7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
8	Ethics	Interact in industry, business and society in a professional and ethical manner.
9	Individual and team work	Function in a multi-disciplinary team.
10	Communication	Proficiency in oral and written Communication.
11	Project management and finance	Implement cost effective and improved system.
12	Life-long learning	Continue professional development and learning as a life-long activity.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

1. Able to solve real world problems by using appropriate systems principles and management techniques in manufacturing field.
2. Able to apply the comprehensive knowledge gained in various nuances of manufacturing system to manage various simple to complex situations occurring in manufacturing system.
3. Able to pursue professional careers as an individual in their areas of interest in manufacturing industries and as a team member in a multidisciplinary environment and will demonstrate abilities to communicate their creative ideas in the research and manage the development of manufacturing systems.

MAPPING PEO'S WITH PO'S

	PROGRAMME OUTCOMES											
PEO'S	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	√	√	√	√	√			√	√	√		√
2	√	√	√	√	√							
3	√	√	√	√	√			√	√	√		√
4						√	√	√	√	√	√	√
5						√	√	√	√	√	√	√

MAPPING OF COURSE OUTCOME AND PROGRAMMED OUTCOME

SEM	**SUBJECT**	**PO1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
I	Statistical Quality Control for Manufacturing systems	√	√	√	√	√							
	Advances in Manufacturing Technology	√	√			√							
	Manufacturing Management	√	√			√				√		√	
	Experimental Design and Analysis	√	√	√									
	Program Elective I												
	Research Methodology and IPR												
	Audit Course – I												
	Manufacturing Systems Laboratory		√	√	√	√							
	Technical Seminar	√	√			√	√		√	√	√		√
II	Lean Manufacturing Systems and Six Sigma		√	√	√	√	√	√	√	√	√	√	√
	Maintenance and Reliability Engineering	√	√	√	√								
	Logistics and Supply Chain Management for Manufacturing Systems	√	√	√								√	
	Automated Product Manufacturing Systems	√	√			√						√	
	Program Elective II												
	Program Elective III												
	Audit Course –II												
	Manufacturing Analytics laboratory	√	√	√	√	√						√	
	Automation and Robotics Laboratory	√	√	√	√	√	√			√			√
III	Program Elective IV												
	Program Elective V												
	Open Elective												
	Dissertation I	√	√			√	√		√	√	√		√
IV	Dissertation II	√	√			√	√		√	√	√		√

ELECTIVES	PO1	2	3	4	5	6	7	8	9	10	11	12
Product Design For Manufacturing	√	√	√									
Mechatronics in Manufacturing	√	√	√	√	√				√			√
Cellular Manufacturing Systems	√	√	√	√	√	√	√	√	√	√	√	√
Solid Freeform Manufacturing	√	√	√	√	√					√		√
Competitive and Sustainable Manufacturing Systems	√				√							√
Process Planning and Cost Estimation	√	√	√	√	√						√	
Advanced Materials and its Processing	√	√	√	√								
Human Resources Management	√				√							
Modern Techniques of Materials Characterization	√	√	√	√	√							√
Nanostructured Materials And Technology	√	√	√	√								
Sustainable and Green Manufacturing		√	√	√		√	√				√	√
Integrated Product Design and Process Development												
Enterprise Resource Planning and Management	√		√	√	√	√			√	√	√	√
Financial Management and Accounting	√	√									√	
Material Handling Systems and Design	√	√	√	√	√	√	√					√
Materials Management	√	√	√								√	

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM
M.E. MANUFACTURING SYSTEMS AND MANAGEMENT (FULL - TIME)
SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MS5101	Statistical Quality Control for Manufacturing Systems	FC	3	1	0	4	4
2.	CI5251	Advances in Manufacturing Technology	PCC	3	0	0	3	3
3.	MS5151	Manufacturing Management	PCC	3	0	0	3	3
4.	MS5102	Experimental Design and Analysis	PCC	4	0	0	4	4
5.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Program Elective I	PEC	3	0	0	3	3
7.		Audit Course – I*	AC	2	0	0	2	0
PRACTICALS								
8.	MS5111	Manufacturing Systems Laboratory	PCC	0	0	4	4	2
9.	MS5112	Technical Seminar	EEC	0	0	4	4	2
			TOTAL	**20**	**1**	**8**	**29**	**23**

* Audit Course is optional.

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MS5201	Lean Manufacturing Systems and Six Sigma	PCC	3	0	0	3	3
2.	MS5202	Maintenance and Reliability Engineering	PCC	3	0	0	3	3
3.	MS5203	Logistics and Supply Chain Management for Manufacturing Systems	PCC	3	0	0	3	3
4.	PD5071	Automated Product Manufacturing Systems	PCC	3	0	0	3	3
5.		Program Elective II	PEC	3	0	0	3	3
6.		Program Elective III	PEC	3	0	0	3	3
7.		Audit Course – II*	AC	2	0	0	2	0
PRACTICALS								
8.	MS5211	Manufacturing Analytics Laboratory	PCC	0	0	4	4	2
9.	MS5212	Automation and Robotics Laboratory	PCC	0	0	4	4	2
			TOTAL	**20**	**0**	**8**	**28**	**22**

* Audit Course is optional.

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Program Elective IV	PEC	3	0	0	3	3
2.		Program Elective V	PEC	3	0	0	3	3
3.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
4.	MS5311	Dissertation I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**12**	**21**	**15**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	MS5411	Dissertation II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 72

FOUNDATION COURSE [FC]

Sl. No.	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	MS5101	Statistical Quality Control for Manufacturing Systems	4	0	0	4	1

PROGRAM CORE COURSES (PCC)

Sl. No	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	CI5251	Advances In Manufacturing Technology	3	0	0	3	1
2.	MS5151	Manufacturing Management	3	0	0	3	1
3.	MS5102	Experimental Design and Analysis	4	0	0	4	1
4.	MS5111	Manufacturing Systems Laboratory	0	0	4	2	1
5.	MS5201	Lean Manufacturing Systems and Six Sigma	3	0	0	3	2
6.	MS5202	Maintenance and Reliability Engineering	3	0	0	3	2
7.	MS5203	Logistics and Supply Chain Management for Manufacturing Systems	3	0	0	3	2
8.	PD5071	Automated Product Manufacturing Systems	3	0	0	3	2
9.	MS5211	Manufacturing Analytics Laboratory	0	0	4	2	2
10.	MS5212	Automation and Robotics Laboratory	0	0	4	2	2

PROGRAM ELECTIVE COURSES

SEMESTER I, ELECTIVE – I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MS5001	Product Design For Manufacturing	PEC	3	0	0	3	3
2.	MS5002	Mechatronics in Manufacturing	PEC	3	0	0	3	3
3.	MS5003	Cellular Manufacturing Systems	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE – II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CI5151	Solid Freeform Manufacturing	PEC	3	0	0	3	3
2.	MS5004	Competitive and Sustainable Manufacturing Systems	PEC	3	0	0	3	3
3.	MS5005	Process Planning and Cost Estimation	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MS5006	Advanced Materials and its Processing	PEC	3	0	0	3	3
2.	MS5007	Human Resource Management	PEC	3	0	0	3	3
3.	MS5008	Modern Techniques of Materials Characterization	PEC	3	0	0	3	3
4.	MS5009	Nanostructured Materials and Technology	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MS5010	Sustainable and Green Manufacturing	PEC	3	0	0	3	3
2.	MS5011	Integrated Product Design and Process Development	PEC	3	0	0	3	3
3.	MS5012	Enterprise Resource Planning and Management	PEC	3	0	0	3	3
4.	MS5013	Robotics and Expert System	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE – V

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MS5014	Financial Management and Accounting	PEC	3	0	0	3	3
2.	ED5079	Material Handling Systems and Design	PEC	3	0	0	3	3
3.	QE5072	Materials Management	PEC	3	0	0	3	3

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	RM5151	Research Methodology and IPR	2	0	0	2	2

OPEN ELECTIVE COURSES [OEC]

(Out of 6 Courses one Course must be selected)

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OE5091	Business Data Analytics	OEC	3	0	0	3	3
2.	OE5092	Industrial Safety	OEC	3	0	0	3	3
3.	OE5093	Operations Research	OEC	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	OEC	3	0	0	3	3
5.	OE5095	Composite Materials	OEC	3	0	0	3	3
6.	OE5096	Waste to Energy	OEC	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER			CREDITS
			L	T	P	
1.	AX5091	English for Research Paper Writing	2	0	0	0
2.	AX5092	Disaster Management	2	0	0	0
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0
4.	AX5094	Value Education	2	0	0	0
5.	AX5095	Constitution of India	2	0	0	0
6.	AX5096	Pedagogy Studies	2	0	0	0
7.	AX5097	Stress Management by Yoga	2	0	0	0
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	COURSE CODE	Course Title	Periods per week			Credits	Semester
			Lectur e	Tutorial	Practical		
1	MS5112	Technical Seminar	0	0	4	2	1
2	MS5311	Dissertation I	0	0	12	6	3
3	MS5411	Dissertation II	0	0	24	12	4

SUMMARY

	M.E. (MANUFACTURING SYSTEMS AND MANAGEMENT) (Full Time)					
	Subject Area	**Credits per Semester**				**Credits Total**
		I	**II**	**III**	**IV**	
1.	FC	04	00	00	00	04
2.	PCC	12	16	00	00	28
3.	PEC	03	06	06	00	15
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	02	00	06	12	20
7.	Non Credit / Audit Courses	✓	✓	00	00	
	Total Credit	**23**	**22**	**15**	**12**	**72**

MS5101	STATISTICAL QUALITY CONTROL FOR MANUFACTURING SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

1. To provide an overview of the quality concepts and statistical methods
2. To familiarize the control chart for variables and six sigma concept
3. To give an insight to control chart for attributes.
4. To attain knowledge of non-shewart control chats and process capability analysis.
5. To learn the different acceptance sampling plan to carry out quality checks.

UNIT – I INTRODUCTION 12

Basic concepts of Quality, Meaning and definition of quality, Quality control, objectives of quality control, Quality Characteristics, Quality costs, Quality of Design, Quality of conformance, quality planning, quality measurement, troubleshooting, diagnostic techniques.

Sampling theory – Population, sample, influence of sample size – Estimation of population parameter from samples – Mean, variance, differences of means, ratios of variances.Test of Hypothesis-Null and Alternate Hypothesis, Level of Significance, One tail and two tailed tests,Test of Hypothesis of mean, variance and ratios of variances

UNIT – II CONTROL CHART FOR VARIABLES 12

Variation in process – causes for variation – Factors control charts, X-R, X-σ, Run Chart – Tolerance design – Establishing and interpreting control charts – pattern study – Six sigma concept

UNIT – III CONTROL CHART FOR ATTRIBUTES 12

Control chart for attributes – Control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – c and u charts, quality rating – Demerit chart – State of control and process out of control identification in charts.

UNIT – IV SPECIAL CONTROL CHART AND PROCESS CAPABILITY 12

Cumulative sum (CUSUM) control charts- V mask procedure- Control chart for Multiple stream process- Group control charts- Tool wear control chart. Process capability studies: Natural tolerance limits, Process capability analysis using histogram, probability plot and control chart. Process capability ratios, Process capability analysis of normal and non-normal distributions. Process capability analysis using Designed experiments and Attribute data - Gauge and Measurement system capability studies.

UNIT – V ACCEPTANCE SAMPLING 12

Lot by lot sampling – Types – Probability of acceptance in single, double, multiple sampling plans– OC curves – Producer's risk and consumer's risk – AQL, LTPD, AOQL, Concepts – Design of sampling plans – Standard sampling plans for AQL and LTPD – Use of standard sampling plans, sequential sampling plan.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

1. Realize the quality concepts and use of statistical method in quality control.
2. Design control charts for measurable variables to identify the variation in the process.
3. Apply the control chart for attributes to identify the state of control of the process.
4. Evaluate the natural tolerance and capability of a process in meeting the specification. Also, apply the non-shewart control charts to identify the process out of control in specialized situations.
5. Use the strategies of acceptance sampling plan to perform quality audit in the customer site.

