ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM
M.E. INDUSTRIAL ENGINEERING

VISION :

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

MISSION :

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

Attested

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CHOICE BASED CREDIT SYSTEM
M.E. INDUSTRIAL ENGINEERING (FULL – TIME)

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Industrial Engineering 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, satisfying its constraints.
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.

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3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Industrial Engineering program the student will have following Program specific outcomes.

1. Students will have a solid formulation in the mathematics of Industrial Engineering and Operations Research models and supporting quantitative methods by having a firm grasp of the mathematical theory necessary to understand and build such models.

2. Formulate and analyze problems in complex manufacturing and service systems by comprehending and applying the basic tools of Industrial Engineering such as modeling and optimization, stochastic, statistics.

3. Design and Develop appropriate analytical solution strategies for problems in integrated production and service systems involving human capital, materials, information, equipment and energy.

4. Implement solution, strategies on a computer platform for decision - support purposes by employing effective computational and experimental tools.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓					✓				
II						✓		✓		✓	✓	
III			✓	✓	✓		✓	✓				
IV				✓	✓					✓	✓	✓
V			✓			✓			✓	✓	✓	✓

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Mapping of Course Outcome and Programme Outcome

		Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
YEAR 1	Semester 1	Statistical Methods for Engineers	✓		✓									
		Work System Design and Ergonomics		✓							✓			
		Optimization Techniques	✓		✓									
		Program Elective I												
		Research Methodology and IPR	✓											
		Audit Course – I												
		Work System Design and Ergonomics Laboratory		✓			✓							
		Optimization Laboratory		✓			✓							
	Semester 2	Multi-Variate Data Analysis	✓		✓								✓	
		Applied Quality Engineering	✓		✓								✓	
		System simulation				✓	✓						✓	
		Program Elective II												
		Program Elective III												
		Audit Course – II												
		Data Analytics Laboratory				✓	✓							
		Simulation Laboratory				✓	✓							
YEAR 2	Semester 3	Program Elective IV												
		Program Elective V												
		Open Elective												
		Technical Seminar							✓	✓				
		Dissertation-I			✓	✓	✓		✓	✓				
	Semester 4	Dissertation-II			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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UNIVERSITY DEPARTMENTS

REGULATIONS - 2019

CHOICE BASED CREDIT SYSTEM

M.E. INDUSTRIAL ENGINEERING (FULL – TIME)

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5157	Statistical Methods for Engineers	FC	3	1	0	4	4
2.	IL5101	Work System Design and Ergonomics	PCC	4	0	0	4	4
3.	IL5151	Optimization Techniques	PCC	3	1	0	4	4
4.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
5.		Program Elective I	PEC	3	0	0	3	3
6.		Audit Course – I*	AC	2	0	0	2	0
PRACTICALS								
7.	IL5111	Work System Design and Ergonomics Laboratory	PCC	0	0	4	4	2
8.	IL5161	Optimization Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**2**	**8**	**27**	**21**

* Audit Course is optional.

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IL5251	Multi-Variate Data Analysis	PCC	3	0	0	3	3
2.	QE5251	Applied Quality Engineering	PCC	3	1	0	4	4
3.	IL5201	System simulation	PCC	3	1	0	4	4
4.		Program Elective II	PEC	3	0	0	3	3
5.		Program Elective III	PEC	3	0	0	3	3
6.		Audit Course – II*	AC	2	0	0	2	0
PRACTICALS								
7.	IL5211	Data Analytics Laboratory	PCC	0	0	4	4	2
8.	IL5212	Simulation Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**2**	**8**	**27**	**21**

* Audit Course is optional.

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SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	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.	IL5311	Technical Seminar	EEC	0	0	2	2	1
5.	IL5312	Dissertation - I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**14**	**23**	**16**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	IL5411	Dissertation - II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS : 70

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FOUNDATION COURSES (FC)

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	MA5157	Statistical Methods for Engineers	3	1	0	4	1

PROGRAM CORE COURSES (PCC)

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	IL5101	Work System Design and Ergonomics	4	0	0	4	1
2.	IL5151	Optimization Techniques	3	1	0	4	1
3.	IL5111	Work System Design and Ergonomics Laboratory	0	0	4	2	1
4.	IL5161	Optimization Laboratory	0	0	4	2	1
5.	IL5251	Multi-Variate Data Analysis	3	1	0	4	2
6.	QE5251	Applied Quality Engineering	3	1	0	4	2
7.	IL5201	System Simulation	3	1	0	4	2
8.	IL5211	Data Analytics Laboratory	0	0	4	2	2
9.	IL5212	Simulation Laboratory	0	0	4	2	2

PROGRAM ELECTIVE COURSES [PEC]

SEMESTER I, ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IL5072	Applied Object oriented programming	PEC	3	0	0	3	3
2.	IL5001	Operations Management	PEC	3	0	0	3	3
3.	IL5076	Industrial Automation and Robotics	PEC	3	0	0	3	3
4.	IL5079	Management Accounting and Financial Management	PEC	3	0	0	3	3
5.	IL5002	Total Quality Management	PEC	3	0	0	3	3

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SEMESTER II, ELECTIVE II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IL5003	Design and analysis of Algorithms	PEC	3	0	0	3	3
2.	IL5077	Lean Manufacturing and Six Sigma	PEC	3	0	0	3	3
3.	IL5071	Advanced Optimization Techniques	PEC	3	0	0	3	3
4.	IL5078	Logistics and Distribution Management	PEC	3	0	0	3	3
5.	IL5084	Supply Chain Management	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.	IL5004	Manufacturing systems and Models	PEC	3	0	0	3	3
2.	IL5081	Project Management	PEC	3	0	0	3	3
3.	IL5005	Design of Experiments	PEC	3	0	0	3	3
4.	QE5073	Product Innovation and Development	PEC	3	0	0	3	3
5.	IL5083	Services Operations Management	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.	IL5006	Scheduling Algorithms	PEC	3	0	0	3	3
2.	QE5071	Maintenance Engineering and Management	PEC	3	0	0	3	3
3.	IL5007	Productivity Management and Re-Engineering	PEC	3	0	0	3	3
4.	IL5080	Plant Layout and Material Handling	PEC	3	0	0	3	3
5.	QE5074	Software Quality Engineering	PEC	3	0	0	3	3

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SEMESTER III, ELECTIVE V

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IL5082	Reliability Engineering	PEC	3	0	0	3	3
2.	IL5008	Human Factors Engineering	PEC	3	0	0	3	3
3.	IL5075	Human Industrial Safety and Hygiene	PEC	3	0	0	3	3
4.	IL5073	Decision Support Systems	PEC	3	0	0	3	3
5.	IL5074	Enterprise Resource Planning	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

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	IL5312	Dissertation-I	0	0	12	6	3
2.	IL5411	Dissertation-II	0	0	24	12	4
3.	IL5311	Technical Seminar	0	0	2	1	3

Summary

	Name of the Programme					
	Subject Area	Credits per Semester				Credits Total
		I	II	III	IV	
1.	FC	04	00	00	00	04
2.	PCC	12	15	00	00	27
3.	PEC	03	06	06	00	15
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	00	00	07	12	19
7.	Non Credit/Audit Courses	✓	✓	00	00	
	Total Credit	**21**	**21**	**16**	**12**	**70**

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MA5157 **STATISTICAL METHODS FOR ENGINEERS** **L T P C**
3 1 0 4

OBJECTIVES:

- To enable them to estimate the value of the parameters involved in the specific distribution from a possible continuum of alternatives.
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using suitable test statistics which follows standard sampling distributions.
- To establish a relationship that make it possible to predict one or more variable in terms of others using correlation and regression analysis.
- To introduce the various experimental designs and their corresponding analysis of variance which play vital role in many real time scenarios.
- To impart knowledge of handling random vectors which represent random variables in multi-dimensional space.

UNIT I ESTIMATION THEORY **12**

Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency–Maximum Likelihood Estimation – Method of moments.

UNIT II TESTING OF HYPOTHESIS **12**

Tests based on Normal, *t*, χ^2 and *F* distributions for testing of means, variance and proportions – Analysis of *r x c* tables – Goodness of fit.

UNIT III CORRELATION AND REGRESSION **12**

Multiple and Partial Correlation - Method of Least Squares- Plane of Regression - Properties of Residuals - Coefficient of Multiple Correlation - Coefficient of Partial Correlation - Multiple Correlation with total and partial correlations - Regression and Partial correlations in terms of lower order coefficients.

