KERALA TECHNOLOGICAL UNIVERSITY

ERNAKULAM WESTCLUSTER

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

PRODUCTION AND INDUSTRIAL ENGINEERING

(2015 ADMISSION ONWARDS)

SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN PRODUCTION AND INDUSTRIAL ENGINEERING

SEMESTER-1

Exam Slot	Course No:	Name	L-T -P	Internal Marks	END SEMESTER EXAM		Credits
					Marks	Duration (hrs)	
A	06ME6015	Probability & statistics	4-0-0	40	60	3	4
B	06ME6025	Decision modeling – I	4-0-0	40	60	3	4
C	06ME6035	Quality engineering & management	4-0-0	40	60	3	4
D	06ME6045	Precision machining & metrology	3-0-0	40	60	3	3
E	06ME6x55	Elective - I	3-0-0	40	60	3	3
F	06ME6065	Research methodology	0-2-0	100	0	0	2
G	06ME6075	Seminar I	0-0-2	100	0	0	2
H	06ME6085	Manufacturing &Precision Engineering Lab	0-0-3	100	0	0	1

Credits:23

	Elective I (06ME6x55)
06ME6155	Safety & Human Factors Engineering
06ME6255	Non-Traditional Machining Processes
06ME6355	Flexible Manufacturing Systems
06ME6455	Product Design & Development

SEMESTER-II

Exam Slot	Course No:	Name	L- T – P	Internal Marks	END SEMESTER EXAM		Credits
					Marks	Duration (hrs)	
A	06ME6016	Materials Technology	4-0-0	40	60	3	4
B	06ME6026	Operations Management	3-0-0	40	60	3	3
C	06ME6036	Work Study and Ergonomics	3-0-0	40	60	3	3
D	06ME6x46	Elective II	3-0-0	40	60	3	3
E	06ME6x56	Elective III	3-0-0	40	60	3	3
F	06ME6066	Mini Project	0-0-4	100	0	0	2
G	06ME6076	IndustrialEngineering & Computational Lab	0-0-3	100	0	0	1

Credits:19

Elective II - **(**06ME6x46)		Elective III- (06ME6x56)	
06ME6146	Supply Chain Management	06ME6156	Management Information Systems
06ME6246	Processing Of Non-Metals	06ME6256	Additive Manufacturing
06ME6346	Decision Modelling - II	06ME6356	Friction And Wear
06ME6446	Computer Aided Process Planning	06ME6456	Metaheuristics

SEMESTER-III

Exam Slot	Course No:	Name	L- T – P	Internal Marks	END SEMESTER EXAM		Credits
					Marks	Duration (hrs)	
A	06ME7x15	Elective IV	3-0-0	40	60	3	3
B	06ME7x25	Elective V	3-0-0	40	60	3	3
C	06ME7035	Seminar II	0-0-2	100	0	0	2
D	06ME7045	Project(Phase 1)	0-0-12	50	0	0	6

Credits: 14

Elective-IV**(**06ME7x15**)**		Elective-V**(**06ME7x25**)**	
06ME7115	Maintenance Management	06ME7125	Statistical Design Of Experiments
06ME7215	Fundamentals of RoboticSystems	06ME7225	Systems Modeling And Analysis
06ME7315	Metal Forming	06ME7325	Welding Science
06ME7415	Industrial Automation	06ME7425	Advanced Production Planning And Inventory Control

SEMESTER-IV

Exam Slot	Course No:	Name	L- T – P	Internal Marks	END SEMESTER EXAM		Credits
					Marks	Duration (hrs)	
A	06ME7015	Project (Phase 2)	0-0-21	70	30	0	12

Credits: 12

Total Credits for all semesters: 68

SEMESTER - I

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6015	Probability & Statistics	4-0-0-4	2015
Pre-requisites	**Nil**		

Course Objective

To provide information about Estimation theory, Correlation, Regression and Testing ofhypothesis.

Syllabus

Relative frequency definition of probability, Bayes theorem, Rules of Probability, Random Variables, Joint Distributions, Mathematical Expectation, Chebychev's theorem, Discrete Distributions, Continuous Distributions, Sampling mean and variance, Sampling distributions, Estimation, Properties of point estimators, Confidence interval, Maximum likelihood and Least square estimations, Prediction intervals, Hypothesis testing Goodness of fit test, non-parametric tests.

Course Outcome

On completion of the course the students will be aware of the basic concepts of probability and statistics which will allow them to explore more into applied statistical applications in engineering and science.

Textbooks

1. Scheaffer, R.L and McClave, J.T.: Statistics for Engineers, Du Burg Press Boston, 1982.
2. Miller J.R., Freund J.E. and Johnson R: Probability and Statistics for Engineers,8th Edition, Pearson, 2010.

References

1. Bethea, R.M and Rhineheart, R.R: Applied Engineering Statistics, Marcel Dekker, 1991.
2. Chatfeld, C: Statistics for Technology, Chapman and Hall, 1976.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Probability: Relative frequency definition of probability, Axiomatic definition of probability, Conditionalprobability, Bayes theorem, Rules of Probability, Random Variables, Joint Distributions, Mathematical Expectation, Chebychev's theorem.	**14**	**25**
Module II Discrete Distribution: Bernouli, Binomial, Geometric, Poisson, Hypergeometric, Multinomial Distributions. Continuous Distributions:	**14**	**25**

Uniform, Exponential, Gamma, Normal, Weibull, Beta, Distribution of function of Random variables.		
FIRST INTERNAL EXAM		
Module III Sampling mean and variance, Sampling distributions based on normal, Estimation, Properties of point estimators, Confidence interval, Maximum likelihood and Least square estimations, Prediction intervals.	**14**	**25**
SECOND INTERNAL EXAM		
Module IV Hypothesis testing, Single and multiple sample case, Chi-square tests, Goodness of fit test, non-parametric tests, Wilcoxon rank sum and sign rank tests, Kruskal-Wallis test, Friedman f test, Rank correlation coefficient.	**14**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6025	Decision Modelling – I	4-0-0-4	2015
Pre-requisites	**Nil**		

Course Objective

To make the students aware about the importance of making decisions and the techniques of making best decisions in real life systems.

Syllabus

Linear programming, Transportation, Assignment models, Sequencing, Game theory, PERT – CPM – WBS, Queuing models, Replacement models

Course Outcome

This course will make the students to select the most apt technique in relation to the problem situation they are tackling with to make the best optimal decisions.

Textbooks

1. Ravindran, Phillips, Solberg; Operations Research: Principles and Practice,John Wiley and sons, 2007.
2. Hillier, F.S and Lieberman, G. J: Introduction to Operations Research, Ninth Edition, Mc Graw-Hill, 2012.

References

1. Hartely, R.V.: Operations Research: A Managerial Emphasis, Good Year Publishing Company.
2. Millier, D.M and Schimidt J. W: Industrial Engineering and Operations Research, John Wiley and sons, 1990.
3. Taha, H.A : Operations Research, VIII Edition, Wiley, 2007.
4. Cooke, W.P.: Quantitative Methods for Management Decisions, McGraw, Hill Book Company, 1985.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Linear programming .- requirements- assumptions-graphical methods- mathematical formulation of LP-canonical form of L P- Standard form of L P-theory of simplex method - L P maximization – Minimization – artificial variable for finding initial basic feasible solution – big M method – 2 phase method – degeneracy – unrestricted variables – duality theory - dual problem primal is of canonical form and standard form – properties of primal and dual optimal solutions.	12	25
Module II Transportation – matrix terminology - definitions – obtaining initial	13	25

basic feasible solutions – formulation and solution of transportation models – degeneracy in transportation problem – variants in transportation problem. Assignment models – mathematical representation of assignment model- - comparison with transportation model – Variants of assignment model. Sequencing – definition – processing n jobs through two machines and three machines – processing two jobs through m machines		
FIRST INTERNAL EXAM		
Module III Game theory – charteristics – terminologies – max min and mini max criteria of optimality – dominance property – mixed strategies for games without saddle point – algebraic method for 2 X 2 games – arithmetic method for 2 X2 games – mixed strategies 2 X n games or m X 2 games – graphic method for 2 X n or m X 2 games – solution of 3 X # or higher games – method of liner programming. PERT – CPM – WBS – Fulkerson's rule – crashing – usefulness of network techniques for decision making – applications of net work techniques	**15**	**25**
SECOND INTERNAL EXAM		
Module IV Queuing models – elements of queuing system – charteristic – waiting and idle time cost – transient and steady state of the system – single channel queuing theory – models of arrival and service times - Kendall's notation for representing queuing models – Model I (m/Mi/ : FCFS/α/α) – Model II generalization of model (M/M/I : SIRO/α/α) (Birth and Death process) – multi channel queuing theory model IV (M/M/C : FCFS/α/α) – Erlang family distribution – Model V (M/ER/1 : FCFS/α/α) –deterministic models- Mode VI (D/D/I) - Model VII (M/D/I). Replacement models – replacement of items that deteriorate – replacement of items whose maintenance and repair cost increases with time, ignoring changes in value of money during the period – replacement of itmes whose maintenance costs increases with time and value of money also changes with time – replacement if item that suddenly fails	**16**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6035	Quality Engineering & Management	4-0-0-4	2015
Pre-requisites	**Nil**		