REFERENCES:

1. Amitava Mitra “Fundamentals of Quality Control and improvement” Wiley, 2008.
2. Douglas.C. Montgomery, “Introduction to Statistical quality control”, 7th edition, John Wiley 2012.
3. Douglas.C. Montgomery, “Applied statistics and Probability for Engineers”, Wiley 2018.
4. Edwards Staple Smith, “ Control charts- Introduction to Statistical Quality control” McGraw-Hill 2013
5. Grant, Eugene .L “Statistical Quality Control”, TMH, 2005
6. John.S. Oakland. “Statistical process control”, Elsevier Butterworth-Heinemann, 2008
7. Jeya Chandra M, “Statistical Quality Control”, CRC press, 2001.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.3										0.6	0.3	
2		0.6	0.6	0.6	0.3								0.6	0.6	
3		0.6	0.6	0.6										0.6	
4	0.3	0.6	0.6										0.6		
5		0.6	0.3	0.6									0.6	0.3	
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

CI5251 ADVANCES IN MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To interpret and compare different non-traditional machining processes.
- To recognize different precision machining processes.
- To interpret modern metal forming processes.
- To differentiate between micromachining and microfabrication.
- To formulate smart manufacturing systems.

UNIT I UNCONVENTIONAL MACHINING 9

Introduction - Electrical discharge machining - Micro electrical discharge machining - Wire electrical discharge machining - Micro wire electrical discharge machining - Electro chemical machining - Ultrasonic machining - Plasma arc machining- Laser beam machining- Electron beam machining - Ion beam machining - Abrasive flow machining - Abrasive water jet machining- Comparison of different non-traditional machining processes- Hybrid machining processes.

UNIT II PRECISION MACHINING 9

Introduction - Ductile mode machining of hard and brittle materials - Ultra precision grinding and selection of grinding wheels - Electrolytic in process dressing -Chemical mechanical polishing - Diamond turn machining - High speed machining -Magneto rheological finishing processes.

UNIT III MODERN METAL FORMING 9

Introduction - Orbital forging - Isothermal forging - Rubber pad forming –Incremental forming - Fine blanking -Powder forming: Powder rolling, Powder extrusion - High speed extrusion.

UNIT IV MICRO MACHINING AND MICRO FABRICATION 9

Introduction - Mechanical micro machining - Micromachining tool design - Chip formation - Size effect in micromachining - micro turning, micro milling. Micro drilling- micro machine tools. Introduction to micro fabrication - LIGA, surface micromachining - Bulk micromachining -Etching - Sputtering - Chemical vapor deposition - Physical vapor deposition.

UNIT V INDUSTRY 4.0 9

Introduction - Industry 4.0 – Smart manufacturing: Smart design, smart machining, smart monitoring, smart control, smart scheduling - Internet of Things - Industrial Internet of Things - Framework: Connectivity devices and services - Intelligent networks of manufacturing - Cloud computing - Data analytics -Cyber physical systems -Machine to Machine communication- case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

CO1: Categories different non-traditional machining processes.
CO2: Infer the different precision machining processes.
CO3: Recognize the modern metal forming processes.
CO4: Interpret different micro machining and micro fabrication techniques.
CO5: Demonstrate the Industry 4.0 and smart manufacturing system concepts.

	PO						PSO			
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**
CO1	0.6		0.3	0.9	0.9		0.9	0.9	0.6	0.6
CO2	0.6		0.3	0.6	0.3	0.3	0.9	0.3	0.6	0.6
CO3	0.3	0.3	0.6	0.6	0.9	0.3	0.9	0.3	0.3	0.6
CO4	0.3	0.3	0.6	0.6	0.9	0.6	0.9	0.9	0.6	0.9
CO5	0.3		0.9	0.6	0.9	0.6	0.9	0.9	0.9	0.9

REFERENCES:

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, A press, 2016.
2. Anand Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, 2019.
3. Balasubramaniam R. and Ramagoplan V.S, Sathyan Subbiah, “Diamond Turn Machining”, CRC Press, New York, 2018.
4. Jain V.K., “Introduction to Micromachining”, Narosa, New Delhi, 2014.
5. Kalpakjian S., and Schmid S.R., “Manufacturing Processes for Engineering Materials”, Pearson, New Delhi, 2012.
6. Venkatesh V. C. and SudinIzman, “Precision Engineering”, Tata McGraw-Hill, New Delhi, 2007.

MS5151 MANUFACTURING MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

1. Students will be able to study the concepts in facility planning.
2. Students will be able to study types of plant layout and capacity planning methods.
3. Students will be able to study the concepts of Project management.
4. Students will be able to study the concepts and methods in production planning and control.
5. Students will be able to study the concepts in Inventory and maintenance management.

UNIT-I FACILITY PLANNING 9

Facility planning – Factors affecting selection of plant location, Factor rating analysis: Break – even analysis, Load distance model, closeness ratings – case study

UNIT-II CAPACITY & LAYOUT PLANNING 9

Types of plant layout, criteria for good layout, Process layout, Assembly line balancing. Computer based solutions to layout problems such as CRAFT, ALDEP, CORELAP and PREP. Capacity planning – Analysis of designed capacity, installed capacity, commissioned capacity, utilized capacity, factors affecting productivity and capacity expansion strategies.

UNIT-III PROJECT MANAGEMENT 9

Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, Project management – its role in functional areas of management, network representation of a project, CPM and PERT techniques – case study

UNIT-IV PRODUCTION PLANNING & CONTROL 9

Aggregate production planning, production planning strategies, Disaggregating the aggregate plan, Materials Requirement Planning (MRP), MRP-II, Supply chain management, Operation scheduling, prioritization.

UNIT-V INVENTORY AND MAINTENANCE MANAGEMENT 9

Introduction to EOQ models, Inventory control techniques – ABC, FSN, VED etc. Types of inventory control – Perpetual, two-bin and periodic inventory system – JIT, SMED, Kanban, Zero inventory, Maintenance strategies and planning, Maintenance economics: quantitative analysis, optimal number of machines, Replacement strategies and policies – economic service life, opportunity cost, replacement analysis using specific time period.

TOTAL = 45 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

1. Able to acquire knowledge on facility, and problems associated with it.
2. Ability to learn the various capacity and layout planning models
3. Understand the concepts of demand forecasting and project management with relevant case studies.
4. Able to understand the concepts of production planning and scheduling.
5. Understand the various inventory and maintenance management techniques.

REFERENCES:

1. Chary, SN, “Production and Operations Management”, 4th Edition, SIE, TMH, 2009.
2. Chase. RB, N. J. Aquilano, & F. R. Jacobs, “Operations Management – For Competitive Advantage”, 11th Edition, SIE, TMH, 2007.
3. James. B. Dilworth, “Operations Management – Design, Planning and Control for Manufacturing and Services”, McGraw Hill Inc. Management Series, 1992.
4. KanishkaBedi, “Production and Operations Management”, 2 nd Edition, Oxford Higher Education, 2007
5. Lee. J. Krajewski, L. P. Ritzman, & M. K. Malhothra, “Operations Management – Process and Value Chains”, 8th Edition, PHI/Pearson Education, 2007.
6. MelnykDenzler, “Operations Management – A Value Driven Approach”, Irwin McGraw Hill 1996.
7. Pannererselvam, R “Production and Operations Management”, 3rd Edition, PHI, 2012.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.3			0.3				0.3		0.3		0.3		
2	0.6	0.3			0.3						0.3				0.3
3	0.6	0.3			0.3						0.3		0.3	0.3	0.3
4	0.6	0.3									0.3				
5	0.6	0.3									0.3		0.3		0.3
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5102 EXPERIMENTAL DESIGN AND ANALYSIS L T P C
4 0 0 4

OBJECTIVES:

The main learning objective of this course is to prepare students for:

1. Applying the fundamental principles of Statistics, Sampling, ANOVA and Regression Analysis in the design of experiments.
2. Applying the concept of various factorial design principles and methods in the design of experiments.
3. Applying the concept of blocking, confounding and fractional factorial in the design of experiments.
4. Applying the concept of Regression Approach, Response Surface Methodology, Robust Design, and Orthogonal Array in the design of experiments.
5. Applying the concept of Experiments with Random Factors, Nested and Split-Plot Designs, Grey Relational Analysis, Multivariate Analysis of Variance in the design of experiments.

UNIT – I FUNDAMENTALS 12

Basic Principles - Guidelines for Designing Experiments - Simple Comparative Experiments - Basic Statistical Concepts - Sampling and Sampling Distributions - Inferences About the Differences in Means, Randomized Designs - Inferences About the Differences in Means, Paired Comparison Designs - Inferences About the Variances of Normal Distributions – Experiments with a Single Factor: ANOVA - Analysis of the Fixed Effects Model - Model Adequacy Checking - Practical Interpretation of Results - Determining Sample Size - Discovering Dispersion Effects - The Regression Approach to the Analysis of Variance - Nonparametric Methods in the Analysis of Variance - Problems

UNIT – II FACTORIAL DESIGN I 12

The Randomized Complete Block Design - The Latin Square Design - The Graeco-Latin Square Design - Balanced Incomplete Block Designs - Basic Definitions and Principles of Factorial Design - The Advantage of Factorials - The Two-Factor Factorial Design - The General Factorial Design - Fitting Response Curves and Surfaces - Blocking in a Factorial Design - The 2^2 Design - The 2^3 Design - The General 2^k Design - A Single Replicate of the 2^k Design - The Addition of Center Points to the 2^k Design - Problems

UNIT – III FACTORIAL DESIGN II 12

Blocking a Replicated 2^k Factorial Design - Confounding in the 2^k Factorial Design - Confounding the 2^k Factorial Design in Two Blocks - Confounding the 2^k Factorial Design in Four Blocks - Confounding the 2^k Factorial Design in 2^p Blocks - Partial Confounding - The One-Half Fraction of the 2^k design - The One-Quarter Fraction of the 2^k Design - The General 2^{k-p} Fractional Factorial Design - Resolution III Designs - Resolution IV and V Designs - The 3^k Factorial Design - Confounding in the 3^k Factorial Design - Fractional Replication of the 3^k Factorial Design - Factorials with Mixed Levels - Problems.

UNIT – IV REGRESSION APPROACH, RESPONSE SURFACE METHODOLOGY, ROBUST DESIGN, AND ORTHOGONAL ARRAY 12

Linear Regression Models - Estimation of the Parameters in Linear Regression Models - Hypothesis Testing in Multiple Regression - Confidence Intervals in Multiple Regression - Prediction of New Response Observations - Regression Model Diagnostics - Testing for Lack of Fit - Introduction to Response Surface Methodology - The Method of Steepest Ascent - Analysis of a Second-Order Response Surface - Experimental Designs for Fitting Response Surfaces - Mixture Experiments - Evolutionary Operation - Robust Design – Orthogonal array – Design – Column effect method – Problems.

UNIT – V EXPERIMENTS WITH RANDOM FACTORS, NESTED AND SPLIT-PLOT DESIGNS, GREY RELATIONAL ANALYSIS, MULTIVARIATE ANALYSIS OF VARIANCE 12

The Random Effects Model - The Two-Factor Factorial with Random Factors - The Two-Factor Mixed Model - Sample Size Determination with Random Effects - Rules for Expected Mean

Squares - Approximate F Tests - Some Additional Topics on Estimation of Variance Components Disruptive - The Two-Stage Nested Design - The General m-Stage Nested Design - Designs with Both Nested and Factorial Factors - The Split-Plot Design - Other Variations of the Split-Plot Design - Nonnormal Responses and Transformations - Unbalanced Data in a Factorial Design - The Analysis of Covariance - Repeated Measures - Grey relational analysis – Multivariate analysis of variance (MANOVA) – One way MANOVA – Factorial MANOVA with 2 factors – Problems.

