KERALA TECHNOLOGICAL UNIVERSITY

ERNAKULAM WEST CLUSTER

DRAFT

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

COMPUTER INTEGRATED MANUFACTURING

(2015 ADMISSION ONWARDS)

SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN COMPUTER INTEGRATED MANUFACTURING

SEMESTER-1

Exam Slot	Course No:	Name	L - T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06ME6011	Computational Methods in Engineering	4-0-0	40	60	3	4
B	06ME6021	Advanced Materials Engineering	4-0-0	40	60	3	4
C	06ME6031	Computer Aided Designin Manufacturing	4-0-0	40	60	3	4
D	06ME6041	Industrial Automation	3-0-0	40	60	3	3
E	06ME6x51	Elective I	3-0-0	40	60	3	3
F	06ME6061	Research methodology	0-2-0	100	0	0	2
G	06ME6071	Seminar I	0-0-2	100	0	0	2
H	06ME6081	Computer Integrated Manufacturing Laboratory - I	0-0-3	100	0	0	1

Credits:23

	Elective I (06ME6x51)
06ME6151	Industrial Robotics
06ME6251	Computer Aided Process Planning
06ME6351	Manufacturing Systems Engineering
06ME6451	MEMS and NEMS

SEMESTER-II

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06ME6012	Computer Aided Manufacturing	4-0-0	40	60	3	4
B	06ME6022	Modelling and Analysis of Manufacturing Systems	3-0-0	40	60	3	3
C	06ME6032	Automation and Control Systems	3-0-0	40	60	3	3
D	06ME6x42	Elective II	3-0-0	40	60	3	3
E	06ME6x52	Elective III	3-0-0	40	60	3	3
F	06ME6062	Mini Project	0-0-4	100	0	0	2
G	06ME6072	Computer Integrated Manufacturing Laboratory - II	0-0-3	100	0	0	1

Credits: 19

Elective II - (06ME6x42)		Elective III- (06ME6x52)	
06ME6142	Production and Operations Management	06ME6152	Corrosion and Surface Engineering
06ME6242	Global Optimization Algorithm	06ME6252	Composite Material Technology
06ME6342	Computer Integrated Quality Management	06ME6352	Industrial Welding Technology
06ME6442	Supply Chain Management	06ME6452	Material Characterization

SEMESTER-III

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06ME7x11	Elective IV	3-0-0	40	60	3	3
B	06ME7x21	Elective V	3-0-0	40	60	3	3
C	06ME7031	Seminar II	0-0-2	100	0	0	2
D	06ME7041	Project(Phase 1)	0-0-12	50	0	0	6

Credits: 14

Elective-IV(06ME7x11)		Elective-V(06ME7x21)	
06ME7111	Rapid Prototyping	06ME7121	Finite Element Analysis
06ME7211	Tribology	06ME7221	Fracture Mechanics
06ME7311	Precision Engineering and Micromachining	06ME7321	Sustainable Manufacturing
06ME7411	Nano Technology	06ME7421	Concurrent Engineering

SEMESTER-IV

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06ME7012	Project(Phase 2)	0-0-21	70	30	0	12

Credits: 12

Total Credits for all semesters: 68

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6011	COMPUTATIONAL METHODS IN ENGINEERING	4-0-0-4	2015

Pre-requisites: Nil

Course Objectives:

- To introduce students to the mostly used numerical methods in the different engineering fields.
- The emphasis will be on understanding the concepts of the numerical methods and on applying these concepts for solving various problems.
- MATLAB and Microsoft Excel may be used as tools to solve the problems using the different numerical methods.

SYLLABUS

Linear interpolation methods, Newton's method, Gaussian - Jordon methods, Lagrangian Polynomials, Newton's forward and backward difference formulas. Fourier Approximation, Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method, Double Integrals, Taylor series method – Euler's methods, -Eigen Value problems.

Course Outcome:

At the end of the course the students should be able to:

i. Understand the different numerical methods to solve the algebraic equations and to solve system of linear and non linear equations.
ii. Understand the different numerical methods for interpolation, differentiation, integration and solving set of ordinary differential equations.
iii. Understand how numerical methods afford a mean to generate solutions in a manner that can be implemented on digital computers.

Text Books:

1. Chapra, Steven. C and Canale, Raymond. P, "Numerical Methods for Engineers", Third Edition, Tata Mc-Graw Hill Pub. Co. Ltd., NewDelhi, 2000.