Course Objective

The course is to teach the students the basic axioms and philosophies of quality engineering.

Syllabus

The concept of quality, need for quality assurances, Acceptance Sampling, Control charts, process capability studies, Management tools, Quality systems.

Course Outcome

This course will lay a firm foundation of quality engineering and management in students.

Textbooks

1. Amitava Mitra, Fundamentals of Quality Control and Improvement, 3rd Edition, Wiley.
2. Juran, J.M and Gryna, F.M : Quality Planning and Analysis for Enterprise Quality, 5th Edition, McGraw Hill, 2007.

References

1. Besterfield, D.H et al: Total Quality Management, 3rd Edition, Pearson Education, 2003.
2. Evans J.R and Lindsay W.M.: The Management and Control of Quality, Cengage Learning, 2008.
3. Pyzdek, T.: Six sigma handbook ,3rd Edition, McGraw Hill, 2010

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I The concept of quality, need for quality assurances, Acceptance Sampling for attributes, Design and analyzing of single, double, multiple and sequential sampling plans, measurement of the performance of the sampling plans, AOQ, AOQ, AOQL, ASN and ATI.	**13**	**25**
Module II Acceptance sampling by variables, Sampling plans with a simple specification limit with known and unknown variance, Sampling plan with double specification limits, Comparison of sampling plans by variables and attributes.	**15**	**25**

FIRST INTERNAL EXAM		
Module III Control charts, basic ideas, design and uses, Shewhart control chart for attributes and variables, modified control, process capability studies, control charts with memory, CUSUM charts, Six Sigma limits.	**13**	**25**
SECOND INTERNAL EXAM		
Module IV Management tools: Forced field analysis – Nominal group techniques – Affinity diagram – Interrelationship digraph – Tree diagram – Matrix diagram – Prioritization matrices – Process decision chart – Activity network diagram, Quality system: ISO 9000/QS 9000 – Basics, Six sigma for Quality, ISO 14000 Basics.	**15**	
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6045	Precision Machining & Metrology	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objective

This course is offered with the main object of making the students aware about the importance of precision engineering in the world of manufacturing.

Syllabus

Micromachining, Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS), Nano finishing process, Grinding, Metrology of micro machined components.

Course Outcome

The students are expected to know the different precision engineering techniques and its applications in the modern manufacturing technology.

Textbooks

1. V.K.Jain, "Introduction to Micromachining", Narosa Publishing House, 2010.
2. Mark J. Jackson, "Micro Fabrication and Nano machining", Taylor and Francis, 2006.

References

1. M.J. Madou, "Fundamentals of Micro Fabrication", CRC Press, 2002.
2. Serope Kalpakjain, "Manufacturing Engg. and Technology", Pearson Education, 2005.
3. Yi Qin, "Micro-Manufacturing Engineering and Technology", Elsevier Publication,2010.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Micromachining- Classification-mechanical advanced micromachining processes-advanced nano finishing processes.	**10**	**25**
Module II Micro Electro Mechanical Systems (MEMS) - Nano Electro Mechanical Systems (NEMS) Lithography-diamond turning- micro	**11**	**25**

drilling - micro milling - Electrical Discharge Micro-Machining (EDMM) Wire Electrical Discharge Micro-Machining (EDMM)-Electrical Discharge Grinding (EDG)-Electro Chemical Micro-Machining (ECMM) – Laser Micro-Machining (LMM).		
FIRST INTERNAL EXAM		
Module III Nano finishing- magnetorheological finishing process-micro/nano finishing with flexible flow of abrasives- Electrolytic In-process Dressing (ELID) Grinding-Emerging trends in manufacturing.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Metrology of micro machined components-profilometers- optical microscopy- confocal laser scanning microscopy- Scanning Electron Microscope (SEM)-Atomic Force Microscope (AFM).	**10**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6155	Safety & Human Factors Engineering	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objective

Effectively communicate information on safety and human factorsfacilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.

Syllabus

Human Factors, Occupation Health &Hygiene, Personal Protective Equipment, Hazards, Safety Culture, Safety Organization, Work Related Stress, Stress Management Systems, Motivation, Appraisal, Job Enrichment, Job Analysis.

Course Outcome

Communicate effectively on health and safety matters with society at large.

Textbooks

1. Dr. Sam Mannan, Lees' Loss Prevention in the process Industries, Vol I and II, 4th Edition Elseiver
2. John V. Grimaldi and Rollin H. Simonds, Safety Management, All India Travelers Book seller, New Delhi, 1989.

References

1. N.V. Krishnan, Safety in Industry, Jaico Publishery House, 1996.
2. Safety in the use of wood working machines, HMSO, UK 1992.
3. Dr. A. K. Gupta, Engineering Management, S. Chand, 2007
4. Anshu, Engineering Management, Jain Brothers, 2009

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Human Factors, Occupation Health, Occupational Hygiene, COSHH Regulations, Dust Hazards, Ventilation, Physico-Chemical Hazards, Ionizing Radiation Hazards, Non Ionizing Radiation Hazards, Machinery Hazards, Electricity Hazards. Personal Protective Equipment, Respiratory Protective Equipment, Rescue and First Aid.	**10**	**25**

Module II Safety Culture, Definition, Developments, Evaluation, Implementation. Safety Organization, Safety Representatives, Safety Committees, Safety Advisor, Safety Training, Safety Communication, Safety Auditing, Safety Rating.	**10**	**25**
FIRST INTERNAL EXAM		
Module III Work Related Stress, Causes of Stress, Signs of Stress, Duties of Employers and Employees, Measurement of Stress, Stress Management Systems, Prevention of Stress at Work, Steps towards Prevention, Job Stress and Health, Stress Health and Productivity.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Motivation: Definition, Assumptions, Determinants, Characteristics. Theories of motivation-Maslow's Theory, McClelland's Theory, Herzberg's Theory, McGregor's Theory X and Theory Y. Incentive Schemes and Promotion Policies, Appraisal, Job Enrichment, Job Analysis.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6255	Non-Traditional Machining Processes	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objective

This course aims to cover the details of various non-traditional/unconventional or advanced machining processes (AMPs).

Syllabus

Types of advanced manufacturing processes; Evolution, Advanced Fine Finishing Process, Types of AMPs, Derived and Hybrid AMPs.

Course Outcome

The students are expected to be aware of various developments in non-traditional/unconventional or advanced machining processes (AMPs).

Textbooks

1. Benedict G. F., "Nontraditional Manufacturing Processes", Marcel Dekker, Inc.New York.
2. Ghosh A., Mallik A. K., "Manufacturing Science", Affiliated East-West Press Ltd,New Delhi.