TOTAL : 60 PERIODS

OUTCOMES:

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

1. Apply the fundamental principles of Statistics, Sampling, ANOVA and Regression Analysis in the design of experiments.
2. Apply the concept of various factorial design principles and methods in the design of experiments.
3. Apply the concept of blocking, confounding and fractional factorial in the design of experiments.
4. Apply the concept of Regression Approach, Response Surface Methodology, Robust Design, and Orthogonal Array in the design of experiments.
5. Apply the concept of Experiments with Random Factors, Nested and Split-Plot Designs, Grey Relational Analysis, Multivariate Analysis of Variance in the design of experiments

REFERENCES:

1. Montgomery, D.C., “Design and Analysis of Experiments”, John Wiley & Sons, 2010.
2. Dean, A. M., & Voss, D. T., “Design and Analysis of Experiments”, Springer, 1999.
3. http://www.itl.nist.gov/div898/handbook/pri/section3/pri3.htm
4. Krishnaiah, K. & Shahabudeen, P., “Applied Design of Experiments & Taguchi Methods”, PHI, 2012.
5. Mason, R. L., Gunst, R. F., & Hess, J. L., “Design and Analysis of Experiments: with Applications to Engineering & Science”, Wiley Series on Probability & Statistics, John Wiley & Sons, 2003.
6. Panneerselvam. R, “Design & Analysis of Experiments”, PHI, 2012.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.3										0.6	0.3	
2	0.6	0.6	0.3										0.6	0.3	
3	0.3	0.6	0.6											0.3	
4	0.3	0.6	0.6										0.6		
5	0.6	0.6	0.3										0.6	0.3	
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

RM5151 RESEARCH METHODOLOGY AND IPR L T P C

2 0 0 2

COURSE OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc.
Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

COURCE OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

MS5111 MANUFACTURING SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

To get hands on experience of the various aspects involved in manufacturing systems in the following areas

1. Incoming product inspection
2. Manufacturing a product to the given specification
3. Quality checks on the manufactured product
4. Measurement system analysis
5. Process capability study, time study and machine maintenance

LIST OF EXPERIMENTS

1. Performing quality checks on given raw materials (hardness, tensile strength, etc.)
2. Interpretation of dimensional and geometric tolerances in the given component drawing and prepare process plans to manufacture the component.
3. Manufacturing the component according to the prepared process plan by selecting appropriate process parameters
4. Measurement of typical dimensional parameters in a machined component.
5. Measurement of typical GD&T in a Machined component
6. Measurement of surface finish in a given component
7. Perform Measurement system analysis for a typical measurement process.
8. Process capability studies for the a given machining process
9. Time study of typical machining processes (standard time calculation)
10. Condition based monitoring of machine tools

TOTAL: 60 PERIODS

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

- Interpret engineering drawings and prepare process plans to manufacture simple components.
- Measure the important linear dimensions, form parameters and surface finish in a given component using appropriate measuring instruments.
- Carryout measurement system analysis
- Perform time study and measure the process capability of a given process.
- Use condition based monitoring to judge the performance of a machine tool

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		0.6	0.6	0.9											0.6
2		0.6	0.6	0.9									0.3		0.6
3		0.6	0.6	0.9									0.3		0.6
4		0.6	0.6	0.9									0.3		0.6
5		0.6	0.6	0.9	0.6								0.3		0.6
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5112 **TECHNICAL SEMINAR** **L T P C**
0 0 4 2

COURSE OBJECTIVES:
To get hands on experience of the various aspects involved in manufacturing systems in the following areas

1) To train the students to be fluent with their communication.
2) To make them conversant with presentation aide and tools.
3) To imbibe confidence and fine tune their gesture.
4) To structure their presentation encompassing all the salient points relevant to the topic of presentation.
5) To acumen the thrust points that will make the audience to understand better.

TECHNICAL SEMINAR

- To make 3 presentations in the specified topics from the domain of their post graduate program.

TOTAL:60 PERIODS

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

1) Able to communicate assiduously without stammering.
2) To present the topic in a unstill and presumptive manner.
3) Convey their thoughts audaciously without hesitation.
4) Competent with the latest presenting aides and select the appropriate tool for effective communication.
5) Exhibit apt gesture and zeal to learn.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3	0.6								0.9			0.3	0.3	
2		0.3			0.6	0.3								0.3	0.6
3						0.3		0.6	0.6					0.6	
4	0.3				0.9										0.3
5								0.6	0.3			0.9		0.3	0.3
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5201 **LEAN MANUFACTURING SYSTEMS AND SIX SIGMA** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To explain the lean principles and the need to follow these principles in industries.
2. To give an overview of the various tools and techniques involved in lean manufacturing used in industries.
3. To provide the necessary skills needed to analyse a given situation to draw the current state map and to identify potential improvement areas and then draw the future state map.
4. To give an understanding of the various tools used in a six sigma project for quality improvement.
5. To provide an overview of the DMAIC methodology in a six sigma project.

UNIT – I EVOLUTION AND OVERVIEW OF 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.

UNIT – II LEAN MANUFACTURING – TOOLS AND TECHNIQUES 9

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 – III 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 – IV SIX SIGMA – TOOLS AND TECHNIQUES 9

Integrated quality control - Off-line vs On-line inspection, Cost of Quality – Conformance and Non-Conformance cost, 7 Basic Quality Control Tools, Seven Management tools, FMEA.

UNIT – V SIX SIGMA METHODOLOGY 9

Statistical theory, Need for Six Sigma, Six Sigma Team, DMAIC Methodology – Various quality tools used in the Define, Measure, Analyse, Improve and Control phases; Lean Six Sigma, Design for lean six sigma, Case studies.

TOTAL:45 PERIODS

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

- Explain the importance and evolution of lean principles.
- Apply the various tools, techniques and methodology of lean manufacturing to improve the efficiency of an organization.
- Apply the technique of value stream mapping to improve an organization by drawing current and future state maps.
- Explain the various tools and techniques needed for a six sigma project.
- Apply six sigma methodology to improve quality in a manufacturing organisation.

REFERENCES:

1. Issa Bass and Barbara Lawton, “Lean Six Sigma using Sigma XL and Minitab”, Tata McGraw Hill 2010.
2. Pascal Dennis, “Lean production Simplified: A plain language guide to the world’s most powerful Production system”, Productivity Press 2007
3. Askin R G and Goldberg J B, “Design and Analysis of Lean Production Systems”, John Wiley and Sons Inc., 2003.
4. Donna C. S. Summers, “Six sigma: Basic tools and techniques”, Pearson / Prentice Hall 2007.
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CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1						0.6	0.6								
2		0.6	0.9	0.6				0.6			0.6	0.9	0.9	0.9	0.6
3		0.6	0.9	0.6	0.6			0.3	0.6	0.6	0.9		0.6	0.6	0.6
4		0.6	0.6	0.9	0.9			0.6				0.9	0.6	0.3	0.6
5		0.6	0.9	0.6	0.9			0.6	0.6	0.6	0.9		0.9	0.9	0.9
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5202 MAINTENANCE AND RELIABILITY ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To give an overview about maintenance concepts, its types and evaluation.
2. To acumen the different maintenance strategies, methodology and implementation.
3. To inculcate the ability to perceive the organization structure, maintenance and materials management
4. To provide an insight about the reliability concepts
5. To instill the knowledge of reliability systems and appraise the various reliability testing and analysis.

UNIT – I MAINTENANCE CONCEPTS 9

Maintenance: Definition, Systems approach, Objectives, Requirements, Levels, Maintenance policies and procedures, Maintenance principles and benefits. Types of maintenance systems, R&D in maintenance, Role of overhauling in maintenance, Expert systems in maintenance and Maintenance evaluation and its types.

UNIT – II MAINTENANCE STRATEGIES 9

Preventive maintenance: Needs, Elements, Steps, Measures and benefits. Corrective maintenance: Types, Steps, measures and benefits. Reliability Centered Maintenance (RCM): Goals and principles, Process, Components Measures and Advantages. Condition based Maintenance: Condition Monitoring Techniques, Systems approach, Applications and benefits. Total Productive Maintenance: Methodology and implementation.

UNIT – III MAINTENANCE MANAGEMENT 9

Organisation structure for management: Objectives, Functions and Requirements, Types of organization and cost minimization. Maintenance planning: Manpower allocation, Planning Techniques & Procedure and maintenance scheduling. Spare parts management: Conventional system, EOQ, Two-bin system and Materials management manual. Economic aspects of Maintenance: Life cycle costing, Maintenance cost, Budget and Audit.

UNIT – IV RELIABILITY CONCEPTS 9

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

UNIT – V RELIABILITY PREDICTION & MANAGEMENT 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Identify the maintenance requirements, policies and procedures and apply them in a given situation.
2. Attain the cognizance to appraise the various maintenance strategies
3. Plan the work force, schedule and manage the spares.
4. Explain the reliability concepts and identify the data requirements
5. Develop model, assess the effect environment and perform reliability analysis.

REFERENCES:

1. Mishra R C, “Reliability and Maintenance Engineering”, New Age International, 2006.
2. Charles E. Ebling., “An Introduction to Reliability and Maintability Engineering”,TataMcGraw Hill, 2004.
3. Mohamed Ben-Daya, Salih O. Duffuaa, Abdul Raouf, Jezdimir Knezevic, Daoud Ait-Kadi, “Handbook of Maintenance Management and Engineering”, Springer Science & Business Media, 2009
4. Srinath L S, “Reliability Engineering”, Affiliated East West Press, 1991.
5. Connor, P. D. T. O., “Practical Reliability Engineering”, John Wiley, 1997.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.3										0.6	0.3	
2	06	0.3	0.6										0.6	0.9	
3	0.3	0.6	0.6											0.9	
4	0.6	0.6	0.3										0.6		
5		0.6	0.6	0.3									0.6	0.3	
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5203 LOGISTICS AND SUPPLY CHAIN MANAGEMENT FOR MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

The main learning objective of this course is to prepare students for:

1. Applying the fundamental concepts and principles of logistics and supply chain in manufacturing systems.
2. Applying the concept and principles of information, demand forecasting, inventory in manufacturing systems.
3. Applying the concept and principles in solving problems in transportation, warehousing & distribution in manufacturing systems.
4. Applying the concept and principles of protective packaging,order processing, materials handling, purchasing & sourcing in manufacturing systems.
5. Applying the concept and principles of logistics and supply chain administration in manufacturing systems.

UNIT I INTRODUCTION TO L&SCM 9

Logistics: Nature & Concepts – Evolution – Importance – Advantage – Objectives – Components – Functions – Supply Chain Management: Nature & Concepts – Value chain – Functions & Contribution – Effectiveness – Framework – Outsourcing – 3 PLs – 4 PLs – Bull whip effect – SC Relationships – Conflict resolution – Harmonious relationship – Customer Service: Nature & Concepts – Importance – Components – Cost – Gap analysis – Strategic management – Case Study.

UNIT II INFORMATION,DEMAND FORECASTING,INVENTORY MANAGEMENT 9

Information: Position of Information in L&SCM – Logistical Informational Systems – Operational Logistical Informational Systems – Integrated Information Technology Solution for L&SCM – Emerging L&SCM – Demand Forecasting: Nature & Components – Impact of forecast on L&SCM – Effective forecasting – Techniques – Selection – Principles – Inventory: Concepts – Types – Functions – Elements – Inventory management – ABC analysis – ABC-VED matrix – Materials Requirement Planning – Distribution Requirement Planning – Just in Time System – Prerequisites – Case study.

UNIT III TRANSPORTATION, WAREHOUSING & DISTRIBUTION 9

Transportation: Introduction – Position of transportation in L&SCM – Elements of transportation cost – Modes – Multimodal transport – Containerization – Selection of transportation modes – Transportation decision – Transportation network: routing & scheduling – Warehousing & Distribution Centers: Introduction – Concepts – Types – Functions – Strategy – Design – Operational Mechanism – Case study.

UNIT IV PROTECTIVE PACKAGING,ORDER PROCESSING, MATERIALS HANDLING, PURCHASING & SOURCING MANAGEMENT 9

Protective Packaging: Introduction – Concepts – Functions – Forms – Problems – Policy – Order Processing: Introduction – Concepts – Functions – Elements – Significance – Materials Handling: Introduction – Concept – Objective- Principles – Equipments – Considerations – Purchasing & Sourcing Management: Introduction – Nature – Scope – Importance – Trends – Contemporary sourcing & supplier management – Case study.

UNIT V L&SCM ADMINISTRATION 9

Organization: Introduction – Evolutionary trends of L&SCM – Principles – Factors. Performance Measurement: Introduction – Dimensions – Basic tools – Impediments to improve performance – Case Study.

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Apply the fundamental concepts and principles of logistics and supply chain in manufacturing systems.
2. Apply the concept and principles of information, demand forecasting, inventory in manufacturing systems.
3. Apply the concept and principles in solving problems in transportation, warehousing & distribution in manufacturing systems.
4. Apply the concept and principles of protective packaging,order processing, materials handling, purchasing & sourcing in manufacturing systems.
5. Apply the concept and principles of logistics and supply chain administration in manufacturing systems.

