



KERALA TECHNOLOGICAL UNIVERSITY

ERNAKULAM WEST CLUSTER

DRAFT

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	Advanced manufacturing process	4-0-0	40	60	3	4
B	06ME6026	Operations Management	3-0-0	40	60	3	3
C	06ME6036	Ergonomics and Work System Design	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	Industrial Engineering & 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	SEMESTER		Credits
					END EXAM	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 Robotic Systems	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	SEMESTER		Credits
					END EXAM	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 of hypothesis.				
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, Conditional probability, 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 Schmidt 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 – characteristics – 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 – characteristic – 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, 3 rd 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 factors facilitating 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, Expert Systems in Process Engineering.				
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.				
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.			10	25

Safety Organization, Safety Representatives, Safety Committees, Safety Advisor, Safety Training, Safety Communication, Safety Auditing, Safety Rating.		
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 Expert Systems in Process Engineering, Combination of Process Safety with Design and Optimization, Computer Aided Process Engineering, Database Development, Hazard Identification, Pressure Relief Devices Sizing, Hazard Assessment System, Virtual Training	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, and classification 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; Process Parameters; Process Capabilities; Applications; Operational characteristics; Limitations.			11	25
Module II Advanced Fine Finishing Process: Abrasive Flow Machining (AFM), Magnetic Abrasive 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 material removal; 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, Process Capabilities; Applications; Limitations.	12	25
SECOND INTERNAL EXAM		
Module IV Derived and Hybrid AMPs: Electro Stream Drilling (ESD), Shaped Tube Electro Machining (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, concept of 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, FMS configuration, FMS host operator interface.			10	25
FIRST INTERNAL EXAM				
Module III				
FMS Planning and Control: Functional requirements of FMS			12	25

equipments, functions of FMS host computer, host system design, planning, scheduling of FMS, FMS simulation, Databases in FMS, GT in FMS, 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 for Manufacture and Assembly”, 2nd Ed., Marcel Dekker.				
2. Chitale, A. K. and Gutpa, R. C., “Product Design and Manufacturing”, Prentice Hall.				
References				
1. Andrearsen, M. M., and Hein, L., “Integrated Product Development”, Springer.				
2. Zeid I., “CAD/CAM: Theory and Practice”, Tata McGraw Hill.				
3. Chua, C. K and. Leong, K. F., “Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley & Sons.				
Course Plan				
Contents			Contact Hours	Sem. Exam Marks
Module I				
Introduction to Product Design, Traditional and modern design processes, Organization objectives, 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), solid creation system (SCS), etc.; Solid based RP methods: Fused deposition modeling (FDM), laminated object manufacturing (LOM), Powder based 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, Literature review - 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, features of 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, observation and 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 and accountability.	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
<p style="text-align: center;">List of Experiments/Exercises</p> <ul style="list-style-type: none"> • 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 spirit 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, spirit 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	Advanced Manufacturing Process	4-0-0-4	2015	
Pre-requisites	Nil			
Course Objective To inform the students about the various alternative manufacturing processes available and to make them to understand and appreciate the latest manufacturing process for micro fabrication and devices.				
Syllabus Types of advanced manufacturing processes, Mechanical Type AMPs, Chemical Type AMPs, Electro Chemical Type AMPs, Thermal Type AMPs, Derived & Hybrid AMPs.				
Course Outcome The students will learn the art of manufacturing new products due to the development of new materials and processes. The students will totally get a feel of the relevant suitable process while evaluating and deciding.				
Textbooks <div>1. Benedict G. F., "Nontraditional Manufacturing Processes", Marcel Dekker, Inc. New York.</div> <div>2. Ghosh A., Mallik A. K., "Manufacturing Science", Affiliated East-West Press Ltd, New Delhi.</div>				
References <div>1. McGeough J. A.,"Advanced Method of Machining", Chapman and Hall, NewYork.</div> <div>2. Pandey P. C., Shan H. S. "Modern Machining Processes", Tata McGraw-Hill Publishing Co. Ltd, New Delhi.</div> <div>3. Jain V. K.,"Advanced Machining Processes", Allied Publishers, New Delhi.</div>				
Course Plan				
Contents			Contact Hours	Sem. Exam Marks
Module I Types of advanced manufacturing processes, Evolution, need, and classification of advanced machining processes (AMPs). Abrasive Flow Machining, Magnetic Abrasive Finishing.			13	25
Module II Mechanical Type AMPs: USM, Rotary Ultra Sonic Machining, AJM, WJM, AWJM processes - Process principle and mechanism of material			16	25