References

1. McGeough J. A.,"Advanced Method of Machining", Chapman and Hall, New York.
2. Pandey P. C., Shan H. S. "Modern Machining Processes", Tata McGraw-Hill Publishing Co. Ltd, New Delhi.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction: Types of advanced manufacturing processes; Evolution, need, andclassification of advanced machining processes (AMPs).Mechanical Type AMPs: USM, Rotary Ultra Sonic Machining (RUM), AJM, WJM,AWJM processes - Process principle and mechanism of material removal; ProcessParameters; Process Capabilities; Applications; Operational characteristics;Limitations.	**11**	**25**
Module II Advanced Fine Finishing Process: Abrasive Flow Machining (AFM), MagneticAbrasive Finishing (MAF), Magneto Rheological Abrasive	**10**	**25**

Finishing (MRAF) -Process principle; Process equipment; Process Parameters; Process Capabilities;Applications; Limitations.		
FIRST INTERNAL EXAM		
Module III Types of AMPs – Chemical type AMPs: Process principle and details of Chemical Machining (CHM),Photo-Chemical Machining (PCM), and Bio-Chemical Machining (BCM) processes.Electro Chemical Type AMPs: ECM - Process principle; Mechanism of materialremoval; Process Parameters; Process Capabilities; Applications. Thermal Type AMPs: EDM, Wire Electro Discharge Machining (WEDM), LBM,EBM, IBM, PAM processes – Process principle and mechanism of material removal;Process parameters and characteristics; Surface finish and accuracy, ProcessCapabilities; Applications; Limitations.	**12**	**25**
SECOND INTERNAL EXAM		
Module IV Derived and Hybrid AMPs: Electro Stream Drilling (ESD), Shaped Tube ElectroMachining (STEM), Electro Chemical Honing (ECH), Electro Chemical Deburring(ECDE), Electro Chemical Discharge Machining (ECDM) - Process Parameters;Process Capabilities; Applications; Limitations, Introduction to form machining.	**9**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6355	Flexible Manufacturing Systems	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objectives

To introduce the concepts of flexibilities and its importance in batch manufacturing, various types of FMS configurations and their planning and control.

Syllabus

Definition and classification of manufacturing systems,Introduction of FMS,FMS Planning and Control, Material handling in FMS.

Course Outcome

The students will be able to appreciate the modern developments in manufacturing systems like flexible manufacturing systems.

Textbooks

1. Groover, M. P., "Automation, Production System and CIM", 2nd Ed., Prentice Hall.
2. Warnecke, H. J. (Ed.), "Flexible Manufacturing System", Springer.

References

1. Rankey, P., "Design and Operations of FMS", North-Holland Publishing.
2. Bonetto, R., "FMS in Practice", North Oxford Academic Publishers.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction: Definition and classification of manufacturing systems,fundamentals of automated production cycle, need of flexibility, conceptof flexibility, various types of flexibility, measures of flexibility.	**10**	**25**
Module II Flexible Manufacturing System (FMS) Type: Introduction of FMS,definition of FMS, types of FMS, applications of FMS, FMSconfiguration, FMS host operator interface.	**10**	**25**
FIRST INTERNAL EXAM		
Module III FMS Planning and Control: Functional requirements of	**12**	**25**

FMSequipments, functions of FMS host computer, host system design,planning, scheduling of FMS, FMS simulation, Databases in FMS, GT inFMS, cell design and layout design, CAPP in FMS.		
SECOND INTERNAL EXAM		
Module IV Material handling in FMS: Material handling principles in FMS,applications of robots in FMS.	**10**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6455	Product Design & Development	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objective

To expose the students to the concept of design, concurrent engineering, reverse engineering, and rapid prototyping techniques.

Syllabus

Introduction to Product Design, Traditional and modern design processes, Product Modeling and Reverse Engineering, Concept of concurrent engineering, Rapid Prototyping Methods.

Course Outcome

The students are expected to know the different modern techniques in design, manufacturing and maintenance of various products.

Textbooks

1. Boothroyd G., Dewhurst P., and Knight, "Product Design forManufacture and Assembly", 2nd Ed., Marcel Dekker.
2. Chitale, A. K. and Gutpa, R. C., "Product Design andManufacturing", Prentice Hall.

References

1. Andrearsen, M. M., and Hein, L., "Integrated ProductDevelopment", Springer.
2. Zeid I., "CAD/CAM: Theory and Practice", Tata McGraw Hill.
3. Chua, C. K and. Leong, K. F., "Rapid Prototyping: Principles andApplications in Manufacturing", John Wiley & Sons.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction to Product Design, Traditional and modern design processes, Organizationobjectives, Innovation, creation, and diffusion techniques; Evaluation of new product ideas, functional, technological, ecological and legal.	**10**	**25**
Module II Product Modeling and Reverse Engineering, Wireframe modeling, Surface modeling, boundary representation; Solid modeling, CSG;Concept of reverse engineering; Product Data Exchange, Neutral file formats for product data exchange, DXF, IGES, STEP.	**10**	**25**
FIRST INTERNAL EXAM		

Module III Concept of concurrent engineering, Design for manufacturability (DFM), Design for assembly (DFA), Design for reliability (DFR), Design for quality (DFQ).	**10**	**25**
SECOND INTERNAL EXAM		
Module IV Rapid Prototyping (RP) Methods: Liquid based RP methods – stereolithography apparatus (SLA), solid ground curing (SGC), solidcreation system (SCS), etc.; Solid based RP methods: Fused depositionmodeling (FDM), laminated object manufacturing (LOM), Powderbased RP methods, selective laser sintering (SLS), 3D printing (3DP),ballistic particle manufacturing (BPM), etc.	**12**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6065	Research Methodology	0-2-0-2	2015
Pre-requisites	**Nil**		

Course Objective

To teach and make the student aware about the methodology and techniques of doing research both in technology as well as in social sciences.

Syllabus

Objectives and types of research, research methods vs methodology, Different types of research, Research design and execution, Execution of the research, data collection and analysis, Reporting and thesis writing.

Course Outcome

By the course completion the students will be equipped to carry out their research and emanate its outcomes to the outside world.

Textbooks

1. Kothari C.R., Research Methodology, New Age International Publishing.
2. Sam Daniel P. and Aroma G. Sam, Research Methodology, Gyan Publishing House.

References

1. Panneerselvam R., Research Methodology, PHI Learning Pvt. Ltd.
2. Bhattacharyya D.K., Research Methodology, Excel Books India.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Objectives and types of research, research methods vs methodology, Different types of research, Defining and formulating the research problem, selecting the problem,necessity of defining the problem, importance of literature review in defining a problem, Literaturereview - primary and secondary data/information sources, reviews, monographs, patents, discussion series, white papers, research databases like CMIE, BB, UNSD etc., critical literature review, identifying gap areas from literature review.	7	25
Module II Research design and execution: Research design – basic principles, need of research design, featuresof good design, important concepts	7	25

relating to research design, observation and facts, laws and theories, prediction and explanation, development of models.		
FIRST INTERNAL EXAM		
Module III Execution of the research, data collection and analysis: Aspects of method validation, observationand collection of data, methods of data collection, different sampling methods, data analysis techniques of hypothesis testing, ANOVA, randomized block design (RBD) and completely randomized design (CRD).	**7**	**25**
SECOND INTERNAL EXAM		
Module IV Reporting and thesis writing: Structure and components of scientific reports, types of report,technical reports and thesis. Different steps in thesis writing, layout, structure and language of typical reports, bibliography, referencing and footnotes. Research ethics – ethical issues, ethical committees, Scholarly publishing – design of research paper, citation and acknowledgement, plagiarism, reproducibility andaccountability.	**7**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6085	Manufacturing and Precision Engineering Lab	0-0-3-1	2015

List of Experiments/Exercises

- Computer aided drafting.
- Solid modeling: part creation, surface generation and assemblies of parts.
- Surface modeling.
- FEM: creation of model, use of different elements, treatment of different loads and boundary conditions.
- Determination of cutting force in turning, drilling and grinding using tool force dynamometer.
- Study and programming of CNC production machines.
- Study and programming of robots.
- Study and measurements of components using CMM.
- Surface roughness measurements using light, stylus, interference methods.
- Metallographic studies using metallurgical microscope.
- Determination of wear and coefficient of friction of the given specimen using pin on disc tester.
- Study and use of laser interferometer for calibration of linear measurements.
- Study of slip gauges – wringing – surface roughness - standards.
- Study of surface plates, straight edges, angle plate, V-block etc - use of desiccants, corrosion preventing coatings etc.
- Measurement of out of roundness using roundness measuring instrument - V block and dial indicator etc. - reasons for out of roundness etc.
- Measurements of straightness using sprit level, auto collimator etc.
- Measurement of thread parameters using three wire method etc.
- Measurement of tool angles of single point tool using tool maker's microscope.
- Measurement of gear parameters using profile projector.
- Evaluation of straightness error using autocollimator, sprit level, straight edge etc.
- Experiments on limits and fits.
- Study and use of ultrasonic flaw detector.