REFERENCES:

1. Agrawal, D.K., "A Text book of Logistics & Supply Chain Management", MacMillan Publishers India Ltd., 2009.
2. Sunil Chopra & Peter Meindl, "Supply Chain Management, Strategy, Planning and Operation", 2nd Edition, PHI, 2004.
3. David J. Bloomberg, Stephan Lemay & Joe B. Hanna, "Logistics", PHI, 2002.
4. Jeremy F.Shapiro, "Modeling the Supply Chain", Thomson Duxbury, 2002.
5. James B. Ayers, "Handbook of Supply Chain Management", St. Lucle Press, 2000.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3	0.3	0.3								0.3		0.3		
2	0.3	0.3	0.3										0.3	0.3	
3	0.3	0.3	0.3								0.3		0.3	0.3	
4	0.3	0.3	0.3								0.3		0.3	0.3	
5	0.3	0.3	0.3										0.3		
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

PD5071	AUTOMATED PRODUCT MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is to prepare students for:

1. Applying the principles of automation and control techniques toward new product design and development.
2. Applying the principles of numerical control and industrial robotics toward new product design and development.
3. Applying the principles of manufacturing systems; manual and automated assembly systems; and material handling systems toward new product design and development.
4. Applying the principles of cellular manufacturing systems and flexible manufacturing systems toward new product design and development..
5. Applying the principles of manufacturing support systems toward new product design and development.

UNIT – I AUTOMATION & CONTROL TECHNOLOGIES 8

Introduction to CAD, CAM, CAD/CAM and CIM – Introduction to Manufacturing Systems – Automation in manufacturing Systems – Types of Automation – Reasons for Automation – Automation Strategies – Manufacturing Models and Metrics – Basic elements of an Automated System – Levels of Automation – Continuous versus Discrete Control – Computer Process Control

UNIT – II NUMERICAL CONTROL & INDUSTRIAL ROBOTICS 10

Elements of NC Manufacturing Systems – Computer Numerical Control – Axes and Co-ordinate Systems – Features, Advantages, Disadvantages and Limitations – Manual Part Programming – Robot Anatomy – Robot Control Systems – End Effectors – Sensors – Applications – Robot programming.

UNIT – III MANUFACTURING SYSTEMS – MANUAL & AUTOMATED ASSEMBLY SYSTEMS – MATERIAL HANDLING SYSTEMS 9

Components of Manufacturing Systems – Classification of Manufacturing Systems – Single Station Manufacturing cell and analysis – Manual Assembly line – Line Balancing – Automated Assembly System – Material Handling Equipment – Storage Systems.

UNIT – IV CELLULAR MANUFACTURING & FLEXIBLEMANUFACTURING SYSTEMS 8

Part Families – Classification and Coding – Production Flow analysis – Cellular Manufacturing Applications of Group Technology – Flexible Manufacturing Systems – Components – Applications and benefits – FMS planning – Quantitative analysis in FMS.

UNIT – V MANUFACTURING SUPPORT SYSTEMS 10

Process Planning – Computer Aided Process Planning – Production planning and Control Systems – Aggregate Planning and Master Production schedule – Material Requirement Planning – Capacity Planning – Shop Floor Control – Overview of Automatic Identification and Data capture – Bar Code Technology and Radio Frequency Identification.

TOTAL:45 PERIODS

OUTCOMES:

On successful completion of this course the students will be able:

1. Apply the principles of automation and control techniques toward new product design and development.
2. Apply the principles of numerical control and industrial robotics toward new product design and development.
3. Apply the principles of manufacturing systems; manual and automated assembly systems; and material handling systems toward new product design and development.
4. Apply the principles of cellular manufacturing systems and flexible manufacturing systems toward new product design and development..
5. Apply the principles of manufacturing support systems toward new product design and development.

REFERENCES:

1. Mikell P. Groover, "Automation, Production Systems, and Computer –Integrated Manufacturing", 3rd Ed., PHI Learning Pvt. Ltd., New Delhi, 2009.
2. Chris McMahon and Jimmie Browne, "CAD/CAM – Principles, Practice and Manufacturing Management", 2nd Ed., Pearson Education, Asia, 2001.
3. FarazdakHaideri, "CAD / CAM and Automation", 6th Edition, NiraliPrakashan, 2009.
4. Ibrahim Zeid and R. Sivasubramanian, "CAD / CAM – Theory and Practice", 2nd Ed., Tata McGraw Hill, 2010.
5. P. N. Rao, "CAD /CAM – Principles and Applications", 2nd Ed., Tata McGraw Hill, 20044. 4.Mikell P. Groover and Emory W. Zimmers, Jr., "CAD / CAM – Computer – Aided Design and Manufacturing", Pearson Education, 2003.
6. P. Radhakrishnan, S. Subramanyan and V. Raju, "CAD / CAM / CIM", 2nd Edition, New Age International (Pvt.) Ltd. Publishers, 2003.

0.3- Low 0.6- Medium 0.9- High

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.9	0.9								0.3	0.6	0.3	
2	0.9	0.9	0.9	0.9								0.3	0.6	0.3	
3	0.9	0.9	0.9	0.9								0.3	0.6	0.3	
4	0.9	0.9	0.9	0.9								0.3	0.6	0.3	
5	0.9	0.9	0.9	0.9								0.3	0.6	0.3	

MS5211 MANUFACTURING ANALYTICS LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

1. To get hands on experience in using software tools to solve problems in operations research.
2. To use statistical software tools for graphical representation of the given experimental data.
3. To use statistical software tools to solve problems lean manufacturing and six sigma.
4. To use predictive analytics to improve quality of common machining processes.
5. Explain the use of I4.0 data management software in manufacturing industries.

1. Solving Linear programming problems
2. Solving Transportation Problems
3. Network flow analysis using - PERT, CPM
4. Inventory problems
5. Graphical representation of data using statistical software
6. Drawing current state and future state maps using software tools
7. Solving problems in experimental design
    a. ANOVA
    b. Taguchi's experimental design
    c. Response surface methodology
    d. Grey Relational Analysis
    e. TOPSIS
8. Predictive analytics for improvement of manufacturing process quality in common machining processes – turning, milling, drilling
9. Use I4.0 data management software to record and manage quality conformance data

TOTAL:60 PERIODS

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

- Use statistical software tools to solve problems in Operations Research.
- Analyse the experimental data using suitable graphical and statistical tools.
- Solve problems in experimental design using statistical software tools.
- Analyse a given multi-objective optimization problem using statistical software tools.
- Apply concepts of predictive analytics to improve manufacturing processes.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.9	0.9	0.9						0.9		0.9	0.9	0.9
2	0.9	0.9	0.9	0.9	0.9						0.9		0.9		0.9
3	0.9	0.9	0.9	0.9	0.9						0.9		0.9	0.9	0.9
4	0.9	0.9	0.9	0.9	0.9						0.9		0.9	0.9	0.9
5	0.9	0.9	0.9	0.9	0.9						0.9		0.9	0.9	0.9
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5212 AUTOMATION AND ROBOTICS LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

1. To make the student familiarize with the monitoring and measurement of physical quantities by Data Acquisition System (DAQ).
2. To offer hands-on training inthe design and development of automated systems by sensors, fluid power and electrical actuators, PLC and Microcontroller.
3. To impart knowledge on modeling, analysis and actuation of robots.
4. To inculcate practical skills on Internet-of-Things (IoT).
5. To make students comprehend the application of Machine Vision and Robot Vision systems.

LIST OF EXPERIMENTS:

1. Data Acquisition System – Measurement of Physical Quantities.
2. Fluid Power Automation by using Hydraulic, Pneumatic, Electro-Pneumatic and Electro-hydraulic circuits.
3. PLC Automation with Timers and Counters – Bottle filling – Sorting of Objects on Conveyor Belt.
4.. Application of Stepper and Servomotors in CNC machines.
5. Modeling and Analysis of different configurations of Robot.
6. Automatic control of mobile robot maneuverability in multi-terrain.
7. Actuation and control of Quadcopter.
8. Automation of material handling application by Six-Axis Articulated Robot.
9. Internet of Things (IoT) – Robot Control – Smart Work-Cell.
10. Application of Machine Vision System.
11. Application of Robot Vision System.

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Execute the measurement of physical quantitiesby DAQ.
2. Design and develop an apt automated system with the aid of appropriate sensors, fluid power and electrical actuators, PLC and microcontroller.
3. Implement the simulation, automation and control of quadcopter, mobile and articulated robots.
4. Develop automated and control systems by using IoT.
5. Demonstrate the machine vision and robot vision systems.

	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9			0.9	0.9								0.9		0.9
2	0.9	0.9	0.9	0.9	0.9				0.9			0..9	0.9	0.6	0.9
3	0.9				0.9				0.6						0.9
4	0.9		0.9		0.9				0.9			0.9	0.6	0.3	0.9
5	0.9	0.9	0.9	0.9	0.9	0.6			0.9				0.9		0.9
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5001 PRODUCT DESIGN FOR MANUFACTURING

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To learn the nuances of Process Selection.
2. To study about the various Castings' restrictions and apply the same at the design stage.
3. To understand the Machining Process restrictiveness to take care at the design phase.
4. To know the intricacies of all type of Weldings and Forming Processes so as to match with Design.
5. To design a Product meeting the Assembly need.

UNIT – I INTRODUCTION AND CASTING **9**

Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts.

UNIT – II FORMING **9**

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts.

UNIT – III MACHINING **9**

Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts.

UNIT – IV WELDING **9**

Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment.

UNIT – V ASSEMBLY **9**

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Apply economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
- Apply design consideration principles of forming in the design of extruded, stamped, and forged products.
- Apply design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.

- Apply design consideration principles of welding in the design of welded products.
- Apply design consideration principles of assembly in the design of assembled products.

REFERENCES:

1. James G. Bralla, "Handbook of Product Design for Manufacture", McGraw Hill Book Co., 1986.
2. Henry Peck, **"Designing for Manufacture"**, Sir Isaac Pitman & Sons Ltd., 1973.
3. Matousek, **"Engineering Design"**, Blackie & Sons, 1956.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.9											0.6	0.3
2	0.9	0.9	0.9											0.6	0.3
3	0.9	0.9	0.9											0.6	0.3
4	0.9	0.9	0.9											0.6	0.3
5	0.9	0.9	0.9											0.6	0.3
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5002 MECHATRONICS IN MANUFACTURING L T P C

3 0 0 3

OBJECTIVES:

1. To impart knowledge on machine vision technology.
2. To develop competency in programming ARM processor and Raspberry Pi.
3. To provide comprehensive knowledge on robotics.
4. To give exposure on Internet of Things (IoT).
5. To make students familiarize with the industrial applications of Mechatronics.

UNIT – I MACHINE VISION 9

Introduction–Sensors for Image Acquisition – Preprocessing and Image Enhancement – Image Restoration – Segmentation –Object Recognition – Industrial Applications.

UNIT – II ADVANCED MICROPROCESSOR AND MICROCONTROLLER 9

Introduction –ARM Processor – Architecture – Modes of Operations – Register set –Instruction Set – Thumb Instruction Set – Pipeline– Programming, Introduction to Raspberry Pi – Python programming.

UNIT – III ROBOT KINEMATICS AND PROGRAMMING 9

Introduction – Types – Direct and Inverse Kinematics – Homogeneous Coordinates and Arm Equations of Robot – Robot Arm Dynamics, Robot Programming – Different methods.

UNIT – IV INTERNET OF THINGS (IoT) 9

Introduction – Basics of Networking – Communication Protocols – Sensor Networks – Implementation of IoT with Raspberry Pi – Cloud Computing – Fog Computing – Smart Manufacturing by IoT.

UNIT – V MECHATRONICS SYSTEMS AND APPLICATIONS 9

Intelligent Manufacturing – Condition Monitoring and Control, Robot for Automatic Assembly Process, Robot Vision – Material Handling and Inspection, Automotive Mechatronics: Electronic Ignition System – ABS – EBD – Automatic Cruise Control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Apply image acquisition, image processing, image segmentation, image analysis and pattern recognition techniques to implement machine vision.
2. Explain the architecture of ARM and Raspberry Pi, and also develop programs.
3. Discuss about the robot kinematics, and also execute programs.
4. Design and develop IoT based control system.
5. Suggest and formulate an apt Mechatronics system for a real-time application.