UNIT IV DESIGN OF EXPERIMENTS **12**

Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT V MULTIVARIATE ANALYSIS **12**

Random vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Obtain the value of the point estimators using the method of moments and method of maximum likelihood.
- Use various test statistics in hypothesis testing for mean and variances of large and small samples.
- Determine the regression line using the method of least square and also to calculate the partial and multiple correlation coefficient for the given set of data points.
- Test the hypothesis for several means using one way, two way or three way classifications.
- Get exposure to the principal component analysis of random vectors and matrices.

REFERENCES:

1. Devore, J.L., “Probability and Statistics for Engineering and the Sciences”, Thomson and Duxbury, Singapore, 6th Edition, Boston, 2004.
2. Gupta, S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, Eleventh Edition, Reprint, New Delhi, 2019.

3. Johnson, R. A. and Gupta, C. B., “Miller & Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, Eighth Edition, New Delhi, 2015.
4. Johnson, R.A., and Wichern, D.W., “Applied Multivariate Statistical Analysis”, Pearson Education, Sixth Edition, New Delhi, 2013.
5. Spiegel, M.R. and Stephens, L.J.,” Schaum’s outlines on Statistics”, Tata McGraw-Hill, 6th Edition, New York, 2018.

IL5101 WORK SYSTEM DESIGN AND ERGONOMICS L T P C
4 0 0 4

OBJECTIVES:

- Impart knowledge in the area of method study
- Train the students in stop watch time study
- Summarize time standards using predetermined motion time systems.
- Explain the anthropometry measures and its use in the work place design
- Articulate the effect of environmental factors on human performance.

UNIT I METHOD STUDY 12

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

UNIT II WORK MEASUREMENT 12

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

UNIT III APPLIED WORK MEASUREMENT 12

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

UNIT IV PHYSICAL ERGONOMICS 12

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

UNIT V ENVIRONMENTAL FACTORS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

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

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

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REFERENCES:
1. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., Seventh Edition, 2002
2. Barnes, R.M. Motion and Time Study, John Wiley, 2002.
3. Introduction to work study, ILO, 3rd edition, Oxford & IBH publishing,2001
4. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006.

IL5151 OPTIMIZATION TECHNIQUES

L	T	P	C
3	1	0	4

OBJECTIVES

- To provide students the knowledge of optimization techniques and approaches. Formulate a real-world problem as a mathematical model and finding solutions
- To enable the students to learn about revised simplex method and sensitivity analysis of LPP.
- To solve networking problems like transportation, Assignment, Maximal flow , Minimum spanning tree and shortest path problems
- To learn about Decision making under uncertainty and certainty conditions,.
- To learn various Queuing models

UNIT I LINEAR PROGRAMMING 12

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

UNIT II ADVANCES IN LINEAR PROGRAMMING 12

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

UNIT III NETWORK ANALYSIS 12

Transportation problems : Northwest corner rule , Least cost method , Vogel's approximation method - stepping stone method - MODI method – Unbalanced transportation – Assignment problem – Hungarian algorithm – Travelling salesman problem – project management. Minimum spanning tree problem: prim's algorithm, Kruskal's algorithm - Shortest path problem: Dijkstra's algorithms, Floyds algorithm - maximal flow problem : Maximal-flow minimum-cut theorem - Maximal flow algorithm

UNIT IV DECISION AND GAME THEORY 12

Decision making under certainty – Decision making under risk – Decision making under uncertainty – Decision tree analysis –Introduction to MCDM; AHP. Game Theory – Two person zero sum games, pure and mixed strategies – Theory of dominance - Graphical Solution – Solving by LP

UNIT V QUEUING THEORY 12

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

TOTAL: 60 PERIODS

OUTCOMES

CO1: Learned how to translate a real-world problem, given in words, into a mathematical Formulation
CO2: Learn to apply simplex algorithm for LPP.
CO3: Be able to build and solve Transportation Models and Assignment Models, maximal flow problem, minimum spanning tree and shortest path problem.
CO4: The students will be able to handle issues in Decision making under various conditions.
CO5: The students acquire capability in applying and using of queuing models for day today problems.

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

REFERENCES:

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

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

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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

IL5111 WORK SYSTEM DESIGN AND ERGONOMICS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- Develop the graphical tools of method study.
- Prioritize the alternate, modify and propose the new methods.
- Infer the work measurement tools.
- Relate the software products in work measurement and set time standards.
- Collaborate the students in physical fitness test.

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

LABORATORY EQUIPMENTS REQUIREMENTS

1. Time study Trainer.
2. Peg board.
3. Stop watches.
4. Tread mill.
5. Ergo cycle.
6. Any one Ergonomics software (Eg.: Ergomaster, Human CAD)

OUTCOMES:

CO1: Apply the method study tools to record the existing methodology.

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

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

IL5161 **OPTIMIZATION LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- Provide adequate exposure to applications of a optimization software packages for solving Operations Research problems.
- Learn to solve Linear programming problems using Excel
- Summarize the problem solving techniques writing algorithms and procedures.
- Illustrate the syntax and semantics for C programming language
- Develop the C code for simple logic

LABORATORY EXPERIMENTS

1. LP Models formulation and solving using optimization software
2. Formulation of Transportation Problem and solving using optimization software
3. Formulation of Assignment Problems and solving using optimization software
4. Solving Maximal Flow problem using optimization software
5. Solving Minimal Spanning Tree problems using optimization software
6. Solving shortest route problems using optimization software
7. Solving Project Management problems using optimization software
8. Solving Waiting line problems using optimization software
9. Solving two players zero sum game using optimization software
10. Solving LPP using Microsoft EXCEL

TOTAL: 60 PERIODS

SOFTWARE REQUIREMENTS:

Optimization software

OUTCOMES:

CO1: Acquire knowledge in using Optimization software Package
CO2: Acquired knowledge using excel to solve LPP
CO3: Ability to write the algorithms for optimization problems.
CO4: Learned various syntax of C programme.
CO5: Ability to develop C ++programming for solving optimization problem.

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

IL5251 **MULTI - VARIATE DATA ANALYSIS** **L T P C**
3 0 0 3

OBJECTIVES:

- Understanding the basic overview on multi variate data analysis
- Predicting the values of one or more variables on the basis of observations on the other variables.
- Formulating the specific statistical hypotheses, in terms of the parameters of multi variate populations
- Data reduction or structural simplification as simply as possible without sacrificing valuable information and will make interpretation easier.
- Sorting and Grouping "similar" objects or variables are created, based upon measured characteristics.

UNIT I REGRESSION **9**

Simple Regression and Correlation – Estimation using the regression line, Correlation analysis, Multiple regression and Correlation analysis – Finding the Multiple Regression equation, Modelling techniques, Making inferences about the population parameters.

UNIT II MULTIVARIATE METHODS **9**

An overview of Multivariate methods, Multivariate Normal distribution, Eigen values and Eigen vectors.

UNIT III FACTOR ANALYSIS **9**

Principal Component Analysis – Objectives, Estimation of principal components, Testing for independence of variables, Factor analysis model – Factor analysis equations and solution – Exploratory Factor analysis – Confirmatory Factor analysis.

UNIT IV DISCRIMINANT ANALYSIS **9**

Discriminant analysis – Discrimination for two multivariate normal Populations – Discriminant functions – Structured Equation Modelling (SEM).

UNIT V CLUSTER ANALYSIS **9**

Cluster analysis – Clustering methods, Multivariate analysis of Variance.

TOTAL : 45 PERIODS

OUTCOMES:

CO1: To understand the basic overview on multi variate data analysis
CO2: Predict the values of one or more variables on the basis of observations on the other variables.
CO3: Formulate the specific statistical hypotheses, in terms of the parameters of multi variate populations
CO4: Data reduction or structural simplification as simply as possible without sacrificing valuable information and will make interpretation easier.
CO5: Sorting and Grouping "similar" objects or variables are created, based upon measured characteristics.

Attested

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

REFERENCES

1. Dallas E Johnson, Applied Multivariate methods for data analysis, Duxbury Press(2010).
2. Joseph F. Hair, Jr. William C. Black Barry J. Babin, Rolph E. Anderson, Multivariate Data Analysis, Pearson Edition, (2010).
3. Richard I Levin, Statistics for Management, PHI (2011).