SEMESTER - II

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6016	Materials Technology	4-0-0-4	2015
Pre-requisites	**Nil**		

Course Objective

To make them understand the structure, properties, performance, and processing of materials to solve engineering problems.

Syllabus

Crystal structure, , Dislocations, Strain rate and sensitivity, Volume constancy principle, Mass constancy principle, Effect of Mohr's circle on Formability, Formability of low carbon steels, Formability of Carbon, Diffused necking and localized necking, Defects in deep drawing, Cold working, Hot working and Warm working.

Course Outcome

1. Classify the mechanical properties of materials
2. Relate the various forming process
3. Apply the knowledge in formability

Textbooks

1. George Krauss, "Steels; Processes, Structure& Performance", ASM International, The Materials Information Society, 2005
2. Narayanasamy R., "Metal Forming Technology", Ahuja publications, New Delhi, 2000.

References

1. S.Kalpakjian, "Manufacturing Processes for Engineering Materials", Addison Wesley Pub. Co., 1997.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Crystal structure, Slip planes, Slip systems and Formability, Close packed planes and directions, Tensile test, Yielding behavior, True stress, strain, Strain hardening, Dislocations, Tensile instability, Constitutive material relationships, Strain rate and sensitivity, Volume constancy principle, Mass constancy principle	**13**	**25**
Module II Effect of Mohr's circle on Formability, Formability of low carbon steels, Automobile grade steels Effect of grain size on Formability, Effect of second phase particles on formability	**16**	**25**

Formability of Carbon - Manganese steels, Micro alloy steels, HSLA steels, I.F steels, Dual phase steels, etc., Formability of Stainless steels		
FIRST INTERNAL EXAM		
Module III Diffused necking and localized necking in tensile test, Super plasticity and its applications, Deep drawing and deep drawability of sheet metals, Defects in deep drawing	**15**	**25**
SECOND INTERNAL EXAM		
Module IV Cold working, Hot working and Warm working, Recrystallization, Forming Limit Diagram, Workability of materials	**12**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6026	Operations Management	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objective

To impart knowledge on various strategic issues of operations management and developing their skills to design and model various facilities of an organization.

Syllabus

Basic concepts of operations and production management, typesof manufacturing systems and their characteristics, Demand Forecasting, Production Planning and Scheduling, Facilities Planning.

Course Outcome

After the course completion, the students will be able to solve and manage the real life systems related issues.

Textbooks

1. Buffa, E. S. and Sarin, R. K., "Modern Production/Operations Management", 8th Ed., John Wiley & Sons.
2. Mahadevan, B., Operations Management: Theory and Practice, 2nd Edition, Pearson Education.

References

1. Karjewski, L. J, Ritzman, L. P. and Malhotra, M. K., "OperationsManagement: Processes & Supply Chains, 9th Ed., Pearson Education.
2. Adam, E., Jr. and Ebert, R. E., "Production Operations Management", 5thEd., Pearson Education.
3. Dervitsiotis, K. N., "Operations Management", 2nd Ed., McGraw Hill.
4. Starr M. K., "Production and Operations Management", Thomson BusinessInformation.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction: Basic concepts of operations and production management, typesof manufacturing systems and their characteristics.Product and Process Design: System planning and design, long-rangeplanning, product and process design and technological considerations.	**10**	**25**
Module II	**11**	**25**

Demand Forecasting: Role of demand forecasting in operations decisions;various demand patterns, qualitative and quantitative techniques of demandforecasting.		
FIRST INTERNAL EXAM		
Module III Production Planning and Scheduling: Aggregate production planning,operation scheduling, various scheduling criteria, lot sizing, job shop control;Mutli-stage manufacturing systems, their scheduling and management, capacityplanning.Materials Planning: Details of material requirement planning (MRP) andmanufacturing resource planning (MRP-II) and their various techniques.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Facilities Planning: Plant design, types and considerations in the plantlocation, plant layout types, design, evaluation, principles and types of materialflow, optimum plant layout.	**10**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6036	Work Study and Ergonomics	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objective

To optimize the integration of man and machine so as to improve the work rate and accuracy and also to introduce the students with the basics of work system design.

Syllabus

Work Study , Analysis of Work Content, Work Measurement, Ergonomics, Environmental Factors and Work Systems

Course Outcome

The student will have sound knowledge in methods engineering, ergonomic design and the ways of work system improvements.

Textbooks

1. Human factors in engineering and Design by Sanders and McCormick, McGraw Hill.
2. Ergonomics (Man in his working environment) by Murrell, Chapman and Hall.

References

1. Ergonomics at work by D.J.Oborne, Wiley and sons.
2. A guide to Ergonomics of Manufacturing by Martin Helander, East - West and Taylor Francis.
3. Introduction to work study by ILO Geneva, Oxford and IBH.
4. Work Study and Ergonomics by Sharma and Sharma, S. K. Kataria and sons.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Work Study and Productivity:Definition, Aim and Importance of Work Study. Definition of Productivity, Difference between Production and Productivity, Tools of Productivity, Reasons for low Productivity, Factors that help increase Productivity, Productivity index, Kinds of Productivity Measurement, Causes of low Productivity and Techniques of their elimination, Factors affecting Productivity, Technical methods to improve Productivity, Advantages from increased Productivity. Method study: Concept and definition, scope, objectives and procedure of method study, Elements of method design.	**12**	**25**

Module II Work Measurement (Time Study): Definition, Objectives of Work measurement. Basic procedure for Time study, Advantages and Limitations of Time study, Various time recording techniques in Time study. Rating, Standard performance, Rating system, Allowances, Type of Allowances,Estimation of Allowances. Predetermined Motion Time Systems: Introduction, objectives, advantages, limitations and uses of PMTS.	**10**	**25**
FIRST INTERNAL EXAM		
Module III Ergonomics: Introduction, objectives, importance, scope and fields of application of Ergonomics. Occupational loads and stresses analysis, Anthropometry and its importance, Difference between structural and functional body dimensions, Human activities analysis, Design of man – machine systems, Design of information displays. Design, types and selection of controls, Factors to be considered in the design of controls, Layout of working space or working environment.	**10**	**25**
SECOND INTERNAL EXAM		
Module IV Environmental Factors : Lighting – Importance of adequate lighting, Lighting terminology, Daylight, Artificial lighting, Sources of artificial lighting, Ballast (control gear), Luminaries, Lighting control systems, Lighting maintenance, Lighting design. Noise – Types of noise, Legal requirements, Sources of noise, Adverse effects of noise, Sound levels, Noise control, Material solutions to noise problems, Sound absorbers, Sound barriers, Sound insulation. Vibration – Health effects of vibration, Effective management of vibrations, Whole body vibration, Hand – arm vibration, Vibration prevention, Vibration measurement.	**10**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6146	Supply Chain Management	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objective

To provide an insight into functioning and networking of supply chain decisions for thesuccess of a business. The course will provide foundation for design, analysis and performancemetrics and to frame a sound supply chain network in the country.

Syllabus

Understanding supply chain, supply chain performance, Demand forecasting in supplychain, Aggregate planning in supply chain, Transportationaspects in a supply chain, financial evaluation in a supply chain.

Course Outcome

Ability to build and manage a competitive supply chain using efficient strategies, models, techniques and information technology.

Textbooks

1. Chopra S. and Meindel P., "Supply Chain Management: Strategy, Planning, andOperation", Prentice Hall of India, New Delhi.
2. Shapiro J. F., Duxbury Thomson Learning, "Modeling the Supply Chain",Duxbury Thomson Learning Inc., Duxbury, Pacific Grove.