REFERENCES:

1. Bruce G. Batchelor, “Machine Vision Handbook”, Springer, 2012
2. David H., Gonzalo S., Patrick G.,Rob B. and Jerome H.,“IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Pearson Education, 2018.
3. Fu K.S., Gonzalez R.C. and Lee C.S.G., “Robotics: Control, Sensing, Vision and Intelligence”, Tata McGraw-Hill, 2008.
4. KonradReif, “Automotive Mechatronics”, Springer, 2015.
5. Martin C. Brown, “Python: The Complete Reference”, Tata McGraw-Hill, 2018.
6. Michael Miller, “The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World”, Pearson Education, 2015.
7. Sonka M., Hlavac V. and Boyle R., “Image Processing, Analysis and Machine Vision”, Cengage Learning, 2013.
8. Steve Furber, “ARM System-on-Chip Architecture”, Pearson Education, 2015.
9. Wang L. and Gao R.,“Condition Monitoring and Control for Intelligent Manufacturing”, Springer, 2006.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9		0.6		0.6										0.9
2	0.9				0.9										0..9
3	0.9	0.9			0.6				0.9						0.6
4	0.9			0.9	0.9				0.9			0.6		0.6	
5	0.9	0.9	0.9	0.6					0.9			0.9	0.6		0.9

S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

MS5003 CELLULAR MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

1. To provide an overview about different manufacturing systems.
2. To provide knowledge on the planning and design aspects of cellular manufacturing systems.
3. To provide knowledge on the aspects to be considered during the implementation of cellular manufacturing systems.
4. To provide knowledge on the various performance measurement measures and control of cellular manufacturing systems.
5. To provide knowledge on the economical aspects of cellular manufacturing systems.

UNIT I INTRODUCTION 9

Group Technology – Limitations of traditional manufacturing systems – Group machining concept– Principle of cellular manufacturing – Terminology associated with cellular manufacturing – Characteristics and perspectives of cellular manufacturing – Areas of applications of cellular manufacturing – Benefits and limitations of cellular manufacturing

UNIT II CMS PLANNING & DESIGN 9

Problems in GT/CMS – Design of CMS – Production flow analysis – Optimization models – Traditional approaches and heuristics – Simulated annealing – Genetic algorithms.

UNIT III IMPLEMENTATION OF GT/CMS 9

Inter and intra cell layout and capacity planning – Managerial structure and groups – Batch sequencing and sizing – Life cycle issues in GT/CMS – Linkages to JIT systems.

UNIT IV PERFORMANCE MEASUREMENT & CONTROL 9

Evaluation of cellular manufacturing systems – Production control activities and scheduling incellular manufacturing.

UNIT V ECONOMIC OF GT/CMS 9

Characteristics of cell – Economic Justification of cellular manufacturing – Use of computer models in GT/CMS – Human aspects of GT/CMS – Case studies.

OUTCOMES:

Upon the completion of the course the student will be able to

- Understand the perspectives of Cellular Manufacturing.
- Plan and Design a Cellular Manufacturing System.
- Know the factors to be considered during the implementation of Cellular Manufacturing Systems
- Measure the Performance of Cellular Manufacturing Systems and Control theCellular Manufacturing Systems
- The Economical aspects of Cellular Manufacturing Systems

REFERENCES:

1. Askin, R. G., &Vakharia, A.J., “GT planning and operation”, as in Cleland, D. I., &Bidanda, B.,(Editors), "The Automated Factory – Hand Book: Technology and Management", TAB Professional & Reference Books, NY, 1990.
2. NagendraParashar, B. S., “Cellular Manufacturing Systems: An Integrated Approach” PHILearning, 2010.
3. Shahrukh A. Irani, “Handbook of Cellular Manufacturing Systems”, John Wiley & Sons, 1999.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.8	0.3	0.3	0.3	0.3	0.9	0.3	0.9	0.9	0.9	0.6	0.9	0.3	0.3	0.6
2	0.9	0.9	0.9	0.9	0.9	0.3	0.9	0.3	0.9	0.3	0.9	0.9	0.9	0.9	0.9
3	0.9	0.6	0.9	0.6	0.6	0.9	0.3	0.9	0.9	0.3	0.9	0.9	0.9	0.9	0.9
4	0.9	0.9	0.9	0.9	0.9	0.3	0.6	0.3	0.3	0.3	0.9	0.9	0.6	0.9	0.9
5	0.9	0.6	0.9	o.9	0.9	0.9	0.0	0.9	0.9	0.3	0.11	0.9	0.9	0.6	0.9
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

CI5151 SOLID FREEFORM MANUFACTURING L T P C

3 0 0 3

OBJECTIVES:

- To acquaint the students with evolution of Solid Freeform Manufacturing (SFM) / Additive Manufacturing (AM), proliferation into various fields and its effects on supply chain.
- To gain knowledge on Design for Additive Manufacturing (DFAM) and its importance in quality improvement of fabricated parts.
- To acquaint with polymerization and sheet lamination processes and their applications.
- To acquaint with material extrusion and powder bed fusion processes.
- To gain knowledge on jetting and direct energy deposition processes and their applications.

UNIT I INTRODUCTION 9

Need - Development of SFM systems – Hierarchical structure of SFM - SFM process chain – Classification – Applications. Case studies: Bio printing- Food Printing- Electronics printing – Rapid Tooling - Building printing. AM Supply chain. Economics aspect: Strategic aspect- Operative aspect.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization - Lightweight Structures - DFAM for Part Quality Improvement - CAD Modeling - Model Reconstruction - Data Processing for AM - Data Formats - Data Interfacing - Part Orientation - Support Structure Design and Support Structure Generation - Model Slicing - Tool Path Generation. Design Requirements of Additive Manufacturing: For Part Production, For Mass Production, For Series Production. Case Studies.

UNIT III VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES 9

Stereolithography Apparatus (SLA): Principles – Photo Polymerization of SL Resins - Pre Build Process – Part-Building and Post-Build Processes - Part Quality and Process Planning, Recoating Issues - Materials - Advantages - Limitations and Applications. Digital Light Processing (DLP) - Materials - Process - Advantages and Applications.

Laminated Object Manufacturing (LOM): Working Principles - Process - Materials, Advantages, Limitations and Applications. Ultrasonic Additive Manufacturing (UAM) - Process - Parameters - Applications. Case Studies.

UNIT IV MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES 9

Fused deposition Modeling (FDM): Working Principles - Process - Materials and Applications. Design Rules for FDM.

Selective Laser Sintering (SLS): Principles - Process - Indirect and Direct SLS - Powder Structure – Materials - Surface Deviation and Accuracy - Applications. Multijet Fusion.

Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Principles – Processes – Materials – Advantages - Limitations and Applications. Case Studies.

UNIT V JETTING AND DIRECT ENERGY DEPOSITION PROCESSES 9

Binder Jetting: Three dimensional Printing (3DP): Principles – Process - Physics of 3DP - Types of printing: Continuous mode – Drop on Demand mode - Process – Materials - Advantages - Limitations - Applications.

Material Jetting: Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations.

Laser Engineered Net Shaping (LENS): Processes- Materials- Advantages - Limitations and Applications. Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

CO1: Recognize the importance in the evolution of SFM/AM, proliferation into the various fields and its effects on supply chain.

CO2: Evaluate the design for AM and its importance in the quality of fabricated parts.

CO3: Acquire knowledge on principles and applications of polymerization and sheet lamination processes with case studies.

CO4: Acquire knowledge on principles of material extrusion and powder bed fusion processes and design guidelines.

CO5: Perceive jetting and direct energy deposition processes and their applications.

	PO						PSO			
	1	2	3	4	5	6	1	2	3	4
CO1	0.6	0.9	0.3	0.9	0.9	0.6	0.9	0.9	0.9	0.9
CO2	0.9	0.6	0.9	0.9	0.9	0.6	0.9	0.9	0.9	0.6
CO3	0.9	0.9	0.6	0.9	0.6	0.3	0.6	0.9	0.9	0.9
CO4	0.9	0.9	0.6	0.9	0.6	0.3	0.6	0.9	0.9	0.9
CO5	0.9	0.9	0.6	0.9	0.6	0.3	0.6	0.9	0.9	0.9

REFERENCES:

1. Andreas Gebhardt and Jan-Steffen Hotter, “Additive Manufacturing:3D Printing for Prototyping and Manufacturing”, Hanser publications Munchen, Germany, 2015. ISBN: 978-1-56990-582-1.
2. Ben Redwood, Brian Garret, Filemon Schöffer, and Tony Fadel, “The 3D Printing Handbook: Technologies, Design and Applications”, 3D Hubs B.V., Netherland, 2017. ISBN-13: 978-9082748505.
3. Ian Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer - New York, USA, 2nd Edition, 2015. ISBN-13: 978-1493921126.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 1st Edition, 2007 FL, USA. ISBN- 9780849334092.
5. Milan Brandt., “Laser Additive Manufacturing 1st Edition Materials, Design, Technologies, and Applications”, Woodhead Publishing, UK, 2016. ISBN- 9780081004333.

MS5004 COMPETITIVE AND SUSTAINABLE MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES

1. Students will be able to study the basics of Flexible Manufacturing System.
2. Students will be able to study the basics and various elements of Agile Manufacturing System.
3. Students will be able to study the basics and the tools of Lean Manufacturing System.
4. Students will be able to study the basics and evolution of Reconfigurable Manufacturing System.
5. Students will be able to study the basics and applications of Sustainable Manufacturing System.

UNIT-I FLEXIBLE MANUFACTURING SYSTEMS 9

System components – planning and control hierarchy – system design, system setup, scheduling and control – flow shop scheduling, job shop scheduling, Flexible inspection systems

UNIT-II AGILE MANUFACTURING SYSTEM 9

Fundamentals structure of agile manufacturing paradigm, agile manufacturing through – management driver – technology driver – strategy driver – competitive driver, Implementation of agile manufacturing in moderate and smart organizations

UNIT-III LEAN MANUFACTURING SYSTEM 9

Introduction and origin of lean production system - Lean manufacturing through waste elimination – visual management – implementation of lean manufacturing paradigm in traditional and moderate organisations, case study.

UNIT-IV RECONFIGURABLE MANUFACTURING SYSTEM (RMS) 9

Evolution of manufacturing system through Industrial revolutions and Evolution of RMS, RMS design characteristics and feasibility, RMS performance evaluation methods

UNIT-V SUSTAINABLE MANUFACTURING SYSTEM AND APPLICATIONS 9

Introduction to sustainable manufacturing - Enabling low carbon development systems – sustainable solutions- machine tools, product development, Implementation perspectives.

TOTAL = 45 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

1. Able to acquire knowledge on flexible manufacturing system.
2. Ability to implement agile manufacturing concepts.
3. Understand the concepts of Lean manufacturing system with relevant case studies.
4. Able to understand the concepts of reconfigurable manufacturing system.
5. Understand the sustainable manufacturing concepts and applications.

REFERENCES:

1. Dennis, P., “Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System”, (Second edition), Productivity Press, New York, 2007
2. Devadasan. SR, V. Sivakumar, R. Murugesh, P. R. Shalij, Lean And Agile Manufacturing: Theoretical, Practical and Research Futurities, Prentice-Hall of India 2012.
3. Mengchu Zhou, “Modeling, Simulation and Control of Flexible Manufacturing Systems: A Petri Net Approach”, World Scientific Publishing Company Pvt. Ltd., 2000.
4. Rainer Stark, GüntherSeliger, Jérémy Bonvoisin“Sustainable Manufacturing: Challenges, Solutions and Implementation Perspectives”, Book Chapter, Springer, 2017.
5. Reza Abdi. M, Ashraf W. Labib, FaridehDelavariEdalat, Alireza Abdi, “Integrated Reconfigurable Manufacturing Systems and Smart Value Chain”, Springer 2018..

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6				0.3							0.3	0.3		0.3
2	0.6				0.3							0.3			0.3
3	0.6				0.3							0.3	0.3	0.3	0.3
4	0.6				0.3							0.3		0.3	0.3
5	0.6				0.3							0.3	0.3		0.3

S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

MS5005 PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To explain the role and fundamentals of Process Planning in manufacturing industries.
2. To explain the steps involved in process planning and provide the necessary skills to prepare process plans for simple components.
3. To explain the various costs involved in a manufacturing organisation.
4. To estimate the production cost for various production operations.
5. To estimate the machining time and cost for typical machining processes.

UNIT – I INTRODUCTION TO PROCESS PLANNING 9

Aims and Objectives, Place of process planning in Manufacturing cycle, Drawing interpretation, Dimensional tolerance vs Production processes.