removal; Process Parameters; Operational characteristics; Limitations. Chemical Type AMPs: Process principle and details of Chemical Machining, Photo-Chemical Machining, and Bio-Chemical Machining processes. Electro Chemical Type AMPs: ECM process principle; Mechanism of material removal; Process Parameters; Applications.		
FIRST INTERNAL EXAM		
Module III Thermal Type AMPs: EDM, Wire Electro Discharge Machining, LBM, EBM, IBM, PAM processes – Process principle and mechanism of material removal; Process parameters, Surface finish and accuracy.	15	25
SECOND INTERNAL EXAM		
Module IV Derived & Hybrid AMPs: Electro Stream Drilling, Shaped Tube Electro Machining, Electro Chemical Honing, Electro Chemical Discharge Machining.	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, types of 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				
<div>1. Buffa, E. S. and Sarin, R. K., “Modern Production/Operations Management”, 8th Ed., John Wiley & Sons.</div> <div>2. Mahadevan, B., Operations Management: Theory and Practice, 2nd Edition, Pearson Education.</div>				
References				
<div>1. Karjewski, L. J, Ritzman, L. P. and Malhotra, M. K., “Operations Management: Processes & Supply Chains, 9th Ed., Pearson Education.</div> <div>2. Adam, E., Jr. and Ebert, R. E., “Production Operations Management”, 5th Ed., Pearson Education.</div> <div>3. Dervitsiotis, K. N., “Operations Management”, 2nd Ed., McGraw Hill.</div> <div>4. Starr M. K., “Production and Operations Management”, Thomson Business Information.</div>				
Course Plan				
Contents			Contact Hours	Sem. Exam Marks
Module I				
Introduction: Basic concepts of operations and production management, types of manufacturing systems and their characteristics. Product and Process Design: System planning and design, long-range planning, 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 demand forecasting.		
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, capacity planning. Materials Planning: Details of material requirement planning (MRP) and manufacturing resource planning (MRP-II) and their various techniques.	11	25
SECOND INTERNAL EXAM		
Module IV Facilities Planning: Plant design, types and considerations in the plant location, plant layout types, design, evaluation, principles and types of material flow, optimum plant layout.	10	25
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction	
06ME6036	Ergonomics and Work System Design	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 Fundamentals: Productivity and Work Study, Definitions, Scope, and History of Work, Study, Tools of productivity, Productivity index, Kinds of productivity Measurements, Causes of low, productivity and techniques of their elimination, technical Methods to improve productivity, Analysis of Work Content, Management techniques to reduce work content Method Study: Process , Analysis, Process and Activity Charts, Operation Analysis, Basic procedure, Micro Motion Study, Principles of Motion Economy.			12	25
Module II			10	25

Work Measurement: Purposes and uses, Basic procedure, Techniques – Work Sampling, Stop-Watch, Time Study, Rating and Allowances, Setting Standard Times for Jobs, Standard Data, Predetermined Time Standards.		
FIRST INTERNAL EXAM		
Module III Ergonomics: Fundamental Concepts, Issues in Work system Design, Measuring Work by Physiological, means, Muscle Physiology, Muscle Metabolism, Work Posture, Fatigue Measurement and Evaluation, Work rest cycles, Applied anthropometry and work space design, Biomechanics of Human Motion, Sensorimotor responses.	10	25
SECOND INTERNAL EXAM		
Module IV Environmental Factors and Work Systems: Characteristics of Illumination, colour cone, Measurement, of illumination parameters, effect of glare on Human eyes, Effect stress on Human Health and, performance, thermoregulation, Physiological effects of noise and vibration, Measurements of Noise level parameters.	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 the success of a business. The course will provide foundation for design, analysis and performance metrics and to frame a sound supply chain network in the country.			
Syllabus			
Understanding supply chain, supply chain performance, Demand forecasting in supply chain, Aggregate planning in supply chain, Transportation aspects 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			
<div>1. Chopra S. and Meindell P., “Supply Chain Management: Strategy, Planning, and Operation”, Prentice Hall of India, New Delhi.</div> <div>2. Shapiro J. F., Duxbury Thomson Learning, “Modeling the Supply Chain”, Duxbury Thomson Learning Inc., Duxbury, Pacific Grove.</div>			
References			
<div>1. Makridakis, S and Wheelwright, S.S: Forecasting methods and Applications, John Wiley and Sons.</div> <div>2. Hopp W. J., Spearman M. L. and Irwin, “Factory Physics: Foundations of Manufacturing”, McGraw-Hill Inc. New York.</div> <div>3. Viswanadham N., “Analysis of Manufacturing Enterprises”, Kluwer Academic Publishers, UK.</div>			
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 supply chain, Need and uses of forecasting,		10	25