References

1. Makridakis, S and Wheelwright, S.S: Forecasting methods and Applications, John Wiley and Sons.
2. Hopp W. J., Spearman M. L. and Irwin, "Factory Physics: Foundations ofManufacturing", McGraw-Hill Inc. New York.
3. Viswanadham N., "Analysis of Manufacturing Enterprises", Kluwer AcademicPublishers, UK.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction: Understanding supply chain, supply chain performance; supply chain drivers and obstacles, Supply chain micro and macro processes, Push and pull systems.	**10**	**25**
Module II Demand forecasting in supplychain, Need and uses of forecasting, Moving averages, Linearexponential smoothing, Decomposition of time series, trend fitting.	**10**	**25**
FIRST INTERNAL EXAM		

Module III Aggregate planning in supply chain, planning supply and demand; managingpredictable variability, Economic Order Quantity Models, Reorder Point Models.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Transportationaspects in a supply chain, facility Decision, Network design in a supply chain,Information technology and its use in supply chain, Bullwhip effect.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6246	Processing of Non-Metals	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objective

The main objective of the course is to impart an understanding of the manufacturing science and engineering of non-metals along with the study of the basic nature of different non-metals and the manufacturing processes associated thereof.

Syllabus

Classification of engineering materials and processing techniques, Classification of ceramics, Classification of composite materials, properties of composites, Secondary processing of composite materials.

Course Outcome

The students are expected to be aware of the various manufacturing process of non-metals.

Textbooks

1. Kalpakjian S., Manufacturing Processes for Engineering Materials, 3rd edition Addison Wesley, 1997.
2. Brent Strong A., Plastic Materials and Processing, Prentice Hall.

References

1. Mathews F.L. and Rawlings R.D., Composite Materials: Engineering and Science, CRC press.
2. Peters S.T., Handbook of Composites.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction: Classification of engineering materials and processing techniques, structure and properties of non-metals.Glass structure and properties, glass melting and forming, glass annealing.	**9**	**25**
Module II Classification of ceramics, crystal structures and properties, ceramic powder preparation, Synthesis of ceramic powders, fabrication of ceramic products from powders: pressing, casting, vapour phase techniques, sintering, finishing.Structure and mechanical properties of plastics, thermoplastics and thermosets, Processing of Plastics, Extrusion, Injection moulding, Thermoforming, Compression	**11**	**25**

moulding,Transfer moulding, General behavior of polymer melts, Machining of plastics.		
FIRST INTERNAL EXAM		
Module III Classification of composite materials, properties of composites, processing methods of polymeric matrix composites, hand lay-up, autoclaving, filament winding, pultrusion, compression molding, pre-pegging, sheet molding compounds, Ceramic matrix composites, mechanical properties of ceramic matrix composites, different processing techniques for ceramic matrix composites, process capability and applications of various techniques.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Secondary processing of composite materials, Need of secondary operations, different type of secondary operations, machining and drilling of non-metals, machining induced damage, different methods of reducing the damage on account of secondary processing.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6346	Decision Modelling – II	3-0-0-3	2015
Pre-requisites	**Decision Modelling – I**		

Course Objective

The course is aimed at teaching the students more advanced topics in optimization in relation to non-linear systems.

Syllabus

Non-Linear Programming, Stochastic and FuzzyOptimization, Dynamic Programming, Stochastic Processes, DiscreteeventSimulation.

Course Outcome

This course will make the students to tackle with the issues related with non-linear systems.

Textbooks

1. Hillier, F.S and Lieberman, G. J: Introduction to Operations Research, Ninth Edition, Mc Graw-Hill, 2012.
2. Ravindran, Phillips, Solberg; Operations Research: Principles and Practice,John Wiley and sons, 2007.

References

1. Taha, H.A : Operations Research, VIII Edition, Wiley, 2007.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Non-Linear Programming: Classical optimization methods, Univariate and Multi-variate search techniques, Kuhn Tuckerconditions,Fibonacci search method, golden section search method, Hooke and Jeeve's method, Quadratic, Geometric and Separable Programming methods, Stochastic and FuzzyOptimization.	10	25
Module II Dynamic Programming: Bellman's principle of optimality, Concepts of stateand stage, Solution of Discrete Problems through Backward Dynamic Programming,Continuous and Multi-stage Dynamic programming problems, Stochastic DynamicProgramming Problems.	10	25
FIRST INTERNAL EXAM		
Module III Stochastic Processes: Description of state, Transitionprobability matrix, Ergodic Properties, First passage time, etc., MarkovDecision Process, Markov Decision Problems, Policy Improvement Scheme.	11	25

SECOND INTERNAL EXAM		
Module IV DiscreteeventSimulation: Time-flow mechanisms, Random Number and Random Deviategeneration, Simulation of Queuing and Inventory Systems, Validation ofSimulation Models, Sampling of Simulation outputs and Statistical Inferences,Variance Reduction Techniques.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6446	Computer Aided Process Planning	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objectives

To impart knowledge on the integration of design and manufacturing functionsleading to the concepts of process planning.

Syllabus

Traditional process planning, product design evaluation,Group Technology, Automated Process Planning, Interfaces of Process Planning.

Course Outcome

At the end of the course, the students will have sound knowledge in modern manufacturing technology and modern process planning techniques.

Textbooks

1. Cornelius, L.T, "Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes", World Scientific Publishing Company.
2. Chang, T. C. and Wysk, R. A, "An Introduction to Automated Process Planning", Prentice-Hall.

References

1. Gallagher, C. C and Knight, W. A., "Group Technology: Production Method in Manufacturing", Ellis Horewood.
2. Nilsson, N. J., "Principles of Artificial Intelligence", Springer Verlag.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction: Traditional process planning, product design evaluation,various steps in process planning.	**10**	**25**
Module II Group Technology: Introduction, advantages, part families, classificationand coding systems, production flow analysis, design of machine cells.	**10**	**25**
FIRST INTERNAL EXAM		
Module III Automated Process Planning: Advantages of automated processplanning, various approaches to process planning; Variant	**12**	**25**

processplanning, its features and different stages, different variant systems;Generative and semi-generative process planning, its features, designstrategies, planning, modeling and coding scheme, decision mechanisms;Process capability analysis, intelligent process planning system; Artificialintelligence -- overview and application in process planning; Variousrecent process planning systems; Case studies.		
SECOND INTERNAL EXAM		
Module IV Interfaces of Process Planning: Integrating with loading, scheduling,MRP II, and capacity planning and other shop floor functions.	**10**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6156	Management Information Systems	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objectives

The course is mainly aimed at introducing the concept of management information systems and its related concepts.

Syllabus

Introduction to Management Information Systems, Information, management and decision making, Data Base Management Systems, Management issues in MIS, management of quality in MIS, factors for success and failure.

Course Outcome

The students are expected to imbibe the idea of management information systems and data base management systems and their utility.

Textbooks

1. Gordon B. Davis andMargrethe H. Olson, Management Information Systems: Conceptual Foundations, Structure and Development, Second edition, Tata McGraw-Hill publication.
2. Jawadekar W.S., Management Information System, 3rdedition, Tata McGraw-Hill publication.

References

1. James O'Brien, Management Information System, 7thedition, Tata McGraw-Hill publication.
2. Sadagopan, Management Information Systems, Prentice Hall.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction to Management Information Systems,need, purpose and objectives, contemporary approaches to MIS, information as a strategic resource, use of information for competitive advantage, MIS as an instrument for the organizational change.	**10**	**25**
Module II Information, management and decision making,Information Technology definition, models of decision making, classical,	**10**	**25**

administrative and Herbert Simon's models, attributes of information and its relevance to decision making, types of information, IT Capabilities and their organizational impact, telecommunication and networks, types and topologies of networks, IT enabled services.		
FIRST INTERNAL EXAM		
Module III Data Base Management Systems,data warehousing and data mining.Decision Support Systems, group decision support systems,executive information systems, executive support systems, expert systems and knowledge based expert systems, artificial intelligence.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Management issues in MIS, Information security and control, quality assurance, ethical and social dimensions, intellectual property rights as related to IT Services and IT products, managing global information systems, Development of long range plans of MIS, ascertaining the class of information, determining the information requirement, development and implementation of MIS, management of quality in MIS, factors for success and failure.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6256	Additive Manufacturing	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objectives

To educate students with fundamental and advanced knowledge in the field of additivemanufacturing technology and the associated aerospace, architecture, art, medical andindustrial applications.