QE5251 APPLIED QUALITY ENGINEERING L T P C
3 1 0 4

OBJECTIVES

- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing the special control procedures for service and process oriented industries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION 12

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

UNIT II CONTROL CHARTS 12

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

UNIT III SPECIAL CONTROL PROCEDURES 12

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

UNIT IV STATISTICAL PROCESS CONTROL 12

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

UNIT V ACCEPTANCE SAMPLING 12

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

TOTAL: 60 PERIODS

OUTCOMES :

Students will be able to:

CO1: Control the quality of processes using control charts for variables in manufacturing industries.

CO2: Control the occurrence of defective product and the defects in manufacturing companies.

CO3: Control the occurrence of defects in services.

CO4: Analyzing and understanding the process capability study.

CO5: Developing the acceptance sampling procedures for incoming raw material.

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

REFERENCES:

1. Douglas C Montgomery, Introduction to Statistical Quality Control, John Wiley, Seventh Edition, 2012.
3. Grant E.L. and Leavens worth, Statistical Quality Control, TMH, 2000.
4. IS 2500 Standard sampling plans.
5. K Krishnaiah, Applied Statistical Quality control and Improvement, PHI, 2014.

IL5201 SYSTEM SIMULATION L T P C
3 1 0 4

OBJECTIVES

- To learn about generating of random numbers and random variates.
- To learn how to test the random numbers and random variates.
- To learn how to design the simulation experiment.
- To be trained in simulation software packages.
- To apply simulation techniques for various optimization problems.

UNIT I INTRODUCTION AND RANDOM NUMBERS 12

Systems – Modelling – Types – Systems components – Simulation basics- Random numbers – Methods of generation : Manual, table, algorithms – mid square, multiplier, constant multiplier, additive and multiplicative congruential algorithms

UNIT II RANDOM VARIATES GENERATION AND TESTING 12

Random variates for standard distributions like uniform, exponential, poisson, binomial, normal etc – Testing of Random variates – Input Data Modeling - Monte Carlo Simulation.

UNIT III DESIGN OF SIMULATION EXPERIMENTS 12

Steps on Design of Simulation Experiments – Development of models using of High level language for systems like Queing, Inventory, Replacement, Production etc., - Model validation and verification, Output analysis. Use of DOE tools.

UNIT IV SIMULATION LANGUAGES 12

Need for simulation Languages – Study of various simulation software packages.

UNIT V CASE STUDIES USING SIMULATION LANGUAGES 12

Waiting line models, inventory models, and production models.

TOTAL : 60 PERIODS

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OUTCOMES

CO1: Able to generate random numbers and random variates.
CO2: Able to test the statistical stability of random variates
CO 3: Able to develop simulation models for real life systems
CO4: How to use simulation language to simulate and analyze various problems.
CO5: Able to solve waiting line model, inventory models and production models problems using simulation software.

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

REFERENCES:

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2. Jerry Banks, John S Corson, Barry.L. Nelson, David M.Nicol and P.Shahabudeen, Discrete Event Systems Simulation, Pearson education, Fourth edition, 2007.
3. Law A M and Kelton W D, Simulation Modelling and analysis, Tata McGraw Hill, 2003.Thomas J Schriber, “Simulation Using GPSS”, John Wiley, 2002.

IL5211 **DATA ANALYTICS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- Training and Exposure on Correction Analysis, Simple and Multiple Regression.
- Training and Exposure on Factor Analysis, Discriminant and Cluster Analysis.
- Training and Exposure on Control Charts for Variable and Attributes.
- Training and Exposure on Predicting Reliability Parameters.
- Training and Exposure on Analysis of Variance.

1. Determine the linear regression model for fitting a straight line and calculate the least squares estimates, the residuals and the residual sum of squares.
2. Determine the multivariate regression model for fitting the straight line.
3. Perform the Correlation analysis to determine the relationships among the variables.
4. Perform the factor analysis for the given set of model data using both Exploratory and Confirmatory methods and evaluate the model adequacy.
5. Determine which continuous variable discriminate among the given group and determine which variable is the best predictor.
6. Determine the groups using Cluster Analysis
7. Determine the process is within the control or not by developing the control charts for attributes and variables and estimate the process capability.
8. Estimate the parameters (MTTF, MTBF, failure rate, bathtub curve etc) of components and systems to predict its reliability.
9. Develop the single factor and two factor design of experiment model to predict the significance factor.
10. Develop 2^K factorial and 2^{k-p} fractional factorial experiment to determine the parameters which affect the system.

TOTAL : 60 PERIODS

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OUTCOMES:
CO1: Ability to independently formulate, perform and assess hypothesis
CO2: Ability to select appropriate technique
CO3: Ability to apply selected data analysis techniques
CO4: Ability to interpret the results
CO5: Ability to present the results properly to extract meaningful information from data sets for effective decision making.

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

IL5212 **SIMULATION LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:
- Develop C program to generate random number and random variates.
- Develop C program to fest random number and random variates.
- Apply Monte carlo simulation for random walk problem and paper vendor problem
- Develop simulation model using simulation software for different queuing models.
- Develop simulation model using simulation software for Inventory models.

LIST OF EXPERIMENTS:
1. Generate Random Number by Mid Square, Midpoint and Congruential method using 'C' program.
2. Generate Poisson random Variate, uniform random Variate using 'C' program.
3. Generate Normal random Variate, Binomial random Variate using 'C' program.
4. Testing random numbers and random variates for their uniformity.
5. Testing random numbers and random variates for their independence.
6. Solve random walk problem using Monte Carlo simulation.
7. Solve paper vendor problem using Monte Carlo simulation.
8. Solve single server queuing model using simulation software package.
9. Solve multi server queuing model using simulation software package.
10. Solve inventory model using simulation software package.

SOFTWARES REQUIREMENTS:
Simulation software package

TOTAL : 30 PERIODS

OUTCOMES:
CO1: Know to generate random number and random variates.
CO2: Learn to test the random number and random variates.
CO3: Able to apply Monte Carlo simulations to random walk and paper vendor problems.
CO4: Able to apply simulation software to various queuing models.
CO5: Know to use simulation software to various inventory models.

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

Attested

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IL5072 APPLIED OBJECT ORIENTED PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- Explain the fundamentals of C++
- To introduce the object oriented programming
- To learn how to create a class in C++
- Articulate how to derive a class
- Design the object oriented programming for Industrial Problems

UNIT I C++ Basics 9

Expression and statements, operators, precedence, type conversion, control statements, loops, Arrays structures, functions, argument passing, reference argument, overloaded function.

UNIT II FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING 9

Elements of OOP, classes, subjects, messaging, inheritance, polymorphism, OOP paradigm versus procedural paradigm, object-oriented design.

UNIT III C++ CLASS 9

Definition, class objects, member functions, class argument, operator overloading, user defined conversions.

UNIT IV CLASS DERIVATION 9

Derivation specification, public and private base classes, standard conversions under derivation, classscope, initialization and assignment under derivation.

UNIT V APPLICATION 9

OOP's applications in Industrial Engineering.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to and write and execute C++ programs,
CO2: Able to understand the need for object oriented programming
CO3: Able to create class in C++ program
CO4: Able to derive a class from the basic class
CO5: Able to write a program for solving the industrial problem.

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

REFERENCES:

1. E.Balagurusamy, Object oriented programming with C ++,Tata Mc Graw Hill,2003
2. Nabajyoti Barkakati,Object Oriented Programming in C++, Prentice Hall of India, 2001
3. Robert Lafore, "Object oriented programming in C++", Sam Publishing, 2002.
4. R.S.Salaria, Mastering Object Oriented Programming with C++, Khanna Publishers; 6th revised edition,2016
5. Stanley B.Lippman, C++ Printer, Addison – Wesley Pub. Co., 2003.

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IL5001 **OPERATIONS MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- Summarize the operations, its strategy and design.
- Identify the future demand with accuracy.
- Plan the production and its resources.
- Illustrate the Inventory and its control.
- Interpret the control of production.

UNIT I UNDERSTANDING OPERATIONS AND ITS DESIGN 9

Introduction to Operations Management, Manufacturing trends in India, Systems Perspective, Functions of Operations Management, Challenges and current priories for operations management; The Relevance of Operations Strategy, Formulation of Strategy, World Class Manufacturing Process and Emerging Trends and Implications for Operations; Designing Operations – Design of Manufacturing Process and Design of Services Systems.