UNIT – II PROCESS PLANNING STEPS 9

Design of a process plan – Selection of production processes, tools and process parameters- Positioning and work holding devices, Selection of inspection devices and tools, Documenting the process plan, Simple Case studies.

Computer-Aided Process Planning (CAPP) – Benefits, Architecture and approaches.

UNIT – III INTRODUCTION TO COST ESTIMATION 9

Importance, Types, Purpose, Components, Procedure, Classification of costs, Cost elements, Overhead expenses, Break-even analysis.

UNIT – IV PRODUCTION COST ESTIMATION 9

Estimation of production cost for - Casting processes, Welding processes, and Forging processes.

UNIT – V ESTIMATION OF MACHINING TIME AND COST 9

Estimation of Machining time – Lathe operations, Drilling, Milling, Shaping and Planing, and Grinding, Cost estimation for machining processes.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. To explain the role of process planning in the design / manufacturing cycle.
2. To develop process plans for a given component using the standard procedure involved in process planning.
3. To explain the various cost concepts in cost estimation of manufactured components.
4. To prepare cost estimates for simple components in casting, welding and forging processes.
5. To estimate the production time for components in various machining operations.

REFERENCES:

1. M. Adithan," Process Planning and Cost Estimation", New Age International Publishers, 2007.
2. Peter Scallan, "Process planning, The Design/Manufacture interface", Butterworth-Heinemann, 2003.
3. Chitale, A, K., and Gupta, R. C,, "Product Design and manufacturing", Prentice Hall of India, New Delhi , 1997.
4. Gideon Halevi, "Process and operation planning", Kluwer academic publishers (Printed ebook), 2003.
5. Narang, G.B.S., Kumar, V., "Production and Costing", Khanna Publishers, 2000.
6. Phillip F. Ostwald, Jairo Munoz, "Manufacturing Processes And Systems", 9th Edition, Wiley student edition, 2002.
7. Robert Creese, M. Adithan, B.S Pabla, "Estimating and Costing for the Metal Manufacturing Industries", Marcel Dekker, 1992.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		0.3											0.3		
2	0.9	0.9	0.6	0.6							0.6		0.9	0.9	0.9
3					0.6										
4	0.9														0.9
5	0.9	0.6	0.6	0.6							0.6		0.9	0.9	0.9
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5006	ADVANCED MATERIALS AND ITS PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

1. The aim is to import knowledge in advanced metallic materials which are required in the trust areas of mechanical engineering
2. To import knowledge on forming processes and applications of them in forming components with different type of materials
3. To import knowledge on making ceramics components by powder metallurgy route
4. To import knowledge on different nanostructured materials and their growth mechanism
5. To import knowledge on different coating materials, coating techniques and growth mechanism

UNIT-I METALLIC MATERIALS WITH ENHANCED PERFORMANCE CHARACTERISTICS 9

Al Alloys-Al-Li Alloys- First, Second and Third Generation Al-Li alloys-Microstructure-Precipitates Characteristics-Melting and casting of Al-Li alloys-workability-weldability
Shape memory alloys- Shape memory effects- NiTi
Ti alloys- Properties and applications-workability-weldability
Steels-micro alloyed steels-TRIP steel-Microstructure-Properties-Applications

UNIT-II NEAR NET SHAPE FORMING PROCESSES FOR METALS 9

Forming-Compressive forming- tensile forming- combined tensile and compressive forming-sheet forming-Recrystallisation and grain growth-fundamentals of plasticity- forming limit-superplasticity- superplastic forming- superplasticity of metals, ceramics and nanostructured materials

UNIT-III ADVANCED CERAMIC MATERIALS AND THEIR APPLICATIONS 9

Introduction, properties and applications of – oxides, carbides, nitrides; Advanced ceramic products – ceramic fibers, glass ceramics,--High temperature ceramic materials-Ceramics Sintering- Solid state sintering – driving force, effect of surface curvature and boundary defects, mechanism, stages of sintering. Liquid phase sintering – stages, kinetic and thermodynamic factors, phase diagram in liquid phase sintering. Grain growth – different grain growth process, control of grain growth, grain growth and pore evolution in a porous compact, interaction between pore and grain boundary.

UNIT-IV NANOSTRUCTURED MATERIALS 9

Classifications of nanostructured materials-nanoparticles preparation-Mechanical Milling-Mechanochemical synthesis-sol-gel technique-PVD,CVD-characteristics- CNT-BNT-processing-growth mechanism-applications, nanowire – growth mechanism- applications

UNIT-V COATING MATERIALS AND TECHNOLOGY 9

Different coating materials-TiN,TiAlN,TiCrN,TiNbN, DLC-Thin films- Superhard coatings-nanocomposite coatings- Mechanisms-Thermal stability- High Temperature coatings-Different coating techniques-Mechanism of thin film growth

TOTAL:45 PERIODS

OUTCOMES

On successful completion of the course, the students can able

1. To Select and use advanced metallic materials in the trust areas of mechanical engineering
2. To select suitable forming techniques, design the forming process for the industrial component production.
3. To identify and use appropriate ceramics for different applications
4. To produce different nanostructured materials
5. To select suitable coating materials and process to develop coating for industrial components.

REFERENCES

1 Kurt Lange, HANDBOOK OF METAL FORMING, Society of Manufacturing Engineers, USA

2 F. Singer and S. Singer, Industrial Ceramics, Oxford and IBH Publishing Co., 1991.

3 Nanostructured Materials, G. Wilde (Ed.), in the Series Frontiers of Nanoscience (Series Editor R. E. Palmer) Elsevier, Oxford, U. K./ Amsterdam, The Netherlands, 2009, pp. 51 – 126, ISBN-13: 978-0-08-044965-4.

4 Aluminum-Lithium Alloys: Processing, Properties, and Applications, (Editors N. Eswara Prasad, Amol A. Gokhale and RJH Wanhill), Elsevier, 2013, ISBN-13: 978-0124016989.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.6	0.3									0.3	0.3	0.3
2	0.9	0.6	0.3										0.6	0.3	
3	0.6	0.6	0.3										0.6	0.3	
4	0.6	0.6	0.3										0.6		
5	0.9	0.6	0.3										0.6		

MS5007 HUMAN RESOURCE MANAGEMENT

L	T	P	C
3	0	0	3

Objectives

1. Students will be able to study the functions of Human Resource management.
2. Students will be able to study the recruitment and selection methods in Human Resource management.
3. Students will be able to study the training methods in Human Resource management.
4. Students will be able to study the compensation concepts and ensuring quality in Human Resource management.
5. Students will be able to study the concepts in labour relations and employee security in Human Resource management.

UNIT-I HUMAN RESOURCE FUNCTION 9

Human Resource (HR) management – Meaning and importance- Difference between personnel and HR management – Changing environments of HRM – Strategic human resource management – Use of HRM to create competitive advantage – Trends in HRM – Organization of HR department – Role of HR Managers.

UNIT-II RECRUITMENT & SELECTION 9

Job analysis: Methods – Job specification and description – HR and the responsive organization – IT and computerized skill inventory – Computer based job analysis : HR planning and forecasting – Building employee commitment – Recruitment and selection process – Promotion from within – Developing and using application forms – IT and recruiting on the internet – Employee testing & selection: Selection process, basic testing concepts, types of test and

validation – Work samples & simulation, selection techniques, interview, common interviewing mistakes – Designing & conducting the effective interview, competency mapping, computer aided interview – Evaluation of selection process.

UNIT-III TRAINING & DEVELOPMENT 9

Orienting the employees, training process, need for training, training techniques, special purpose training, training via the internet – Training evaluation – Developing Managers: Management development – Responsive managers - On-the-job and off-the-job development techniques – Using HR to build a responsive organization – Use of CD-ROMs – Key factor for success – Performance appraisal: Tools, feedback, appraisal interviews – Performance appraisal in practice – Career planning and development – Managing promotions and transfers.

UNIT-IV COMPENSATION & MANAGING QUALITY 9

Establishing pay plans: Basics of compensation – Factors determining pay rate – Current trends in compensation – Job evaluation – Pricing managerial and professional jobs – Computerized job evaluation – Pay for performance and financial incentives: Money and motivation – Incentives for operations employees and executives – Organization wide incentive plans – Practices in Indian organizations – Services benefits: Statutory benefits – Non-statutory (voluntary) benefits – Insurance benefits – Retirement benefits and other welfare measures to build employee commitment.

UNIT-V LABOUR RELATIONS & EMPLOYEE SECURITY 9

Trade unions – Collective bargaining – Negotiation techniques – Discipline administration – Grievances handling – Managing dismissals and separation – Labour Welfare: Importance & Implications of labour legislations – Employee health – Auditing HR functions, Future of HRM function.

TOTAL (L: 45)=45 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

1. Able to acquire knowledge on Human Resource management functions.
2. Ability to learn the various methods involved in recruitment and selection process.
3. Understand the concepts of training methods and development techniques.
4. Able to understand the concepts of compensation and benefits.
5. Understand the various employee relations and security.

REFERENCES:

1. Biswajeet Pattanayak, “Human Resource Management”, 3rd Edition, PHI, 2008.
2. David A. DeCenzo& Stephen P. Robbins, “Personnel/Human Resource Management”, 3rd Edition, PHI/Pearson, 2011.
3. Diane Arthur, “Recruiting, Interviewing, Selecting and Orienting New Employees”, 4th Edition, PHI, 2007.
4. Gary Dessler, "Human Resource Management", 11th Edition, PHI, 2008.
5. Ian Beardwell, Len Holden, & Tim Claydon, “HRM – A Contemporary Approach”, 4th Edition, Prentice Hall, 2004.
6. John Stredwick, “Introduction to HRM”, Elsevier, 2nd Edition, 2005.
7. Robert L. Mathis & John H. Jackson, “Human Resource Management”, 12th Edition, Thompson South-Western, 2006

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6				0.3								0.3		
2	0.6				0.3										
3	0.6				0.3									0.3	
4	0.6				0.3										
5	0.6				0.3										0.3

S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

MS5008 MODERN TECHNIQUES OF MATERIALS CHARACTERIZATION L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge aboutthe various steps involved in the Metallography.
- To expose the students to various techniques involved in X-ray Diffraction.
- To make the students capable of interpretation and analysis of the results obtained from X-ray diffraction.
- To inculcate the students the concepts Electron Microscopy and some Chemical Thermal Analysis.
- To imbibe knowledge on the various thermal and Chemical analysis involved in materials characterisation.

UNIT I METALLOGRAPHIC TECHNIQUES 9

Macro examination – Applications, metallurgical microscope - principle, construction and working, metallographic specimen preparation, optic properties - magnification, numerical aperture ,resolving power, depth of focus, depth of field, different light sources, lenses aberrations and their remedial measures, various illumination techniques-bright field , dark field, phase-contrast, polarized light illuminations, interference microscopy, high temperature microscopy; quantitative metallography – Image analysis- Confocal laser scanning microscopy.

UNIT II X-RAY DIFFRACTION TECHNIQUES 9

X-ray generation, absorption edges, characteristic spectrum, Crystallography basics, Bragg's law, Diffraction methods – Laue, rotating crystal and powder methods. Stereographic projection. Intensity of diffracted beams – structure factor calculations and other factors – Counters - proportional, Scintillating, Geiger and semiconductor counters.

UNIT III ANALYSIS OF X-RAY DIFFRACTION 9

Line broadening, particle size, crystallite size, Precise parameter measurement, Phase identification, phase quantification, Phase diagram determination, X-ray diffraction application in the determination of crystal structure, lattice parameter, residual stress – quantitative phase estimation. X-ray Fluorescence: Energy Dispersive Spectroscopy (EDS) and Wave Dispersive X-ray Spectrometry (WDS).

UNIT IV ELECTRON MICROSCOPY 9

Basic principles and applications of Transmission Electron Microscope – Selected Area Electron Diffraction and image formation, specimen preparation techniques. Construction, modes of operation and application of Scanning Electron Microscope, Electron Backscattered Diffraction(EBSD) -EDS, Electron Probe Micro Analysis (EPMA), Introduction to Scanning Tunnelling Microscope (STM) and Atomic Force Microscope (AFM).