Syllabus

Classification of additive manufacturing (AM) processes, AM based rapidprototyping systems, Accuracy issues in additive manufacturing, Rapid tooling techniques such as laminated metallic tooling.

Course Outcome

On completion of this course, the students will learn about a variety of additive manufacturing technologies, their potential to support design and manufacturing, and some of the important research challenges associated with AM andits data processing tools.

Textbooks

1. Pham, D.T., Demov, S.S., Rapid Manufacturing: The Technologiesand Applications of Rapid Prototyping and Rapid Tooling, Springer-Verlag London Limited.
2. Paul F Jacobs, "Stereo lithography and other RP&M Technologies", SME, 1996.

References

1. Terry Wohlers, "Wohlers Report 2001", Wohlers Associates, 2008.
2. Prasad H and Badrinarayanan, K S, “Rapid Prototyping and Tooling”, SPI-Pageturners, Bangalore, India, 2013.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction, Survey of applications of Additive Manufacturing, Classification of AM systems. Principle, process parameters, process details and applications of various RP processes - Stereo lithography systems, Selective Laser Sintering, Fused Deposition Modeling, Laminated Object Manufacturing, Solid Ground Curing, Laser Engineered Net Shaping, 3D Printing.	**10**	**25**
Module II Rapid Tooling: Indirect rapid tooling - silicone rubber tooling, aluminum filled epoxy tooling, spray metal tooling, Direct rapid tooling - direct AIM, copper polyamide, sand casting tooling, laminate tooling, soft tooling Vs hard tooling.	**10**	**25**
FIRST INTERNAL EXAM		

Module III Rapid Manufacturing Process Optimization- Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Concept Modelers and Software for RP: Various Concept Modelers - STL files, overview of solid view, magics, mimics, magics communicator, etc., internet based softwares, collaboration tools.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6356	Friction and Wear	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objectives

To impart knowledge on concepts of friction and wear of engineering materials.

Syllabus

Concept of a surface and surface topography of engineering surfaces, Concept and laws of friction, Assessment and Control of Friction, Concept of wear of engineering surfaces.

Course Outcome

At the end of the course, the students will be aware of friction and wear and their importance in engineering and technology.

Textbooks

1. Rabinowicz, E., Friction and Wear of Materials, John Wiley and Sons,Inc., New York.
2. Hutchings, I.M., Tribology: Friction and Wear of EngineeringMaterials, Edward Arnold, London.

References

1. Dowson, D., "History of Tribology", Longman, London.
2. ZumGahr, K. H., "Microstructure and Wear of Materials", Elsevier,Amsterdam.
3. Takadoum, J., "Materials and Surface Engineering in Tribology", JohnWiley and Sons, Inc., London.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Concept of a surface and surface topography of engineering surfaces; Interaction between contacting surfaces, concept of elastic and plastic deformation, Hertz's contact theory; Concept of surface forces – electrostatic forces, capillary forces and van der Waal forces.	**10**	**25**
Module II Friction: Concept and laws of friction; Theories of friction, rolling friction, sliding friction, Coulomb model, junction growth, asperity deformation, stresses in friction; Temperature in friction. Friction of metallic materials, ceramics, polymers and lamellar solids.	**10**	**25**
FIRST INTERNAL EXAM		

Module III Assessment and Control of Friction: Assessment of co-efficient of friction, measurement of friction force and contact temperature, assessment of surface forces, tribometer and atomic force microscope; Lubricants in reducing friction.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Wear: Concept of wear of engineering surfaces; Types of wear; Sliding wear, dry and lubricated wear of surfaces, chemical wear. Abrasion; Adhesion; Erosion; Fatigue; Corrosion; Other forms of wear. Wear of metallic materials, ceramics, composites and polymers. Wear estimation and Control, ASTM standards for estimation of wear of engineering surfaces; Modification of functional surfaces for minimization of wear, selection of materials and techniques.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6456	Metaheuristics	3-0-0-3	2015
Pre-requisites	Decision Modelling - II		

Course Objectives

To introduce the students with various techniques in decision making in case of time consuming hard problems.

Syllabus

Introduction to Metaheuristics and its different methods, Introduction to Genetic Algorithm, Introduction to Data Envelopment Analysis (DEA), Fuzzyoptimization, Introduction to neuralNetworks,Introduction to Simulated Annealing, Introduction to Chaos.

Course Outcome

The students will be aware of nature inspired algorithms and multi criteria decision making techniques to handle time consuming hard problems thereby attaining near optimal solutions.

Textbooks

1. David E. Goldberg, Genetic Algorithms in Search Optimization and Machine Learning, Addison-Wesley Longman Publishing.
2. Kalyanmoy Deb, Multi-Objective Optimization using Evolutionary Algorithms, Wiley.

References

1. Crina Grosan andAjith Abraham, Hybrid Evolutionary Algorithms: Methodologies, Architectures, and Reviews, Springer Link.
2. Rajasekaran S. and Vijayalakshmi PaiG.A.,Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis andApplications, Prentice Hall of India, New Delhi.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction to Metaheuristics and its different methods, Introduction to Genetic Algorithm (GA), mechanism, appraisal of GA performance, data structure, procedures, operations andtechniques in genetic search, computer implementation, applications.	**10**	**25**
Module II Introduction to Data Envelopment Analysis (DEA), definitions, relative efficiency measurement, solutions to the DEA model, Charnes-Cooper-Rhodes algorithm, dual DEA model, DEA issues.	**10**	**25**
FIRST INTERNAL EXAM		
Module III	**11**	**25**

Fuzzyoptimization, soft constraints, approximate reasoning, multi-criteria soft decision modelling, interactive approach, developing expert systems using fuzzylogic.Introduction to neuralNetworks, multi-layer networks, recurrent networks, learningparadigms.		
SECOND INTERNAL EXAM		
Module IV Introduction to Simulated Annealing, metropolis algorithm, heat bath algorithm, fastsimulated annealing, very fast simulated annealing, mean field annealing, Introduction to Chaos:complexity and simplicity, evolution of possibilities, simple models of chaos,strange attractors, deterministic chaos, self-organization, synergistics.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME6076	Industrial Engineering & Computational Lab	0-0-3-1	2015

List of Experiments/Exercises

- Solving linear programming using software.
- Generation and testing of random numbers and simulation of discrete systems.
- Experiments on method study and time study.
- DoE Plan; Analysis of mean, ANOVA for experimental data.
- Application of software like Mat Lab, SPSS, ARENA, WITNESS etc for the modeling, simulation and analysis of decision problems in the following areas:
    - ❖ Quality management
    - ❖ Production planning and control
    - ❖ Inventory and supply chain management
    - ❖ Reliability analysis
    - ❖ Manufacturing system design
    - ❖ Performance of manufacturing systems
    - ❖ Facilities planning

SEMESTER - III

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME7115	Maintenance Management	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objectives

To expose the students to the various policies, strategies, and schedules of maintenanceapplicable in Industries.

Syllabus

Importance of maintenance, Objectives, System Reliability, Maintenance Activities, Replacement Decisions, Maintainability and Availability, Maintenance Organization.

Course Outcome

The students will be aware about the various maintenance management practise and policies and its applicability in different industries.

Textbooks

1. Kelly A., Maintenance Planning and Control, Butterworth-Heinemann.Ltd,London.
2. Dhillon B.S., Engineering Maintenance: a Modern Approac", 1st edition, CRC.