UNIT II DEMAND FORECASTING 9

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

UNIT III PRODUCTION PLANNING 9

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

UNIT IV INVENTORY PLANNING AND CONTROL 9

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

UNIT V CAPACITY ANALYSIS AND OPERATIONAL CONTROL 9

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

TOTAL: 45 PERIODS

OUTCOMES

- CO1: The students will be able to understand what is operations management, its strategies and design of operations.
- CO2: The students will be able to apply various techniques in forecasting the future Demand with accuracy.
- CO3: The students will be able to plan the production schedule and apply techniques like Aggregate plan, MRP, MRP II, DRP and ERP.
- CO4: The students will be able determine the lot size and understand the inventory systems. Also will be able to classify the inventories for a better control.
- CO5: The students will be able to understand capacity planning and exercise control on production. Also understand JIT implementation and control.

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

REFERENCES:

1. Lee J.Krajewski, Larry P.Ritzman, "Operations Management", Pearson Education, 2012.
2. Mahadevan,B. Operations- Theory & Practice, Pearson Education, 2015.
3. Panneerselvam,R. Production and operations management, PHI, 2012.
4. Seetharama L.Narasimhan, Dennis W.McLeavey, Peter J.Billington,"Production Planning and Inventory Control" , PHI, 2002.

IL5076 INDUSTRIAL AUTOMATION AND ROBOTICS L T P C
3 0 0 3

OBJECTIVES:

- Justify the high cost of investment in automation through production economics concepts.
- Summarize the fundamental concepts and elements of computer-integrated manufacturing.
- Articulate various aspects of automated manufacturing such as fixed automation and programmable automation.
- Familiarize the automated material handling and storage systems
- Discover computerized planning, lean and agile systems.

UNIT I AUTOMATION 9

Types of production – Functions – Automation strategies – Production economics – Costs in manufacturing – Break-even analysis.

UNIT II AUTOMATED FLOW LINES 9

Transfer mechanism - Buffer storage – Analysis of transfer lines - Automated assembly systems.

UNIT III NUMERICAL CONTROL AND ROBOTICS 9

NC-CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications – End effectors – Sensors - Robot cell design – CAD/CAM.

UNIT IV AUTOMATED HANDLING AND STORAGE 9

Automated material handling systems – AGV- AS/RS – carousel storage – Automatic data capture – bar code technology- RFID

UNIT V MANUFACTURING SUPPORT SYSTEMS 9

Product design and CAD, CAD/CAM and CIM, Computer aided process planning- variant and generative approaches, Concurrent engineering and design for manufacture, Lean production, Agile manufacturing.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Select automated equipment based on break-even quantity and compute cost per component.

CO2: Analyze an automated flow line without and with buffer for its performance measures.

CO3: Acquire knowledge in Numerical control programming.

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CO4: Identify the elements of manufacturing automation; these include CNC, Robotics, automated assembly and material handling.
CO5: Understand manufacturing planning and control systems.

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

REFERENCES:

1. Mikell P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing" PHI, 2003. 24
2. Weatherall, "Computer Integrated Manufacturing – A total company strategy", 2nd edition, 1995.

IL5079 MANAGEMENT ACCOUNTING AND FINANCIAL MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- Preparing the P&L A/C, Balance sheet and other accounting
- Appling the various cost accounting methods
- Sketch and Prepare a budget
- Evaluating and making investment decisions and select the most desirable projects
- Developing financial decision

UNIT I FINANCIAL ACCOUNTING 9

Trading Account, Profit and Loss Account, Balance sheet statement, Cash flow and fund flow analysis, Working capital management, Inventory valuation, financial ratio analysis– Depreciation.

UNIT II COST ACCOUNTING 9

Cost Accounting systems: Job costing, Process costing, Allocation of Overheads, Activity based Costing, Differential and Incremental cost, Variance analysis, Software costing.

UNIT III BUDGETING 9

Requirements for a sound budget, Fixed budget – Preparation of sales and Production budget, Flexible budgets, Zero base budgeting and budgetary control.

UNIT IV FINANCIAL MANAGEMENT 9

Investment decisions – Capital investment process, Type 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 V FINANCIAL DECISIONS 9

Cost of capital – Capital structure – Dividend policy – Leasing.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Ability to prepare P&L A/C, Balance sheet and other accounting
CO2: Ability to apply the various cost accounting methods
CO3: Ability to prepare a budget
CO4: Ability to Evaluate, make investment decisions and select the most desirable projects
CO5: Ability to make financial decision

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

REFERENCES

1. Bhattacharya, S.K. and John Deardon, "Accounting for management – Text and Cases", Vikas Publishing house, New Delhi, 2010.
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IL5002 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- Summarize the basics of TQM, contributions of various quality Gurus, benefits and obstacles.
- Illustrate the most important principles of TQM.
- Apply QMS, EMS and Benchmarking in the organizations and understand the role of IT in TQM implementation.
- Teach various tools of TQM.
- Recognize TQM in organizations and understand the various TQM awards.

UNIT I INTRODUCTION 9

Defining Quality, Basic approaches of TQM, Gurus of TQM - Shewart, Ronald Fisher, Deming, Juran, Feigenbaum, Ishikawa, Crosby, Taguchi – TQM Framework – Historical review, Obstacles, Benefits of TQM

UNIT II TQM PRINCIPLES 9

Leadership, Customer Satisfaction, Employee Involvement, Continuous Process Improvement, Supplier Partnership, Performance Measures, Cost of Quality.

UNIT III TOOLS AND TECHNIQUES – I 9

Benchmarking, Information Technology, ISO 9000 Series of Quality Management Systems, Environmental Management Systems.

UNIT IV TOOLS AND TECHNIQUES - II 9

QFD, FMEA, Quality Circles, TPM, Traditional Quality Tools and Management tools.

UNIT V IMPLEMENTATION OF TQM 9

Steps in TQM implementation, national and international quality awards, case studies.

TOTAL :45 PERIODS

OUTCOMES:

- CO1: The students will be able to understand the basics of TQM, contributions of various quality Gurus, benefits and obstacles.
- CO2: The students will be able to understand the most important principles of TQM.
- CO3: The students will be able to apply QMS, EMS and Benchmarking in the organizations and understand the role of IT in TQM implementation.
- CO4: The students will be able to apply various tools of TQM.
- CO5: The students will be able to understand the implementation of TQM in organizations and understand the various TQM awards.

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

REFERENCES:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,MaryB.Sacre,HemantUrdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.
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4. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
5. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006.

IL5003 DESIGN AND ANALYSIS OF ALGORITHMS L T P C
3 0 0 3

OBJECTIVES:

- Understand the basic steps in development of an algorithm
- Learn and apply various syntax used in C++ programming language.
- Develop knowledge about Structured programming and data structure.
- Comprehend and apply methods of designs to algorithms.
- Acquire knowledge in various algorithms.

UNIT I INTRODUCTION 5

Algorithms, basic steps in development.

UNIT II REVIEW OF THE STRUCTURED LANGUAGES 10

C++ Basics, Expression, operators, control statements, structures, multi-dimensional array, functions, arguments, overload function.

UNIT III BASIC TOOLS 5

Top down, Structured programming, networks, data structure.

UNIT IV METHODS OF DESIGN 10

Sub goals, hill climbing and working backward, heuristics, back track programming, Branch and bound recursion process, program testing, documentation, Meta heuristics.

UNIT V APPLICATION 15

Development of sorting, searching, algorithms- combinatorial problems, shortest path, probabilistic algorithms.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Know about the algorithms and basic steps in development of algorithm.
CO2: Acquire knowledge in basic structured languages.
CO3: To write a structured program using appropriate data structure.
CO4: Choose and apply the appropriate methods of design in algorithms or programs.
CO5: To write programs for applications using various algorithms.

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

REFERENCES:

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4. John R Hubbard, Fundamentals of Computing with C++, Tata Mc Graw Hill, 2000.
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IL5077 LEAN MANUFACTURING AND SIX SIGMA L T P C
3 0 0 3

OBJECTIVES:

- Summarize the basics of Lean and Six Sigma.
- Describe the need and the process of integrating Lean and Six sigma.
- Identify and select the resources required for LSS Projects and selection of projects including Team building.
- Infer the DMAIC process and study the various tools for undertaking LSS projects.
- Relate how to institutionalize the LSS efforts.

UNIT I INTRODUCTION TO LEAN AND SIX SIGMA 9

Introduction to Lean- Definition, Purpose, Features of Lean ; Top seven wastes, Need for Lean management, The philosophy of lean management, Creating a lean enterprise, Elements of Lean, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six sigma, origin of six sigma, Six sigma concept and Critical success factors for six sigma; Case analysis.