Smoothing methods, Moving averages, Single and linear exponential smoothing, Decomposition of time series, trend fitting, Seasonal adjustments, Econometric models and forecasting.		
FIRST INTERNAL EXAM		
Module III Aggregate planning in supply chain, planning supply and demand; managing predictable variability, Economic Order Quantity Models, Reorder Point Models, Multi-echelon Inventory Systems.	11	25
SECOND INTERNAL EXAM		
Module IV Transportation aspects in a supply chain, facility Decision, Network design in a supply chain, Information technology and its use in supply chain, Bullwhip effect, Role of Coordination and E-business in a supply chain; financial evaluation in a supply chain.	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 Fuzzy Optimization, Dynamic Programming, Stochastic Processes, Discrete event Simulation.			
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	10	25	
Non-Linear Programming: Classical optimization methods, Univariate and Multi-variate search techniques, Kuhn Tucker conditions, Fibonacci search method, golden section search method, Hooke and Jeeve’s method, Quadratic, Geometric and Separable Programming methods, Stochastic and Fuzzy Optimization.			
Module II	10	25	
Dynamic Programming: Bellman's principle of optimality, Concepts of state and stage, Solution of Discrete Problems through Backward Dynamic Programming, Continuous and Multi-stage Dynamic programming problems, Stochastic Dynamic Programming Problems.			
FIRST INTERNAL EXAM			
Module III	11	25	

Stochastic Processes: Description of state, Transition probability matrix, Ergodic Properties, First passage time, etc., Markov Decision Process, Markov Decision Problems, Policy Improvement Scheme.		
SECOND INTERNAL EXAM		
Module IV Discrete event Simulation: Time-flow mechanisms, Random Number and Random Deviate generation, Simulation of Queuing and Inventory Systems, Validation of Simulation 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 functions leading 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, classification and coding systems, production flow analysis, design of machine cells.		10	25
FIRST INTERNAL EXAM			
Module III			
Automated Process Planning: Advantages of automated process planning, various approaches to process planning; Variant process		12	25

planning, its features and different stages, different variant systems; Generative and semi-generative process planning, its features, design strategies, planning, modeling and coding scheme, decision mechanisms; Process capability analysis, intelligent process planning system; Artificial intelligence -- overview and application in process planning; Various recent 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				
<div>1. Gordon B. Davis and Margrethe H. Olson, Management Information Systems: Conceptual Foundations, Structure and Development, Second edition, Tata McGraw-Hill publication.</div> <div>2. Jawadekar W.S., Management Information System, 3rd edition, Tata McGraw-Hill publication.</div>				
References				
<div>1. James O’Brien, Management Information System, 7th edition, Tata McGraw-Hill publication.</div> <div>2. Sadagopan, Management Information Systems, Prentice Hall.</div>				
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 additive manufacturing technology and the associated aerospace, architecture, art, medical and industrial applications.			
Syllabus			
Classification of additive manufacturing (AM) processes, Role of additive manufacturing and rapid prototyping in product design and development, AM based rapid prototyping 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 and its data processing tools.			
Textbooks			
1. Chua, C.K., Leong, K.F., Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley and Sons Inc.			
2. Pham, D.T., Demov, S.S., Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer- Verlag London Limited.			
References			
1. Noorani, R., Rapid Prototyping: Principles and Applications, John Wiley & Sons, Inc., New Jersey.			
2. Saxena, A., Sahay, B., Computer Aided Engineering Design, Anamaya Publishers, New Delhi.			
3. Mortenson, M.E., Geometric Modelling, John Wiley and Sons, Inc.			
Course Plan			
Contents	Contact Hours	Sem. Exam Marks	
Module I			
Classification of additive manufacturing (AM) processes. Role of additive manufacturing and rapid prototyping in product design and development.	10	25	
Module II			
AM based rapid prototyping systems like Stereo-lithography, Fused	10	25	