References

1. Cliffton R. H.,Principle of Planned Maintenance, McGraw Hill Inc. New York.
2. Niebel B.W., Engineering Maintenance Management, Marcel Dekker, NewYork.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction: Importance of maintenance, Objectives, duties, functions andresponsibilities of maintenance engineering department, Organization and structureof maintenance systems. Maintenance policies and planning, Maintenance strategies, advantages anddisadvantages of each strategy, Planned maintenance procedure, advantage ofplanned maintenance, Safety in maintenance.	**11**	**25**
Module II System Reliability: Quantitative estimation of reliability economies of introducing astandby unit into the production system, Optimum design configuration of aseries/parallel system,Breakdown time distribution.	**10**	**25**
FIRST INTERNAL EXAM		
Module III	**11**	**25**

Maintenance Activities, Optimal overhaul/repair or replacement policies forequipment subject to breakdown, Budgeting and control, Production maintenanceintegration.Replacement Decisions, block replacement policy, agereplacement policy, replacement policies to minimize downtime.Maintainability and Availability, Maintainability increment.		
SECOND INTERNAL EXAM		
Module IV Maintenance Organization: Computer applications in maintenance management,automatic chalk out equipment kits capabilities and limitations, Managementinformation system for maintenance.	**10**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME7215	Fundamentals Of RoboticSystems	4-0-0-4	2015
Pre-requisites	**Nil**		

Course Objectives

To enlighten the students about the fundamentals of robotic systems.

Syllabus

At the end of this course the student should be able to understand
1. The basics of robot
2. End effectors and robot controls
3. Robot Transformations and Sensors
4. Robot cell design and applications
5. Micro/Nano robotic systems

Course Outcome

The student will have sound knowledge regarding the basics of Robotic Systems.

Textbooks

1. S.R. Deb, Robotics Technology and flexible automation, TataMcGraw-Hill Education., 2009
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, RogerN Nagel, Ashish Dutta, Industrial Robotics, Technologyprogramming and Applications, McGraw Hill, 2012

References

1. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
2. P.A. Janaki Raman, Robotics and Image Processing an Introduction, Tata McGraw Hill Publishing company Ltd., 1995.
3. Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press, 2008.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Robot anatomy-Definition, law of robotics, History and Terminology ofRobotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of Robot-Robot joints and links-Robotclassifications-Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system.	**14**	**25**
Module II Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators,cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripperforce analysis-Gripper design-Simple problems-Robot	**14**	**25**

controls-Point to pointcontrol, Continuous path control, Intelligent robot-Control system for robotjoint-Control actions-Feedback devices-Encoder, Resolver, LVDT-MotionInterpolations-Adaptive control.		
FIRST INTERNAL EXAM		
Module III Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation,Translation- Homogeneous coordinates, multiple transformation-Simpleproblems. Sensors in robot – Touch sensors-Tactile sensor – Proximity andrange sensors – Robotic vision sensor-Force sensor-Light sensors, Pressuresensors.	**14**	**25**
SECOND INTERNAL EXAM		
Module IV Robot work cell design and control-Sequence control, Operator interface,Safety monitoring devices in Robot-Mobile robot working principle,actuation using MATLAB, NXT Software Introductions-Robot applications-Material handling, Machine loading and unloading, assembly, Inspection,Welding, Spray painting and undersea robot.	**14**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME7315	Metal Forming	3-0-0-3	2015
Pre-requisites	Nil		

Course Objective

The course aims to explain the advanced scientific theoretical aspects of metal forming processes.

Syllabus

Introduction to Metal Forming, c1assification of metal working processes, theories of friction and lubrication, process analysis,rolling, drawing, bending, punching and blanking, hydrostatic extrusion,high speed forming.

Course Outcome

The student is expected to be well versed in the theory and practises of metal forming.

Textbooks

1. Avitzur B., Metal Forming Analysis, Mc Graw Hill.
2. Ghosh A. and Mallik A. K., Manufacturing Science, Affiliated East-West.

References

1. Rowe, and Geoffrey W, "An Introduction to Principles of Metal Working", St.Martin Press.
2. Jhonson W.and Meller P.B., "Plasticity of Mechanical Engineers", Van Nostrand.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction to Metal Forming, stress/strain, strain-rate characteristics of materials, yield criteria ofmetals, c1assification of metal working processes, formability and theory of sheetmetal working, friction and lubrication in metal working operation, theories offriction and lubrication; assessment of friction at interface.Process analysis, various methods of analyzing the metal working processes, sliplinefield theory; upper bound solution; stab methods.	10	25
Module II Rolling- determination of rolling pressure, rollseparating force, driving torque and power, and power loss in bearings; forgingdeterminationof forces in strip forging and disc forging; drawing- determinationof force and power, determination of maximum allowable reduction; deep drawingforce analysis, analysis of tube drawing process with fixed and	10	25

moving mandrel,tandem tube drawing.		
FIRST INTERNAL EXAM		
Module III Bending- determination of work load and spring back;extrusion-determination of work load from stress analysis and energyconsideration, power loss, hydrostatic extrusion; punching and blanking- mode ofmetal deformation and failure, two-dimensional deformation model.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Hydrostatic extrusion, comparison with conventional extrusion; pressure required toextrude, variables affecting the process.High speed forming, classification, comparison of low and high speed forming operation problems, introduction to high forming process, explosive forming, electrical and mechanical high speed forming techniques.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME7415	Industrial Automation	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objectives

The course is to impart to the students a sound foundation in industrial automation.

Syllabus

Introduction of mechanization and automation,High Volume Manufacturing, Assembly systems and their types, Flexible Automation, Introduction of group technology, Introduction of flexible manufacturing systems (FMS), Programmable Automation, Brief introduction of numerical control.

Course Outcome

The students will have knowledge in automation and different modern manufacturing systems.

Textbooks

1. Groover, M. P., Automation, Production systems and ComputerIntegrated Manufacturing, 2nd ed., Prentice Hall.
2. Boothroyd, G., Assembly Automation and Product Design, 2nd ed.,Marcel Dekker.

References

1. Boothroyd, G., Dewhurst, P. and Knight, W., Product Design forManufacture and Assembly, 2nd ed., Taylor & Francis.
2. Tergan, V., Andreev, I. and Lieberman, B., Fundamentals ofIndustrial Automation, Mir Publishers.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction of mechanization and automation,classification and strategies of automation, reasons for and argumentsagainst automation, mechanical, electrical, hydraulic, and pneumaticdevices and controls.	**10**	**25**
Module II High Volume Manufacturing, Automated flow lines, types ofautomatic transfer mechanisms, design and fabricationconsiderations, analysis of automated flow lines.Assembly systems and their types, manualassembly lines and line balancing, Automated assembly lines and their types,automatic assembly transfer systems, automatic feeding	**11**	**25**

and orientingdevices- vibratory and mechanical feeders and their types, orientationof parts, performance and economics of assembly systems, feasibilitystudy for assembly automation.		
FIRST INTERNAL EXAM		
Module III Flexible Automation, Introduction of group technology (GT), stepsin implementing Group Technology (GT), part families and machinecell formation, introduction of flexible manufacturing systems (FMS).	**10**	**25**
SECOND INTERNAL EXAM		
Module IV Programmable Automation, Brief introduction of numerical control(NC), computer numerical control (CNC), machining centers,programmable robots, direct numerical control (DNC) and adaptivecontrol.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME7125	Statistical Design of Experiments	3-0-0-3	2015
Pre-requisites	**Probability & Statistics**		

Course Objectives

The students will be introduced to the different scientific ways of conducting an experiment.

Syllabus

Introduction to Design of Experiments, Occam's razor and effect heredity, General procedure for experimentation, Experiments for One-Way classifications, Experiments for Multi-Way classifications, Introduction to Factorial Experiments, Response surface methodology, Orthogonal arrays, Taguchi's Robust Design.

Course Outcome

At the end of the course, the students are expected to know the techniques of scientifically performing the experiments and to develop robust designs.

Textbooks

1. Douglas C. Montgomery, Design and Analysis of Experiments,Wiley.
2. Dean A.M., Design and Analysis of Experiments, Springer.