UNIT II INTEGRATION OF LEAN AND SIX SIGMA 9

Evolution of lean six sigma, the synergy of Lean and six sigma, Definition of lean six sigma, the principles of lean six sigma, Scope for lean six sigma, Features of lean six sigma. The laws of lean six sigma, Key elements of LSS, the LSS model and the benefits of lean six sigma. Initiation - Top management commitment – Infrastructure and deployment planning, Process focus, organizational structures, Measures – Rewards and recognition, Infrastructure tools, structure of transforming event and Launch preparation; Case study presentations.

UNIT III PROJECT SELECTION AND TEAM BUILDING 9

Resource and project selection, Selection of Black belts, Training of Black belts and Champions, Identification of potential projects, top down (Balanced score card) and Bottom up approach – Methods of selecting projects – Benefit/Effort graph, Process mapping, value stream mapping, Predicting and improving team performance, Nine team roles and Team leadership; Case study presentations.

UNIT IV THE DMAIC PROCESS AND TOOLS 9

The DMAIC process – Toll gate reviews; The DMAIC tools; Define tools – Project definition form, SIPOC diagram; Measure tools – Process mapping, Lead time/cycle time, Pareto chart, Cause and Effect matrix, FMEA; Idea – generating and organizing tools – Brainstorming, Nominal group technique, Multi-voting and Cause and effect diagram, Data collection and accuracy tools- Check sheet, Gauge R&R; Understanding and eliminating variation- run charts, control charts and process capability analysis; Analyze tools - Scatter plots, ANOVA, Regression analysis, Time trap analysis; Improve tools – Mistake proofing, Kaizen, set up time reduction (SMED), TPM, DOE and the pull system. Control tools – statistical process control.

UNIT V INSTITUTIONALIZING AND DESIGN FOR LSS 9

Institutionalizing lean six sigma – improving design velocity, creating cycle time base line, valuing projects, gating the projects, reducing product line complexity, Design for lean six sigma, QFD, Theory of Inventive Problem solving (TRIZ), Robust design; Case study presentations.

TOTAL : 45 PERIODS

OUTCOMES:

- CO1: The students will be able to understand what is Lean and Six sigma and their importance in the globalised competitive world.
- CO2: The students will be able to understand the importance of integrating Lean and Six sigma and also the process of their integration.
- CO3: The students will be able to plan the Resources required to undertake the LSS projects and also acquire how to select the suitable projects and the teams.
- CO4: The students will be able apply DMAIC methodology to execute LSS projects and in this regard they will be acquainted with various LSS tools.
- CO5: The students will be able to understand the process of institutionalizing the LSS effort and also understand the Design for LSS.

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

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2. Michael L. George, Lean Six Sigma, McGraw-Hill., 2002.
3. Ronald G.Askin and Jeffrey B.Goldberg, Design and Analysis of Lean Production Systems, John Wiley & Sons., 2003.
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IL5071 ADVANCED OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- Learn to solve integer programming problems
- To know how to solve the Dynamic programming problems
- Learn to solve non – linear programming problems with un constrained optimization problems
- Understand to solve non-linear programming problems using KKT conditions, quadratic and separable programming
- To create awareness of Meta heuristic algorithms.

UNIT I INTEGER PROGRAMMING 9

Branch and Bound technique –cutting plane algorithm method - Travelling Salesman problem - Traveling Salesman Problem - Branch and Bound Algorithms for TSP - Heuristics for TSP - Chinese Postman Problem - Vehicle Routeing Problem

UNIT II DYNAMIC PROGRAMMING 9

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

UNIT III NONLINEAR PROGRAMMING - I 9

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

UNIT IV NONLINEAR PROGRAMMING – II 9

The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization - Quadratic Programming - Separable Programming - Convex Programming - Nonconvex Programming

UNIT V NON-TRADITIONAL OPTIMIZATION 9

Overview of Genetic algorithms, Simulated Annealing, neural network based optimization. Particle Swarm optimization, Ant Colony Optimization, Optimization of Fuzzy Systems.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Know how to solve integer programming problems
CO2: Able to solve Dynamic programming problems
CO3: Familiar in solving unconstrained non linear optimization problems
CO4: Familiar in solving constrained liner optimization problems
CO5: Know how to solve non linear optimization problems using Meta heuristic algorithms

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

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IL5078 LOGISTICS AND DISTRIBUTION MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- Impart the basic knowledge on the concepts on logistics and distribution.
- Inculcate knowledge in Logistics Process, Planning and Materials Management.
- Teach the principles and activities in warehousing and storage.
- Provide knowledge on modes of transportation and international transport.
- Inculcate knowledge on performance monitoring, outsourcing and ICT application in logistics and distribution.

UNIT I CONCEPTS OF LOGISTICS AND DISTRIBUTION 9

Introduction to logistics and distribution- Integrated logistics and the supply chain- Integrated logistics and the supply chain- Customer service and logistics- Channels of distribution - Key issues an challenges for logistics.

UNIT II PLANNING FOR LOGISTICS 9

Planning framework for logistics -Logistics processes -Supply chain segmentation- Logistics network planning - Logistics management and organization - Manufacturing and materials management

UNIT III WAREHOUSING AND STORAGE 9

Principles of warehousing Storage and handling systems (palletized and non-palletized) - Order picking and replenishment- Receiving and dispatch - Warehouse design- Warehouse management and information.

UNIT IV FREIGHT TRANSPORT 9

International logistics: modal choice - Maritime transport - Air transport - Rail and intermodal transport- Road freight transport: vehicle selection, vehicle costing and planning and resourcing International transportation systems in Global perspective.

UNIT V OPERATIONAL MANAGEMENT 9

Cost and performance monitoring- Benchmarking- Information and communication technology in supply chain- Outsourcing: services and decision criteria, the selection process – Outsourcing management- Security and safety in distribution - Logistics and the environment.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Understand the concepts of logistics and distribution
CO2 – Effectively gain knowledge in logistics planning
CO3 – Apply and analyze various principles and concepts in warehousing and storage
CO4 – Effectively design and analyze a system of logistics for freight transport
CO5 – Understand the basic concepts in outsourcing, benchmarking and safety in distribution

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

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1. Alan Rushton,Phil Croucher and Peter Baker(Eds.)The Handbook of Logistics and Distribution Management, Kogan Page, 4th Edition,2010.
2. Jean-Paul Rodrigue, Claude Comtois and Brian Slack, “The geography of transport systems” (2009), New York: Routledge,

IL5084 **SUPPLY CHAIN MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- Explain the role of supply chain management in an organization.
- Identify the various aspects of supply chain management and the factors affecting them.
- Explain the relationship among various factors involved in planning, organising and controlling supply chain operations.
- Summarize the sourcing and inventory decisions involved in supply chain operations.
- Explain the use of information technology in supply chain management.

UNIT – I INTRODUCTION SUPPLY CHAIN MANAGEMENT 9

Introduction, Types of supply chains with and examples, Evolution of SCM concepts, Supply chain performance, Strategic Fit, Drivers of Supply Chain Performance – key decision areas – External Drivers of Change. Supply contracts – centralized vs. decentralized system

UNIT – II SUPPLY CHAIN NETWORK DESIGN 9

Need for distribution network design- Factors affecting, Design options for distribution network. Network design decisions - Framework, factors influencing, Models of facility location and capacity allocation. Role of Transportation in supply chain, modes of transportation Modal Selection, Classification of carriers, Carrier Selection, Transportation Execution and Control. Food Mile Concept., design options.

UNIT – III DEMAND AND SUPPLY IN SUPPLY CHAIN 9

Forecasting in supply chain- Methods, Approach, Errors. Aggregate planning in supply chain- Problem, Strategies and Implementation. Predictable variability in supply chain, Managing supply and demand. Distribution strategies-direct shipment, traditional warehousing, cross docking, inventory pooling, transhipment, Choosing appropriate strategy, Milk Run Model.

UNIT – IV SOURCING AND INVENTORY DECISIONS IN SUPPLY CHAIN 9

Purchasing Vs Procurement Vs Strategic Sourcing, Item procurement importance matrix, Strategic Sourcing Methodology, Managing sourcing and procurement process, Supplier selection and evaluation, Bullwhip effect and its management, Economies of scale in supply chain- Cycle inventory, Estimation, Quantity discounts, Multiechelon cycle inventory. Uncertainty in supply chain- Safety inventory, Determination of appropriate level, Impact on uncertainity.