Deposition Modeling (FDM), Selective Laser Sintering (SLS), Laminated Object Manufacturing (LOM), and 3-D Printing.		
FIRST INTERNAL EXAM		
Module III Accuracy issues in additive manufacturing, Properties of metallic and non-metallic additive manufactured surfaces, Stress induced in additive manufacturing processes. Surface roughness problem in rapid prototyping, Part deposition orientation and issues like accuracy, surface finish, build time, support structure, and cost.	11	25
SECOND INTERNAL EXAM		
Module IV Rapid tooling techniques such as laminated metallic tooling, direct metal laser sintering, vacuum casting etc. Process planning for rapid prototyping, STL file generation Defects in STL files and repairing algorithms, Slicing and various slicing procedures.	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 Engineering Materials, Edward Arnold, London.			
References			
1. Dowson, D., “History of Tribology”, Longman, London.			
2. ZumGahr, K. H., “Microstructure and Wear of Materials”, Elsevier, Amsterdam.			
3. Takadoun, J., “Materials and Surface Engineering in Tribology”, John Wiley and Sons, Inc., London.			
Course Plan			
Contents	Contact Hours	Sem. Exam Marks	
Module I	10	25	
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.			
Module II	10	25	
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.			
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), Fuzzy optimization, Introduction to neural Networks, 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 and Ajith Abraham, Hybrid Evolutionary Algorithms: Methodologies, Architectures, and Reviews, Springer Link.			
2. Rajasekaran S. and Vijayalakshmi Pai G.A., Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, 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 and techniques 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	

Fuzzy optimization, soft constraints, approximate reasoning, multi-criteria soft decision modelling, interactive approach, developing expert systems using fuzzy logic. Introduction to neural Networks, multi-layer networks, recurrent networks, learning paradigms.		
SECOND INTERNAL EXAM		
Module IV Introduction to Simulated Annealing, metropolis algorithm, heat bath algorithm, fast simulated 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 <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> ❖ 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 maintenance applicable 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”, 1 st edition, CRC.			
References			
1. Clifton R. H.,Principle of Planned Maintenance, McGraw Hill Inc. New York. 2. Niebel B.W., Engineering Maintenance Management, Marcel Dekker, New York.			
Course Plan			
Contents		Contact Hours	Sem. Exam Marks
Module I			
Introduction: Importance of maintenance, Objectives, duties, functions and responsibilities of maintenance engineering department, Organization and structure of maintenance systems. Maintenance policies and planning, Maintenance strategies, advantages and disadvantages of each strategy, Planned maintenance procedure, advantage of planned maintenance, Safety in maintenance.		11	25
Module II			
System Reliability: Quantitative estimation of reliability economies of introducing a standby unit into the production system, Optimum design configuration of a series/parallel system, Breakdown time distribution.		10	25
FIRST INTERNAL EXAM			
Module III		11	25

Maintenance Activities, Optimal overhaul/repair or replacement policies for equipment subject to breakdown, Budgeting and control, Production maintenance integration. Replacement Decisions, block replacement policy, age replacement 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, Management information system for maintenance.	10	25
END SEMESTER EXAM		

Course No.	Course Title	L-T-P-Credits	Year of Introduction
06ME7215	Fundamentals Of Robotic Systems	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, Tata McGraw-Hill Education., 2009			
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming 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	14	25	
Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system.			
Module II	14	25	
Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot			

controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.		
FIRST INTERNAL EXAM		
Module III Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.	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, classification 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 of metals, classification of metal working processes, formability and theory of sheet metal working, friction and lubrication in metal working operation, theories of friction and lubrication; assessment of friction at interface. Process analysis, various methods of analyzing the metal working processes, slipline field theory; upper bound solution; stab methods.		10	25
Module II			
Rolling- determination of rolling pressure, roll separating force, driving torque and power, and power loss in bearings; forging determination of forces in strip forging and disc forging; drawing- determination of force and power, determination of maximum allowable reduction; deep drawing force 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 energy consideration, power loss, hydrostatic extrusion; punching and blanking- mode of metal deformation and failure, two-dimensional deformation model.		11	25
SECOND INTERNAL EXAM			
Module IV			
Hydrostatic extrusion, comparison with conventional extrusion; pressure required to extrude, 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 Computer Integrated Manufacturing, 2 nd ed., Prentice Hall.			
2. Boothroyd, G., Assembly Automation and Product Design, 2 nd ed., Marcel Dekker.			
References			
1. Boothroyd, G., Dewhurst, P. and Knight, W., Product Design for Manufacture and Assembly, 2 nd ed., Taylor & Francis.			
2. Tergan, V., Andreev, I. and Lieberman, B., Fundamentals of Industrial 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 arguments against automation, mechanical, electrical, hydraulic, and pneumatic devices and controls.		10	25
Module II High Volume Manufacturing, Automated flow lines, types of automatic transfer mechanisms, design and fabrication considerations, analysis of automated flow lines. Assembly systems and their types, manual assembly lines and line balancing, Automated assembly lines and their types, automatic assembly transfer systems, automatic feeding and		11	25

orienting devices- vibratory and mechanical feeders and their types, orientation of parts, performance and economics of assembly systems, feasibility study for assembly automation.		
FIRST INTERNAL EXAM		
Module III Flexible Automation, Introduction of group technology (GT), steps in implementing Group Technology (GT), part families and machine cell 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 adaptive control.	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	11	25	
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.			
Module II	11	25	
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.			

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 and Modeling for a Complex World, McGraw-Hill.			
2. Mohapatra P.K.J, Mandal P., and Bora M.C., Introduction to Systems Dynamics Modelling, University press, 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 Emergence.	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 burden archetype, 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 causal relationships. Principal component analysis, Factor analysis, Discriminant analysis, 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, Classification of Welding Processes, Mechanism and types of metal transfer in various arc welding processes, Welding Power Sources, Critical review of different welding processes, 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 University Press.			
2. Rossi E., “Welding Technology”, Mc-Graw Hill.			
References			
1. Baldev, R., “Welding Technology for Engineers”, ASM International.			
2. Welding Handbook, 7th Edition-Volume 1 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	11	25	
Introduction: Welding as compared with other fabrication processes, Classification of Welding Processes. Welding arc, arc initiation and maintenance, voltage distribution along the arc, cathode and anode drops, Arc column, Thermionic and non thermionic cathode, arc characteristics, arc efficiency, Effect of shielding gas on arc, isotherms of arcs, and arc blow.			
Module II	11	25	
Mechanism and types of metal transfer in various arc welding processes, factors controlling melting rate in various welding processes. Welding Power Sources, Basic characteristics of power sources for various arc welding processes, arc length regulation in mechanized			

welding processes, Transformer, Static and dynamic characteristics of power sources.		
FIRST INTERNAL EXAM		
Module III Critical review of MMA, TIG, MIG and CO2 welding processes, plasma arc, submerged arc welding, electro- gas and electro-slag welding; resistance welding. Theory and mechanism of solid state welding; technique and scope of friction welding, diffusion welding; cold pressure welding and ultrasonic welding, electron beam and laser welding processes.	10	25
SECOND INTERNAL EXAM		
Module IV Heat flow in welding, Calculation of peak temperature; width of Heat Affected Zone; cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention. Weldability of metals, Effects of alloying elements on weldability, welding of plain carbon 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 and Production Planing, John Wiley & Sons.				
2. Silver E.A., Pyke D.F. and Peterson R., Inventory Management and Production Planning and Scheduling, John Wiley, 3rd ed.				
References				
1. Narasimhan S.L., Mc Leavy D.W. and Billington P.J., Production Planning and Inventory 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 and matching of PPC system with the Firm. Basic material and Information Flow. Material Requirements Planning and Lot Sizing. Just-In-Time Production.			9	25
Module II				
Capacity planning: tools and techniques. Production Control principles and techniques. Short-range forecasting techniques. Independent			11	25

demand Inventory Management. EOQ Models and order timing decisions, Safety Stock and reorder level decisions. Order quantity and reorder point. 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		