UNIT V CHEMICAL AND THERMAL ANALYSIS 9

Basic principles and applications of Auger spectroscopy, X- ray photoelectron spectroscopy (XPS).U-V, Visible, IR, FTIR and Raman spectroscopy – fluorescence and phosphorescence methods –flame photometry – atomic absorption – Inductively Coupled Plasma -Atomic Emission Spectrometry (ICP- AES). Basic principles and applications of Differential Thermal Analysis (DTA),Differential Scanning Calorimetry (DSC) and Thermo Gravimetric Analysis (TGA).

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able:

- To explain the various steps involved in Metallography and exposed to the operations and construction of Metallurgical Microscopes.
- To compare the different techniques involved in X-ray diffraction and estimate the phases present.
- To interpret and infer the results obtained in X-ray diffraction and perform structure factor calculations, phase identification and determine the crystal structure, lattice parameter, residual stress – quantitative phase estimation.

- To apply the concepts of Scanning Electron Microscopy and Transmission Electron Microscopy for materials characterization.
- To classify the various thermal and Chemical analysis involved in materials characterisation.

REFERENCES:

1. Cullity, B. D., “Elements of X-ray Diffraction”, Addison-Wesley Company Inc., New York, 3rdEdition, 2000.
2. D. A. Skoog, F. James Leary and T. A. Nieman, "Principles of Instrumental Analysis", 5thEdition, Saunders Publishing Co., 1998.
3. Sam Zhang, Lin Li, & Ashok Kumar, “Materials Characterization Techniques”, CRC Press,2009.
4. Thomas G., “Transmission Electron Microscopy of Metals”, John Wiley, 1996.
5. Weinberg, F., “Tools and Techniques in Physical Metallurgy”, Volume I & II, Marcel andDecker, 1970.
6. Yang Leng, “Materials Characterization: Introduction to Microscopic and SpectroscopicMethods”, John Wiley & Sons, 2008.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9				0.6							0.3			0.3
2	0.6				0.9										0.3
3		0.6	0.3	0.9											
4	0.9				0.6										0.3
5	0.9		0.3												0.6

S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

MS5009	NANOSTRUCTURED MATERIALS AND TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To import knowledge on design of nanostructure and discuss the effects due to properties change
2. To provide adequate knowledge to develop zero dimensional nanostructure using different processes
3. To provide adequate knowledge to develop CNT and nanowire using different processes and understanding the mechanism of growth
4. To provide adequate knowledge to develop superhard coatings and bulk nanostructured materials.
5. To import knowledge on characterisation techniques used for characterizing nanostructures.

UNIT-I INTRODUCTION TO NANOMATERIALS 7

Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials - Gleiter’s Classification of Nanostructured materials – properly changes due to size effects, inverse Hall - Petch effects - polymeric nanostructures

UNIT-II ZERO DIMENSIONAL NANOMATERIALS 10

Nano Particles – Properties – Processing – Liquid state processing - Sol-gel process, wet chemical synthesis – Vapour state processing – PVD, CVD, Aerosol processing, solid state processing – mechanical, mechanochemical synthesis – Application of nanoparticle.

Quantum Dots – Quantum confinement – Pauli Exclusion Principle – Processing – Optical lithography – MOCVD – Droplet epitaxy - Applications.

UNIT-III ONE DIMENSIONAL NANOMATERIALS 10

Carbon nanotubes – Old and new forms of carbon – Structure of CNT and classification – Processing – Solid carbon based production techniques – Gaseous carbon based production technique - growth mechanisms – Applications.

Nanowire – processing – vapour – liquid – solid growth (VLS technique) – Laser ablation – Oxide assisted growth – Vapour–Solid growth (VS growth) – carbo thermal reactions – Thermal evaporation – Temperature based synthesis – Electro spinning – Applications.

UNIT-IV SUPER HARD COATINGS AND BULK NANOSTRUCTURE FORMATION 9

Superhard coating – types – characteristics – thermal stability – case studies (nc-TiN/a-Si_3N_4 coating) – Applications.

Buck nanostructure formation – Equal Channel angular pressing (ECAP) – High pressure torsion (HPT), Accumulative roll bending – Reciprocating extrusion compression, cyclic close die forging – Repetitive corrugation and straightening – Grain refinement mechanisms.

UNIT-V CHARACTERIZATION OF NANOMATERIALS 9

Nano indentation – Types of nanoindenter - Atomic force microscope (AFM) –– Electrostatic force mode (EFM) – Magnetic force mode (MFM) – Scanning Tunneling microscope (STM) - Scanning electron microscope (SEM) – Transmission electron microscope (TEM).

TOTAL: 45 PERIODS

OUTCOMES

On completion of this course, the students can able to

1. design of nanostructures considering the effects due to properties change
2. process zero dimensional nanostructures using different processes
3. Fabricate CNT and nanowire using different processes
4. Develop Superhard coatings and bulk nanostructured materials.
5. Use different characterisation techniques for characterizing nanostructures**.**

REFERENCES

1 Mark Ratner and Daniel Ratner, “Nano Technology”, Pearson Education, New Delhi, 2003.
2 G. Wilde, “Nanostructured Materials’, Elsevier, 2008.
3 Bamberg,D., Grundman, M. and Ledentsov,N.N.,“ Quantum Dot Heterostructures”, Wiley, 1999.
4 N John Dinardo,“ Nanoscale characterisation of surfaces & interfaces” , Weinheim Cambridge: Wiley-VCH, 2000 2nd ed
5 G Timp (ed),“ Nanotechnology”, AIP press/Springer, 1999.
6 Bhusan, Bharat (Ed),“ Springer Handbook of Nanotechnology”, 2nd edition, 2007.
7 Charles P. Poole Jr., Frank J. Ownes, ‘Introduction to Nanotechnology”, Wiley Interscience, 2003.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.6	0.6	0.3									0.3	0.3	0.3
2	0.9	0.6	0.3										0.6	0.3	
3	0.6	0.6	0.3										0.6	0.3	
4	0.6	0.6	0.3										0.6		
5	0.9	0.6	0.3										0.6		
S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)															

MS5010 SUSTAINABLE AND GREEN MANUFACTURING **L T P C**
3 0 0 3

OBJECTIVES:

1. To introduce the need for sustainability in manufacturing and the various dimensions of sustainability.
2. To give an overview of the principles of green design and EOL treatment.
3. To explain the principles of green manufacturing.
4. To give an understanding of the concept and importance of sustainable machining.
5. To provide an overview of the concepts of energy efficiency and the regulations governing manufacturing industries.

UNIT – I INTRODUCTION TO SUSTAINABLE MANUFACTURING 9

Introduction, Design for sustainability, design methods and tools, Industrial ecology and sustainability, Economics of sustainable engineering, Analytical techniques for sustainability analysis.

UNIT – II GREEN DESIGN AND EOL TREATMENT 9

Principles of green design, Ecofriendly materials, End of life treatment and Environmental impact scenario, Design for Environment, Reclamation and recycling of waste, Remanufacturing.

UNIT – III ENVIRONMENTALLY BENIGN MANUFACTURING 9

Introduction – Metrics for green manufacturing – Green supply chain - Principles of green manufacturing – Enabling technologies for Green manufacturing.

UNIT – IV SUSTAINABLE MACHINING 9

Energy consumption in machining, Cutting tool sustainability – tool wear maps, Nanofluids, Minimum Quantity Lubrication in machining – drilling, grinding and milling.

UNIT – V ENERGY EFFICIENCY AND REGULATIONS 9

Energy and resource efficiency in manufacturing, Carbon footprint, Product and process metrics for sustainable manufacturing, Environmental regulations and standards.

TOTAL:45 PERIODS

OUTCOMES:

At the end of the course, the students would be able to

- Explain the need for sustainability in product design and manufacturing.
- Evaluate the end of life assessment of products and evaluate the possibilities for recycle and reuse.
- Explain the metrics, principles and techniques of green manufacturing.
- Explain the methods available for sustainable machining.
- Explain the environmental regulations governing manufacturing industries and estimate the energy efficiency of manufacturing processes.

TEXTBOOKS:

1. Dornfield David, “Green Manufacturing”, Springer, 2012.
2. Nand K. Jha, Green Design and manufacturing for sustainability, CRC Press, 2016.

REFERENCES:

1. Atkinson, G., Dietz, S., Neumayer, E., ―Handbook of Sustainable Manufacturing‖. Edward Elgar Publishing Limited, 2007.
2. Christian N. Madu “Handbook of environmentally conscious manufacturing” London : Kluwer Academic Publishers, 2001.
3. Davim.J.Pauls, “Green Manufacturing Processes and Systems”, Springer, 2013.
4. Davim, J.P., “Sustainable Manufacturing”, John Wiley & Sons, 2010.
5. Günther Seliger, Marwan M.K. Khraisheh, I.S. Jawahir, Advances in Sustainable Manufacturing, Springer Verlag, 2011.
6. Joseph Sarkis “Greener manufacturing and operations: from design to delivery and back” Greenleaf Pub., 2001.
7. Jovane, F., Ęmper, W.E. and Williams, D. J., “The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing”, Springer, 2009.
8. Seliger, G ,”Sustainable Manufacturing: Shaping Global Value Creation”, Springer, 2012.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		0.6				0.9	0.9				0.6	0.6	0.6	0.6	0.6
2		0.6	0.6			0.9	0.9				0.6	0.6	0.6	0.6	0.6
3						0.9	0.9				0.6	0.6	0.6	0.6	0.6
4		0.6	0.6	0.6		0.9	0.9				0.6	0.6	0.6		0.6
5						0.9	0.9				0.6	0.6	0.6		0.6

S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

MS5011 INTEGRATED PRODUCT DESIGN AND PROCESS DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To Understand the principles of generic development process; product planning; customer need analysis for new product design and development.
2. To enhance the understanding of setting product specifications and generate, select, screen, and test concepts for new product design and development.
3. To apply the principles of product architecture and the importance of industrial design principles and DFM principles for new product development.
4. To expose the different Prototyping techniques, Design of Experiment principles to develop a robust design and importance to patent a developed new product.
5. Applying the concepts of economics principles; project management practices in development of new product.

UNIT – I INTRODUCTION TO PRODUCT DESIGN AND IDENTIFICATION OF CUSTOMER NEED **9**

Need for IPPD - Strategic importance of Product development –Duration and Cost of Product Development – Challenges in Product Development - Product Development Processes and Organizations – Activities in Identifying Customer Needs

UNIT – II PRODUCT SPECIFICATIONS, CONCEPT GENERATION, SELECTION AND TESTING 9

Plan and establish Target and Final product specifications – Activities of Concept Generation - Task - Concept Selection methodology – Concept Screening and Scoring - Concept Testing Methodologies.

UNIT – III PRODUCT ARCHITECTURE , INDUSTRIAL DESIGN AND DESIGN FOR MANUFACTURE 9

Product Architecture – Implications and establishing the architecture – Delayed Differentiation – Platform Planning - Need and impact of industrial design - Industrial design process - management of the industrial design process - assessing the quality of industrial design – DFM Definition - Estimation of Manufacturing cost- Reducing the component costs, costs of supporting function and assembly costs – Impact of DFM decision on other factors.

UNIT – IV PROTOTYPING, ROBUST DESIGN AND INTELLECTUAL PROPERTY 9

Prototype basics - Principles of prototyping - Planning for prototypes - Robust design – Seven step process of Robust Design through Design of Experiments- Need and Importance of Intellectual Property – Seven step process of preparing a patent document.

UNIT – V PRODUCT DEVELOPMENT ECONOMICS AND MANAGING PROJECTS 9

Economic Analysis – Elements of Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project - project execution – postmortem project evaluation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the principles of generic development process; product planning; customer need analysis for new product design and development.
2. Set product specifications and generate, select, screen, test concepts for new product design and development.
3. Apply the principles of product architecture, industrial design and design for manufacturing principles in new product development.
4. Apply the adopt Prototyping techniques and Design of Experiment principles to develop a robust design and document a new product for patent.
5. Apply of the concepts of economics principles; project management practices in accelerating the new product development activity.

REFERENCES:

1. Karl T.Ulrich, Steven D.Eppinger, Anita Goyal, "Product Design and Development", McGraw –Hill Education (India) Pvt. Ltd, 4th Edition, 2012.
2. Kenneth Crow, "Concurrent Engineering/Integrated Product Development". DRM Associates, 6/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book
3. Kevin N Otto, Kristin L Wood, “Product Design – Techniques in Reverse Engineering and New Product Development”, Pearson Education, Inc, 2016
4. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992
5. Stuart Pugh, "Total Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, Neyourk, NY,1991.