UNIT – V SUPPLY CHAIN AND INFORMATION SYSTEMS 9

Information in supply chain, Role of Information technology, IT framework in supply chain, Supplier and Customer relationship management. Role of e-business in supply chain, e-sourcing and e-procurement. Technology drivers in supply chain.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

CO1: To introduce the concepts and elements of supply chain management.
CO2: to understand supply chain network design aspects for various manufacturing and service sectors.
CO3: To understand the principle of demand and supply in supply chain
CO4: To gain knowledge on the sourcing and inventory decisions in supply chain.
CO5: To understand the concepts of supply chain information systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1					✓						
CO2		✓									
CO3		✓	✓				✓	✓			
CO4					✓						✓
CO5					✓						✓

Attested

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3. Kaminsky S., “Design and Managing the Supply chain” , McGraw Hill International Edition. 2000.
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5. Sahay B.S. “Supply Chain Management: For Global Competitiveness”, 2nd Edition, Macmillan, India Ltd, 2011.

IL5004 MANUFACTURING SYSTEMS AND MODELS L T P C
3 0 0 3

OBJECTIVES

- To introduce the basic manufacturing systems and its performance measures.
- To learn and apply DTMC models
- To learn and apply CTMC models
- To model and analyse the manufacturing systems for queuing problems
- To model the problems as Petrinet-models

UNIT I MANUFACTURING SYSTEMS- PERFORMANCE MEASURES 9

Manufacturing systems- Types, Concepts. Performance measures- types. Manufacturing Models- Types.

UNIT II DISCRETE TIME MARKOV CHAINS 9

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

UNIT III CONTINUOUS TIME MARKOV CHAINS 9

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

UNIT IV QUEUING MODELS 9

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

UNIT V PETRINET MODELS 9

Introduction to petrinet models-Representational powers of Petrinets- Reachability graphs, Markings, Applications of petrinet models in manufacturing systems.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to identify and measure the performance of manufacturing system
CO2: Able to apply the DTMC model to a Manufacturing systems
CO3: Able to apply the CTMC model to a Manufacturing system
CO4: Able to apply the Queuing network model to a Manufacturing system
CO5: Able to apply the Peterinet model to a Manufacturing system

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

CO5	✓		✓									✓

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IL5081 **PROJECT MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- Compare various models used in project selection.
- Define project planning, and estimate the cost involved.
- Apply network techniques for project scheduling and resource allocation.
- Summarize the information needed planning, monitoring and controlling cycle of a project.
- Recognize the values of project audit.

UNIT I STRATEGIC MANAGEMENT AND PROJECT SELECTION 9

Project selection models, Project portfolio process, Analysis under uncertainty, Project organization, Matrix organization

UNIT II PROJECT PLANNING AND COST ESTIMATION 9

Work breakdown structure, Systems integration, Interface coordination, Project life cycle, Conflict and negotiation, Estimating Project Budgets, Process of cost estimation.

UNIT III PROJECT IMPLEMENTATION 9

Scheduling: Network Techniques PERT and CPM, Risk analysis using simulation, CPM- crashing a project, Resource loading, leveling, and allocation.

UNIT IV MONITORING AND INFORMATION SYSTEMS 9

Information needs and the reporting process, computerized PMIS, Earned value analysis, Planning- Monitoring-Controlling cycle, Project control: types of control processes, design of control systems, control of change and scope

UNIT V PROJECT AUDITING 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- CO1 - Understand various models used in project selection.
- CO2 - Acquire knowledge in project planning, and estimate the cost involved.
- CO3 - Prepare Project Scheduling and resource allocation.
- CO4 - Understand about planning, monitoring and controlling cycle of a project.
- CO5 - Understand the values of project audit.

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

Attested

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Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

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IL5005 DESIGN OF EXPERIMENTS L T P C
3 0 0 3

OBJECTIVES:

- Impart knowledge on principles and steps in designing a statistically designed experiment.
- Build foundation in analysing the data in single factor experiments and to perform post hoc tests.
- Provide knowledge on analysing the data in factorial experiments.
- Educate on analysing the data analysis in special experimental designs and Response Surface Methods.
- Impart knowledge in designing and analysing the data in Taguchi's Design of Experiments to improve Process/Product quality.

UNIT I EXPERIMENTAL DESIGN FUNDAMENTALS 12

Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression models.

UNIT II SINGLE FACTOR EXPERIMENTS 12

Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.

UNIT III MULTIFACTOR EXPERIMENTS 12

Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F- tests. 2^K factorial Experiments.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS: 12

Blocking and confounding in 2^K designs. Two level Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methods.

UNIT V TAGUCHI METHODS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

CO1: Understand the fundamental principles of Design of Experiments.
CO2: Analyze data in the single factor experiments.
CO3: Analyze data in the multifactor experiments.
CO4: Understand the special experimental designs & Response Surface Methods.
CO5: Apply Taguchi based approach to evaluate quality.

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

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QE5073 PRODUCT INNOVATION AND DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:
- Gain knowledge of innovation in Product design and development.
- Summarize the development of new products through conceptualization, design and development phases.
- Associate various aspects of product development with industrial design and manufacturing.
- Interpret the fundamental concept of Rapid Prototyping.
- Generate products which are suitable for the needs of the society.

UNIT I PRODUCT DEVELOPMENT AND CONCEPT SELECTION 9

Product development process – Product development organizations- Identifying the customer needs – Establishing the product specifications – concept generation – Concept selection.

UNIT II PRODUCT ARCHITECTURE 9

Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT III INDUSTRIAL AND MANUFACTURING DESIGN 9

Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration -Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors

UNIT IV PROTOTYPING AND ECONOMIC ANALYSIS 9

Principles of prototyping – Planning for prototypes – Rapid Prototyping- Elements of economic analysis – Base case financial model – Sensitivity analysis – Influence of the quantitative factors.

UNIT V MANAGING PRODUCT DEVELOPMENT PROJECTS 9

Sequential, parallel and coupled tasks - Baseline project planning – Project Budget- Project execution – Project evaluation- patents- patent search-patent laws-International code for patents.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: The students should be able to understand the basic concept of product development.
CO2: Design and develop new products in a systematic using the studied tools and techniques.
CO3: To associate various aspects of product development with industrial design and manufacturing.
CO4: To understand the fundamental concept of Rapid Prototyping.
CO5: To be able to design products which are suitable for the needs of the society.

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
1		✓			✓						
2		✓	✓								
3											
4	✓										
5			✓					✓		✓	✓

REFERENCES:

1. Gevirtz C, Developing New products with TQM, McGraw – Hill International editions,1994.
2. Jamnia A, Introduction to Product Design and Development for Engineers, Taylor and Francis Group, 2018.
3. RosenthalS, Effective product design and development, Irwin 1992.
4. Ulrich K, Eppinger S, Product Design and Development, McGraw- Hill International Fifth Editions, 2012.

IL5083 SERVICES OPERATIONS MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- Summarize the importance of services in competitive environment
- Describe the services design and development
- Illustrate the services performance
- Conclude decisions in services facility
- Plan operations involved in services

UNIT I INTRODUCTION 9

Services – Importance, role in economy, service sector – growth; Nature of services -Service classification , Service Package, distinctive characteristics , open-systems view; Service Strategy – Strategic service vision, competitive environment, generic strategies, winning customers; Role of information technology; stages in service firm competitiveness; Internet strategies – Environmental strategies.

UNIT II SERVICE DESIGN 9

New Service Development – Design elements – Service Blue-printing - process structure – generic approaches –Value to customer; Retail design strategies – store size – Network configuration ; Managing Service Experience –experience economy, key dimensions ; Vehicle Routing and Scheduling

UNIT III SERVICE QUALITY 9

Service Quality- Dimensions, Service Quality Gap Model; Measuring Service Quality –SERVQUAL - Walk-through Audit; Quality service by design - Service Recovery - Service Guarantees; Service Encounter – triad, creating service orientation, service profit chain; Front-office Back-office Interface – service decoupling.

UNIT IV SERVICE FACILITY 9

Service scapes – behavior - environmental dimensions – framework; Facility design – nature, objectives, process analysis – process flow diagram, process steps, simulation; Service facility layout; Service Facility Location – considerations, facility location techniques – metropolitan metric, Euclidean, centre of gravity, retail outlet location , location set covering problem

UNIT V MANAGING CAPACITY AND DEMAND 9

Managing Demand – strategies; Managing capacity – basic strategies, supply management tactics, operations planning and control; Yield management; Inventory Management in Services– Retail Discounting Model, Newsvendor Model; Managing Waiting Lines –Queuing systems, psychology of waiting; Managing for growth- expansion strategies, franchising , globalization.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to summarize service strategies
CO2. Able to describe service network
CO3. Able to illustrate service performance using software tools
CO4. Able to locate facilities using simulation
CO5. Able to formulate inventory and queuing models.