References

1. Paul Mathews, Design of Experiments with MINITAB, New Age International Publishers.
2. Panneerselvam R., Design and Analysis of Experiments,PHI.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction to Design of Experiments (DOE), definition, scope and motivation, Definition of experiment and design, types of variables, responses, experiments and models; Interactions, randomization, replication, repetition, blocking and confounding. Occam's razor and effect heredity, General procedure for experimentation.	**11**	**25**
Module II Experiments for One-Way classifications: Introduction to Analysis of Variance (ANOVA), Bonferroni's method, Duncan's multiple range test, Tuckey's multiple comparison test.Experiments for Multi-Way classifications: Two-Way ANOVA, Randomized Block Design, Completely Randomized Design.	**11**	**25**

FIRST INTERNAL EXAM		
Module III Introduction to Factorial Experiments, a x b x c factorial design, Latin Square Designs, Two level factorial experiments, 2^1 Factorial experiment, 2^2 Factorial experiment, 2^3 Factorial experiment, 2^k Factorial experiment. Fractional factorial designs, Design resolution.	**10**	**25**
SECOND INTERNAL EXAM		
Module IV Response surface methodology, Terms in Quadratic models, Orthogonal arrays, controllable and uncontrollable factors, Adjustment factors, Parametric design, Tolerance design, Taguchi's Robust Design.	**10**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME7225	Systems Modelling and Analysis	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objectives

The course aims at introducing the students to the theories and techniques in system analysis.

Syllabus

Introduction to systems, Concept of wholeness, Classification of systems, General systems theory, System concepts and systems thinking, Introduction to System Dynamics and Policy Planning, Introduction to Systems Archetypes, Modeling of large scale systems.

Course Outcome

The students will be able to visualise the system as a whole, they will learn to develop mental models through rational thinking and to develop models to experiment for various policies for its outcomes.

Textbooks

1. John Sterman, Business Dynamics: Systems Thinking andModeling for a Complex World, McGraw-Hill.
2. Mohapatra P.K.J, Mandal P., and Bora M.C., Introduction toSystems Dynamics Modelling, Universitypress, Orient Longman, India.

References

1. Peter M. Senge, The Fifth Discipline: The Art & Practice of the Learning Organization, Doubleday, New York.
2. Andrew P. Sage, Methodology for Large-Scale Systems, McGraw Hill.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction to systems, reduction-summation concept, Concept of wholeness, Organisation, hierarchy, Methodology and use of systems approach, Classification of systems, General systems theory, System concepts and systems thinking, Learning organizations, Synergy and Emergance.	**10**	**25**
Module II Introduction to System Dynamics (SD) and Policy Planning, Instantaneous flows, level variables, rate variables, accumulation,	**10**	**25**

auxiliary variables, parameters and constants, Causation and causality, Causal loop models, Stock and flow models, Modelling non-linearity, Physical and information flows, Feedbacks, First, second and third order delays, Kutta's Integration, Euler's Integration, Policy synergy and policy resistance.		
FIRST INTERNAL EXAM		
Module III Introduction to Systems Archetypes, Fixes that fails archetype, Shifting the burdenarchetype, Eroding goals archetype, Escalation archetype, Success to the successful archetype, Limits to growth archetype, Growth and underinvestment archetype, and Tragedy of the commons archetype. Viable systems design.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Introduction to Modeling of large scale systems, Consensus Methodologies, Measurement of Consensus, Multi-criteria decision making (MCDM), Interpretive structural modeling, Analytical hierarchy process, Analytical network process, Statistical investigations into causalrelationships. Principal component analysis, Factor analysis, Discriminantanalysis, Cluster analysis.	**11**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME7325	Welding Science	3-0-0-3	2015
Pre-requisites	Nil		

Course Objectives

To introduce with fundamentals of arc welding processes, metal transfer and weldability of metals as well.

Syllabus

Welding as compared with other fabrication processes, Classificationof Welding Processes, Mechanism and types of metal transfer in various arc weldingprocesses, Welding Power Sources, Critical review of different weldingprocesses, Heat flow in welding,Weldability of metals.

Course Outcome

The course will familiarize the students with the concepts of welding engineering, welding processes and parameters affecting the welding process.

Textbooks

1. Houdlecroft P.T., "Welding Process Technology", Cambridge UniversityPress.
2. Rossi E., "Welding Technology", Mc-Graw Hill.

References

1. Baldev, R., "Welding Technology for Engineers", ASM International.
2. Welding Handbook, 7th Edition-Volume l to 5, American Welding Society.
3. Udin H, Fruk F and Wulff J, Welding for Engineers, John Wiley.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Introduction: Welding as compared with other fabrication processes, Classificationof Welding Processes.Welding arc, arc initiation and maintenance, voltagedistribution along the arc, cathode and anode drops, Arc column, Thermionic andnon-thermionic cathode, arccharacteristics, arc efficiency, Effect ofshielding gas on arc, isotherms of arcs, and arc blow.	11	25
Module II Mechanism and types of metal transfer in various arc weldingprocesses, factors controlling melting rate in various welding processes.Welding Power Sources, Basic characteristics of power sources for various arcwelding processes, arc length regulation in mechanized welding	11	25

processes,Transformer, Static anddynamic characteristics of power sources.		
FIRST INTERNAL EXAM		
Module III Critical review of MMA, TIG. MIG and CO2 weldingprocesses, plasma arc, submerged arc welding, electro- gas and electro-slag welding;resistance welding. Theory and mechanism of solid state welding; technique andscope of friction welding, diffusion welding; cold pressure welding and ultrasonicwelding, electron beam and laser welding processes.	**10**	**25**
SECOND INTERNAL EXAM		
Module IV Heat flow in welding, Calculation of peak temperature; width of Heat AffectedZone; cooling rate and solidification rates; weld thermal cycles; residual stresses andtheir measurement; weld distortion and its prevention.Weldability of metals, Effects of alloying elements on weldability, welding of plaincarbon steel, stainless steel, cast iron and aluminium.	**10**	**25**
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME7425	Advanced Production Planning and Inventory Control	3-0-0-3	2015
Pre-requisites	**Nil**		

Course Objectives

To familiarise the students with the production planning and inventory control methods.

Syllabus

Production Planning and Control Systems, Production Control principles and techniques, Aggregate Control of Inventory Systems, Static and Dynamic Production Planning Models.

Course Outcome

The students are expected to know the various modern methods for production planning and inventory control carried out in an organization.

Textbooks

1. Peterson R. and Silver E.A., Decision Systems for Inventory Management andProduction Planing, John Wiley & Sons.
2. Silver E.A., Pyke D.F. and Peterson R., Inventory Management and ProductionPlanning and Scheduling, John Wiley, 3rd ed.

References

1. NarasimhanS.L., Mc Leavy D.W. and BillingtonP.J., Production Planning andInventory Control, PHI, 2nd Edition.
2. Holt C.C., Modigliani F., Muth J.F. and Simon H.A., Planning Production,Inventories, and Workforce, Prentice Hall, NJ.

Course Plan

Contents	Contact Hours	Sem. Exam Marks
Module I Production Planning and Control Systems: Classification, activities andmatching of PPC system with the Firm.Basic material and Information Flow. Material Requirements Planning and LotSizing. Just-In-Time Production.	**9**	**25**
Module II Capacity planning: tools and techniques. Production Control principles andtechniques. Short-range forecasting techniques.Independent demand	**11**	**25**

Inventory Management. EOQ Models and order timingdecisions, Safety Stock and reorder level decisions.Order quantity and reorderpoint.Distribution Requirement Planning. Spare parts inventory control.		
FIRST INTERNAL EXAM		
Module III Aggregate Control of Inventory Systems, Exchange Curve, Coverage Analysis and Hierarchial Control Systems, Diagnostic Analysis of Inventory Systems. Static and Dynamic Production Planning Models, Aggregate Production Planning, Hierarchial Production Planning, Desegregation of Aggregate Plan, Master Production Scheduling.	**11**	**25**
SECOND INTERNAL EXAM		
Module IV Scheduling of Production: Sequencing Decisions in Single Machine and Flow Shops, Job-shop Scheduling. Scheduling in parallel Machines and Networks, FMS scheduling. Manufacturing Resource Planning, Distribution Requirements Planning, Optimized Production Technology, Planning and Control of JIT Systems, Information Systems, Diagnostic Study of PPC System.	**11**	**25**
END SEMESTER EXAM		