0.3- Low 0.6- Medium 0.9- High

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.9	0.9	0.9	0.9							0.9	0.9	0.9	0.6
2	0.9	0.6	0.9	0.9	0.9					0.6		0.6	0.9	0.6	0.9
3	0.9	0.6	0.6	0.9	0.6								0.6	0.6	0.3
4	0.9	0.9	0.9	0.9	0.9					0.6		0.9	0.9	0.9	0.9
5	0.9	0.6	0.6	0.9	0.9					0.6		0.9	0.9	0.9	0.9

MS5012	ENTERPRISE RESOURCE PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

1. Students will be able to identify the needs of Enterprise resource planning.
2. Students will be able to understand the various technologies of ERP.
3. Students will be able to distinguish the various ERP packages.
4. Students will be able to understand the various architecture of ERP.
5. Students will be able to identify the issues in ERP procurement.

UNIT-I ENTERPRISE RESOURCE PLANNING AND VALUE CHAIN MANAGEMENT 9

Principle –ERP framework –BusinessBlue Print –Business Engineeringvs Business process Re-Engineering –Tools –Languages –Value chain –Supply and Demand chain –Extended supply chain management –Dynamic Models –Process Models.

UNIT-II TECHNOLOGY AND ARCHITECTURE 9

Client/Server architecture –Technology choices –Internet direction – Evaluation framework –CRM – CRM pricing –chain safety –Evaluation framework.

UNIT-III ERP SYSTEM PACKAGES 9

SAP, People soft, Baan and Oracle –Comparison –Integration of different ERP applications –ERP as sales force automation –Integration of ERP and Internet –ERP Implementation strategies – Organizational and social issues.

UNIT-IV ERP ARCHITECTURE 9

Overview – Architecture–AIM –applications –Oracle SCM. SAP: Overview –Architecture – applications -Before and after Y2k –critical issues –Training on various modules of IBCS ERP Package-Oracle ERP and MAXIMO, including ERP on the NET.

UNIT-V ERP PROCUREMENT ISSUES 9

Market Trends –Outsourcing ERP –Economics –Hidden Cost Issues –ROI –Analysis of cases from five Indian Companies.

TOTAL = 45 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

1. Able to acquire integrated view of the various facets of business, including planning, manufacturing, sales, finance and marketing.
2. Able to understand the development of software to integrate business activities such as inventory management and control, order tracking, customer service, finance and human resources.
3. Awareness on the software applications and tools that are available to business to use to drive out costs and improve efficiency.
4. Understand the architecture of various ERP packages available in the market.
5. Ability to learn the outsourcing concepts of ERP and its economics.

REFERENCES:

1. Garg &Venkitakrishnan, ERPWARE , ERP Implementation Framework, , Prentice Hall, 1999
2. Jose Antonio Fernandez , The SAP R/3 Handbook, Tata Mcgraw Hill, 1998.
3. Sadagopan.S , ERP-A Managerial Perspective, Tata McGraw Hill, 1999.
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5. Vinod Kumar Crag and N.K.Venkitakrishnan , Enterprise Resource Planning –Concepts and Practice, Prentice Hall of India, 1998.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9					0.6						0.3	0.9	0.6	0.3
2	0.9		0.6		0.6				0.6	0.6			0.6	0.6	0.3
3	0.9		0.6		0.6	0.3						0.3	0.9	0.6	0.3
4	0.9		0.6	0.3					0.3			0.3	0.3	0.6	0.3
5	0.9					0.3					0.6	0.3	0.3	0.3	0.3

S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

MS5013 ROBOTICS AND EXPERT SYSTEM L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF ROBOT 9

Robot - Definition - Robot Anatomy – Co-ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications, Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Expert system, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOMES:

Upon the completion of this course the students will be able to

CO1 Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors.

CO2 Illustrate the different types of robot drive systems as well as robot end effectors.

CO3 Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
CO4 Develop robotic programs for different tasks and familiarize with the kinematics motions of robot.
CO5 Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

REFERENCES:

1. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2012.
2. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
3. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008. 2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
5. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.

MS5014 FINANCIAL MANAGEMENT AND ACCOUNTING L T P C
3 0 0 3

OBJECTIVES:
The main learning objective of this course is to prepare students for:
- Applying the fundamental concepts and principles financial management in manufacturing systems.
- Applying the concepts and principles of financial accounting in manufacturing systems.
- Applying the concepts and principles of cost accounting in manufacturing systems.
- Applying the concepts and principles of budgeting in manufacturing systems.
- Applying the concepts and principles of financial decision making in manufacturing systems..

UNIT I FINANCIAL MANAGEMENT 9
Investment decisions – Capital Investment process, types of investment proposals, investment appraisal techniques – payback period method, Accounting rate of return, net present value method, internal rate of return and profitability index method.

UNIT II FINANCIAL ACCOUNTING 9
Salient features of Balance sheet and Profit & Loss Statement, Cash Flow and Fund Flow Analysis, Working Capital management, Inventory valuation, Financial Ratio analysis – Depreciation.

UNIT III COST ACCOUNTING 9
Cost accounting systems: Job costing, Process costing, Allocation of overheads, Activity based costing, differential cost and incremental cost, Variance analysis, Software costing.

UNIT IV BUDGETING 9
Requirements for a sound budget, fixed budget-preparation of sales and production budget, flexible budgets, zero base budgeting and budgetary control.

UNIT V FINANCIAL DECISIONS 9
Cost of Capital – Capital structure – Dividend Policy – Leasing

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply the fundamental concepts and principles financial management in manufacturing systems.
- Apply the concepts and principles of financial accounting in manufacturing systems.
- Apply the concepts and principles of cost accounting in manufacturing systems.
- Apply the concepts and principles of budgeting in manufacturing systems.
- Apply the concepts and principles of financial decision making in manufacturing systems..

REFERENCES:

1. Bhattacharya, S.K. and John Deardon, "Accounting for Management – Text and Cases", Vikas Publishing House, New Delhi, 1996.
2. Charles, T.Horn Green – "Introduction to Management Accounting", Prentice Hall, New Delhi, 1996.
3. James, C.Van Horne, "Fundamental of Financial Management", Pearson Education, 12th Edition, 2002.
4. Pandey, I.M., "Financial Management", Vikas Publishing House, New Delhi, 8th Edition, 2004.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.3									0.3		0.3		
2	0.3	0.3									0.3		0.3		
3	0.3	0.3									0.3		0.3		0.3
4	0.6	0.3									0.3		0.3		
5	0.3	0.3									0.3		0.3		

S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

ED5079 MATERIAL HANDLING SYSTEMS AND DESIGN (Use of Approved Data Book Is Permitted)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. Fundamental concepts related to material handling.
2. Design of various hoisting gears for different material handling applications
3. Development of conveyer systems for material flow in different industrial production systems.
4. Design of elevators for various manufacturing and service applications.
5. Integrated mechanical system design for machine tools, power transmission and engine parts

UNIT – I INTRODUCTIONS AND DESIGN OF HOISTS 9

Types, selection and applications, Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

UNIT – II DRIVES OF HOISTING GEAR 9

Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

UNIT – III CONVEYORS 9

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT – IV ELEVATORS 9

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

UNIT – V INTEGRATED DESIGN 9

Integrated Design of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Bale lifter, Cam Testing Machine, Power Screws, Gear Box Design more than six speed.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Design hoists and brakes used in any handling applications.
2. Design drive mechanisms and hoisting gear for different handling applications.
3. Design different conveyor systems for material handling applications.
4. Design bucket, cage and fork lift elevators for to and fro transportation of .materials in vertical direction.
5. Design of integrated mechanical system for machine tools, power transmission and engine parts

REFERENCES:

1. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
2. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958
3. Norton. L Robert. “Machine Design – An Integrated Approach” Pearson Education, 2nd Edition, 2005.
4. Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.
5. Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985.

APPROVED DATA BOOKS:

1. P.S.G. Tech., “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2003.
2. Lingaiah. K. and Narayana Iyengar, “Machine Design Data Hand Book”, Vol. 1 & 2, Suma Publishers, Bangalore, 1983

0.3- Low 0.6- Medium 0.9- High

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.3	0.6	0.9	0.6	0.6	0.3	0.3					0.3	0.3	0.3	0.3
2	0.3	0.6	0.9	0.6	0.6	0.3	0.3						0.3	0.3	0.3
3	0.3	0.6	0.9	0.6	0.6	0.3	0.3						0.3	0.3	0.3
4	0.3	0.6	0.9	0.6	0.6	0.3	0.3						0.3	0.3	0.3
5	0.6	0.6	0.9	0.6	0.6	0.3						0.3	0.3	0.3	0.6

QE5072 **MATERIALS MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- Impart knowledge on basic concepts of aggregate planning, manufacturing planning and enterprise resource planning.
- Pivot foundation in material planning concepts.
- Articulate knowledge on inventory management models.
- Educate the purchasing techniques and concepts.
- Exposure on warehouse management activities.

UNIT I INTRODUCTION **9**

Operating environment-aggregate planning-role, need, strategies, costs techniques, approaches master scheduling-manufacturing planning and control system-manufacturing resource planning enterprise resource planning-making the production plan.

UNIT II MATERIALS PLANNING **9**

Materials requirements planning-bill of materials-resource requirement planning-manufacturing resource planning-capacity management-scheduling orders-production activity control-codification.

UNIT III INVENTORY MANAGEMENT **9**

Policy Decisions–objectives-control -Retail Discounting Model, Newsvendor Model; EOQ and EBQ models for uniform and variable demand With and without shortages -Quantity discount models. Probabilistic inventory models.

UNIT IV PURCHASING MANAGEMENT **9**

Establishing specifications-selecting suppliers-price determination-forward buying-mixed buying strategy-price forecasting-buying seasonal commodities-purchasing under uncertainty-demand -price forecasting-purchasing under uncertainty-purchasing of capital equipment, international purchasing

UNIT V WAREHOUSE MANAGEMENT **9**

Warehousing functions – types - Stores management-stores systems and procedures-incoming materials control-stores accounting and stock verification-Obsolete, surplus and scrap-value analysis-material handling-transportation and traffic management -operational efficiency productivity-cost effectiveness-performance measurement

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1 : Understand the basic concepts of aggregate planning, manufacturing planning and enterprise resource planning

CO2 : Effectively gain knowledge of materials planning concepts

CO3 : Design and analyze inventory management models

CO4 : Effectively understand the purchasing techniques and concepts

CO5 : Gain knowledge on warehouse management activities

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓										
CO2		✓	✓									
CO3		✓	✓	✓	✓							
CO4		✓	✓	✓	✓	✓						
CO5		✓	✓	✓		✓						

REFERENCE BOOKS:
1. Ajay K Garg, Production and Operations Management, Tata McGraw Hill , 2012
2. A.K.Chitale and R.C.Gupta, Materials Management, Text and Cases, PHI Learning, 2nd Edition, 2006
3. A.K.Datla, Materials Management, Procedure, Text and Cases, PHI Learning, 2nd Edition, 2006
4. ARonald H. Ballou and Samir K. Srivastava, Business Logistics and Supply Chain Management, Pearson education,Fifth Edition.
5. J.R.Tony Arnold, Stephen N. Chapman, Lloyd M. Clive, Materials Management, Pearson, 2012.

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce

- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

OE5092 INDUSTRIAL SAFETY L T P C

3 0 0 3

COURSE OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn ,Foundation Engineering Handbook, Chapman & Hall London,2013.
4. Higgins & Morrow , Maintenance Engineering Handbook, Eighth Edition, 2008

OE5093 OPERATIONS RESEARCH L T P C

3 0 0 3

COURSE OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation , assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method,Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control Techniques
CO5 - Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095 COMPOSITE MATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5				✓	✓		✓					

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096 **WASTE TO ENERGY** **L T P C**
3 0 0 3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNITV BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

COURSE OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AX5092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

COURSE OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

COURSE OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS 6

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES 6

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

COURSE OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX5094 **VALUE EDUCATION** **L T P C**
2 0 0 0

COURSE OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.
Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV
Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING
1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AX5095 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

COURSE OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950 (Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096 **PEDAGOGY STUDIES** **L T P C**
2 0 0 0

COURSE OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT III THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT IV EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT V PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT VI RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

COURSE OUTCOMES

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097 STRESS MANAGEMENT BY YOGA L T P C
2 0 0 0

COURSE OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)

UNIT II
Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS L T P C
2 0 0 0

COURSE OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

COURSE OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.