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

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IL5006 SCHEDULING ALGORITHMS L T P C
3 0 0 3

OBJECTIVE:

- Introduce the basic concepts of scheduling theory.
- Understand the application of single machine scheduling algorithms.
- Perceive knowledge in parallel machine scheduling algorithms.
- Grasp the concept of flow shop scheduling and its algorithm.
- Familiarize the students in the use of algorithms for job scheduling problems

UNIT I SCHEDULING THEORY 9

Scheduling background – Scheduling function – Sequencing – Ready time – Flow time – Tardiness - Weighted flow time – Inventory – Regular measures of performance – Dominant schedules – SPT, EDD, WSPT sequences – Scheduling Theorems.

UNIT II SINGLE MACHINE SCHEDULING 9

Pure sequencing model – Hodgson's algorithm – Smith's rule – Wilkerson Irwin algorithm – Neighborhood search – Dynamic programming technique – Branch and Bound algorithm – Non simultaneous arrivals – Minimizing T and F for dependent jobs – Sequence dependent set up times.

UNIT III PARALLEL MACHINE SCHEDULING 9

Preemptive jobs: McNaughton's algorithm – Non preemptive jobs – Heuristic procedures – Minimizing Fw : H1 & Hm heuristics – Dependent jobs: Hu's algorithm – Muntz Coffman algorithm.

UNIT IV FLOW SHOP SCHEDULING **9**

Characteristics – Johnson's algorithm – Extension of Johnson's rule – Campbell Dudek Smith algorithm – Palmer's method – Start lag, stop lag – Mitten's algorithm – Ignall Schrage algorithm - Despatch index heuristic.

UNIT V JOB SHOP SCHEDULING **9**

Characteristics –Graphical tools – Jackson's algorithm – Feasible, Semi-active and Active schedules – Single pass approach – Non delay schedule – Priority dispatching rules – Heuristic schedule generation – Open shop scheduling.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Understand the basics of Scheduling theory.
CO2: Understand various single machine scheduling algorithms.
CO3: Understand various parallel machine scheduling algorithms.
CO4: Understand various flow shop scheduling algorithms.
CO5: Understand various job shop scheduling algorithms

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

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2. Richard W. Conway, William L.Maxwell and Louis W. Miller,"Theory of Scheduling", Dover Publications, 2003.

QE5071 MAINTENANCE ENGINEERING AND MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES:

- Describe basic maintenance concepts
- Extract optimum maintenance decisions
- Illustrate the root cause for maintenance problems
- Plan the spare parts for maintenance activity
- Discover the losses and improve the Overall Equipment Effectiveness

UNIT I MAINTENANCE CONCEPT **9**

Maintenance definition – Maintenance objectives - Maintenance challenges – Tero Technology Maintenance costs - Scope of maintenance department.

UNIT II MAINTENANCE MODELS **9**

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

UNIT III MAINTENANCE QUALITY **9**

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

UNIT IV MAINTENANCE MANAGEMENT 9

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

UNIT V TOTAL PRODUCTIVE MAINTENANCE 9

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

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to describe basic maintenance concepts.
CO2: Able to extract maintenance policies for maximizing the profit
CO3: Able to make a diagnosis of maintenance problems
CO4: Able to improve uptime of machines by effective spare parts management
CO5: Able to improve the overall Equipment Effectiveness

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

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2. Bikas Badhury & Basu S K, “Tero Technology: Reliability Engineering and Maintenance Management”, Asian Books, 2003.
3. Mishra R C and Pathak K., “Maintenance Engineering and Management”, PHI,2012
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IL5007 PRODUCTIVITY MANAGEMENT AND RE - ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- Identify the basic principles of Productivity Models
- Classify various ways in which productivity is measured and evaluated.
- Describe the basic concept of Re-Engineering.
- Use Re-Engineering tools and techniques to improve productivity.
- Compare the various Re-Engineering Models.

UNIT I PRODUCTIVITY 9

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle Productivity Measurement at International, National and Organisation level - Productivity measurement models.

UNIT II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT 9

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector.

UNIT III ORGANISATIONAL TRANSFORMATION 9

Elements of Organisational Transformation and Reengineering-Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, LMI CIP Model – DSMC Q & PMP model.

UNIT IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS 9

PMI models, PASIM Model, Moen and Nolan Strategy for process improvement, LMICIP Model, NPRDC Model.

UNIT V RE-ENGINEERING TOOLS AND IMPLEMENTATION 9

Analytical and process tools and techniques – Information and Communication Technology – Implementation of Reengineering Projects – Success Factors and common implementation Problem– Cases.

TOTAL: 45 PERIODS

OUTCOMES:

Student will be able to:

- CO1: Understand the term productivity.
- CO2: Measure and evaluate productivity.
- CO3: Plan and implement various productivity techniques.
- CO4: Reengineer the process for improving the productivity.
- CO5: Implement BPR tools for improving the productivity.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1		✓			✓						
CO2		✓	✓								
CO3	✓						✓				
CO4					✓			✓			
CO5			✓					✓		✓	

REFERENCES

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2. Rastogi, P.N., “Re-engineering and Re-inventing the Enterprise”, Wheeler Pub. New Delhi, 1995.
3. Sumanth, D.J., ‘Productivity Engineering and Management’, TMH, New Delhi, 1990
4. Vrat P, Sardana, G.D. and Sahay, B.S., “Productivity Management – A Systems Approach”,Narosa Publishing House. New Delhi, 1998.

IL5080 PLANT LAYOUT AND MATERIAL HANDLING L T P C

3 0 0 3

OBJECTIVES:

- Explain the basic principles in facilities planning and plant location
- Interpret the basic principles in facility layout design decisions through proper analysis.
- Illustrate and explain various techniques while designing a layout
- Impart knowledge in line balancing concepts to implement improved system
- Summarize the basic principles in designing, measuring and analyzing material flow to improve the efficiency of the system

UNIT I PLANT LOCATION 9

Plant location analysis – factors, costs, location decisions – Single facility location models, Multi facility location models - Mini-sum model - Mini-max model - Gravity location models, Brown & Gibbs model

UNIT II FACILITIES LAYOUT 9

Facilities requirement, need for layout study – types of layout, Systematic layout planning, Relationship diagram, Designing the product layout – Line balancing - mixed model assembly line balancing

UNIT III LAYOUT DESIGN 9

Designing the process layout - computerized layout planning procedure – ALDEP, CORELAP, CRAFT – Trends in computerized layout

UNIT IV GROUP TECHNOLOGY 9

Group technology – OPTIZ classification system - Production Flow analysis (PFA), ROC (Rank Order Clustering)

UNIT V MATERIALS HANDLING 9

Principles, unit load concept, material handling system design, handling equipment types, selection and specification, containers and packaging.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 : apply and evaluate appropriate location models for various facility types
CO2 : effectively design and analyze various facility layouts
CO3 : apply and analyze various computerized techniques while designing a layout
CO4 : effectively design and analyze a layout using grouping techniques
CO5 : implement smooth and cost effective system in the material handling process

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

REFERENCES:

1. James Apple, M.Plant layout and “Material Handling”, John Wiley, 1977.
2. Pannerselvam,R, “Production and Operations Management”, PHI,2017
3. Richard Francis.L. and John A.White, “Facilities Layout and location - an analytical approach”, PHI., 2002
4. Tompkins, J.A. and J.A.White, “Facilities planning”, John Wiley, 2010.

QE5074 SOFTWARE QUALITY ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- Studying the basic principles and concepts in software quality
- Effectively designing, analyzing and developing the software engineering activities
- Gaining knowledge on software quality assurance and risk management
- Analyze the principles and applications of software quality management tools
- Gaining knowledge about software quality standards

UNIT I SOFTWARE QUALITY 9

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

UNIT II SOFTWARE ENGINEERING ACTIVITIES 9

Estimation, Software requirements gathering, Analysis, Architecture, Design, development, Testing and Maintenance.

UNIT III SUPPORTING ACTIVITIES 9

Metrics, Reviews –SCM – Software quality assurance and risk management.

UNIT IV SOFTWARE QUALITY MANAGEMENT TOOLS 9

Seven basic Quality tools – Checklist – Pareto diagram – Cause and effect diagram – Run chart – Histogram – Control chart – Scatter diagram – Poka Yoke – Statistical process control – Failure Mode and Effect Analysis – Quality Function deployment – Continuous improvement tools – Case study.

UNIT V QUALITY ASSURANCE MODELS 9

Software Quality Standards, ISO 9000 series – CMM, CMMI – P-CMM – Case study.

TOTAL: 45 PERIODS

OUTCOMES :

CO1 – understand the basic principles and concepts in software quality
CO2 – effectively design, analyze and develop software engineering activities
CO3 – gain knowledge on software quality assurance and risk management
CO4 – understand the principles and applications of software quality management tools
CO5 – gain knowledge about software quality standards

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

REFERENCES:

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

IL5082 RELIABILITY ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- Impart knowledge in reliability concepts.
- Facilitate students in filling the life data into theoretical distribution.
- Educate the students in reliability evaluation of various configuration.
- Impart knowledge in reliability monitoring methods.
- Analyze effectively various techniques to improve reliability of the system.

UNIT I RELIABILITY CONCEPTS 9

Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazard rate – Measures of Reliability – Design life –A priori and posteriori probabilities – Mortality of a component –Mortality curve – Useful life.

UNIT II LIFE DATA ANALYSIS 9

Data collection –Non Parametric methods: Ungrouped/Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull – Probability plotting – Goodness of fit tests.

UNIT III RELIABILITY ASSESSMENT 9

Different configurations – Redundancy – k out of n system – Complex systems: RBD – Baye's approach – Cut and tie sets – Fault Trees – Standby systems.

UNIT IV RELIABILITY MONITORING 9

Life testing methods: Failure terminated – Time terminated – Sequential Testing –Reliability growth monitoring – Reliability allocation – Software reliability-Human reliability.

UNIT V RELIABILITY IMPROVEMENT 9

Analysis of downtime – Repair time distribution – System repair time – Maintainability prediction – Measures of maintainability – Inspection decisions –System Availability.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 : Understand the basic concepts of reliability engineering
CO2 : Effectively analyze various non parametric methods and failure distributions
CO3 : Conduct reliability assessment and failure analysis on any complex systems
CO4 : Effectively design and analyze reliability monitoring techniques
CO5 : Analyze various techniques to improve reliability of the system

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

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1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000.
2. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.

IL5008 HUMAN FACTORS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- Use Knowledge of basic human science and Engineering science to improve physiological performance
- Illustrate an ergonomic analysis and ergonomic recommendations for modern work environment problems
- Design the Equipment by apply skills associated with ergonomic measurement methods
- Use ergonomic principles to design workplaces for the improvement of human performance
- Modify the work place based on Environment factors

UNIT I PHYSIOLOGICAL PERFORMANCE 9

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

UNIT II WORK SPACE DESIGN 9

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

UNIT III DESIGN OF EQUIPMENT 9

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

UNIT IV COGNITIVE ERGONOMICS 9

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

UNIT V DESIGN OF ENVIRONMENT 9

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

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Ability toapply Knowledge of basic human science and Engineering science to improve physiological performance

CO2: Ability to conduct an ergonomic analysis and ergonomic recommendations for modern work environment problems

CO3: Ability to design the Equipment by apply skills associated with ergonomic measurement methods

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

CO5: Ability to improve the work place based on Environment factors

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

REFERENCES:

1. Bridger, R. S. ”Introduction to Ergonomics”, 3rd ed. CRC Press, New York and London,2008
2. Martin Helander, A guide to Human Factors and Ergonomics, 2nd Edition, CRC, Taylor & Francis Group 2006.
3. MeCormik, J., Human Factors Engineering and Design, McGraw Hill, 1992.

IL5075 HUMAN INDUSTRIAL SAFETY AND HYGIENE

L	T	P	C
3	0	0	3

OBJECTIVES:

- Identify and prevent operational hazard
- Categorize, analyze and interpret the accidents data based on various safety techniques.
- Use proper safety techniques on safety engineering and management.
- Design the system with environmental consciousness by implementing safety regulation
- Use safety management practices in Industries.

UNIT I OPERATIONAL SAFETY 9

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipes- metal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – planning security and risk assessments, on – site and off site. Control of major industrial hazards.

UNIT II SAFETY APPRAISAL LAND ANALYSIS 9

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation .Measurement of safety performance, accident reporting and investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT III OCCUPATIONAL HEALTH 9

Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV SAFETY AND HEALTH REGULATIONS 9

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT V SAFETY MANAGEMENT 9

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Ability to Identify and prevent operational hazard

CO2: Ability to collect, analyze and interpret the accidents data based on various safety techniques.

CO3: Ability to apply proper safety techniques on safety engineering and management.

CO4: Ability to design the system with environmental consciousness by implementing safety regulation

CO5: Ability to apply safety management practices in Industries.

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

REFERENCES:

1. John. V. Grimaldi and Rollin. H Simonds, "Safety Management", All India traveler Book seller, New Delhi – 1989.
2. John V Grimaldi, Safety Management. AITB publishers, 2003.
3. Krishnan N.V, "Safety in Industry", Jaico Publisher House, 1996.
4. Singh, U.K and Dewan, J.M., "Sagety, Security and Risk Management", APH publishing company, New Delhi, 1996.

IL5073 DECISION SUPPORT SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- Summarize managerial role in decision making.
- Articulate insights in the models used for decision making
- Interpret knowledge management methods
- Relate knowledge acquisition and representation.
- Discover the issues in implementation of decision making systems.

UNIT I DECISION MAKING 9

Managerial decision making, system modeling and support-preview of the modeling process-phases of decision making process.

UNIT II MODELING AND ANALYSIS 9

DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development.

UNIT III KNOWLEDGE MANAGEMENT 9

Group support systems- enterprise DSS- supply chain and DSS-knowledge management methods, technologies and tools.

UNIT IV INTELLIGENT SYSTEMS 9

Artificial intelligence and expert systems-concepts, structure, types-knowledge acquisition and validation, knowledge representation

UNIT V IMPLEMENTATION 9

Implementation, integration and impact of management support systems.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 – Make decisions in the semi structured and unstructured problem situations using systems and semantic networks.
CO2 – Understand various components of DSS and modeling & analysis phases of DSS
CO3 – Understand the concepts of knowledge management methods in DSS
CO4 – Gain knowledge on artificial intelligence systems
CO5 – Implement management support systems

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

REFERENCES:

1. Efraim Turban and Jay E Aronson, Decision Support and Intelligent Systems, Pearson education Asia, Seventh edition, 2005.
2. Elain Rich and Kevin Knight, Artificial intelligence, TMH, 2006.

IL5074 ENTERPRISE RESOURCE PLANNING L T P C

3 0 0 3

OBJECTIVES:

- Describe an idea about ERP
- Creating awareness of core and extended modules of ERP
- Extract knowledge of ERP implementation cycle
- Gaining knowledge about effects of ERP after its implementation.
- Understanding the emerging trends on ERP

UNIT I INTRODUCTION 9

Overview of enterprise systems – Evolution - Risks and benefits - Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems.

UNIT II ERP SOLUTIONS AND FUNCTIONAL MODULES 9

Overview of ERP software solutions- Small, medium and large enterprise vendor solutions, BPR, and best business practices - Business process Management, Functional modules.

UNIT III ERP IMPLEMENTATION 9

Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work- Training – Data Migration. People Organization in implementation-Consultants, Vendors and Employees.

UNIT IV POST IMPLEMENTATION 9

Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation.

UNIT V EMERGING TRENDS ON ERP 9

Extended ERP systems and ERP add-ons -CRM, SCM, Business analytics - Future trends in ERP systems-web enabled, Wireless technologies, cloud computing.

TOTAL: 45 PERIODS

Attested

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

OUTCOMES

CO1: Get an idea about ERP
CO2: Awareness of core and extended modules of ERP
CO3: Knowledge of ERP implementation cycle
CO4: Gain knowledge about effects of ERP after its implementation.
CO5: Understand the emerging trends on ERP

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

REFERENCES

1. Alexis Leon, Enterprise Resource Planning, second edition, Tata McGraw-Hill, 2008.
2. Jagan Nathan Vaman, ERP in Practice, Tata McGraw-Hill, 2008
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5. Vinod Kumar Grag and N.K. Venkitakrishnan, ERP- Concepts and Practice, Prentice Hall of India, 2006.

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.
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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

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	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

COURSE 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

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

COURSE 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

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.

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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.

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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	✓	✓	✓									

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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.

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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.

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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 THEMATIC OVERVIEW

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

UNIT III 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 IV 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 V 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

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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

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TOTAL: 30 PERIODS

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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.

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Anna University, Chennai-600 025