References:

1. Gerald, C.F, and Wheatley, P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
2. Balagurusamy, E., "Numerical Methods", Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 1999.
3. M.K.Jain, SRK Iyengar and R.L.Jain, "Numerical Methods for Scientific and Engineering Computation", Wiley Eastern Ltd., 1987.
4. Dr. M.K. Venkataraman, "Numerical Methods in Science and Engineering", National Publishing Co., 1999.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks%**
Module : 1	Linear interpolation methods (method of false position) – Newton's method - Fixed pointiteration: x=g(x) method - Solution of linear system by Gaussian elimination and Gauss-Jordon methods- Iterative methods: Gauss Jacobi and Gauss-Seidel methods- Inverseof a matrix by Gauss Jordon method – Eigen value of a matrix by power method.	14	25
Module : 2	Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline –Newton's forward and backward difference formulas. Fourier Approximation – Discrete Fourier transform (DFT), Fast Fourier Transform (FFT).	14	25
FIRST INTERNAL EXAM			
Module : 3	Derivatives from difference tables – Divided differences and finite differences –Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and Three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpson's rules.	14	25
SECOND INTERNAL EXAM			
Module : 4	Single step methods: Taylor series method – Euler and modified Euler methods – Fourth order Runge – Kutta method for solving first and second order equations - Eigen Value problems.	14	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6021	ADVANCED MATERIALS ENGINEERING	4-0-0-4	2015

Pre-requisites: Nil

Course Objectives:

- This course provides knowledge in the areas of advanced materials and its selection for important applications.
- To provide fundamental concepts of atomic structure, chemical bonds, crystal structure, grain size, heat treatment etc. of metals with mechanical behaviour.
- To understand the strengthening mechanisms of different types of metals.
- To enable students to be more aware of the behaviour of materials in engineering applications and select the materials for various engineering applications.

SYLLABUS

Introduction to atomic structure; chemical bonds; crystallography; mechanism of crystallization; Imperfections; Phase diagrams; Kinetics of phase transformations; Heat treatment of steels; Maraging steel; Ceramics- crystal structures; High temperature super alloys; physical metallurgy of nickel and its alloys; Molybdenum: Production, properties, effect of molybdenum alloying and applications; Production of niobium and its alloys; Titanium-Sponge Production; Detailed discussions on Vacuum induction melting (VIM);Vacuum arc remelting (VAR); electroslag remelting (ESR).

Course Outcome:

After this course students get knowledge about various advanced materials and their properties. They will be able to choose different materials in various field of application and will get ideas about heat treatment techniques on various materials and their behaviour.

Text Books

1. Callister William. D., “Material science and engineering”, John Wiley.
2. Raghavan V., “Material science and engineering”, Prentice Hall.
3. Roger C. Reed, “The Superalloys Fundamentals and Applications”, Cambridge university press.

References:

1. Richard K. Wilson (Editor), “Maraging steels - recent development and applications”, TMS Publication.
2. Westbrook J. H., “Intermetallic compounds”, John Wiley.

3. Matthew J. Donachie, Stephen J. Donachie, Superalloys, "A Technical Guide", ASM International.
4. G.Lutjering, J. C Williams., "Engineering Materials and processes – Titanium" , Second edition , Springer - Verlag Berlin Heidelberg 2007.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
MODULE : 1	Atomic structure: primary bonds - classification- bond energy, cohesive force, density, directional and non-directional etc. Specific properties of bonding: Deeper energy well and shallow energy well bond- secondary bonds: classification, hydrogen bond, specific heat etc. Crystallography: BCC, FCC, HCP structures - short and long range order - determination of atomic packing factor of SC, BCC, FCC, HCP and diamond - coordination number – linear and planar densities - Schmid's law applications, problems. Mechanism of Crystallization - polishing and etching to determine the microstructure.	13	25
MODULE : 2	Imperfections- problems - role of surface defects on crack propagation – forest of dislocation - Burgers vector - Phase diagrams: Limitations of pure metals and need of alloying - Hume Rothery`s rule - single phase, multi-phase equilibrium diagrams - lever rule and Gibb`s phase rule – Equilibrium diagrams having intermediate phases or compounds- Congruent phase transformations- Iron – Iron carbide Phase diagram – Development of microstructure in Iron – Carbon alloys. Phase Transformations- Kinetics of phase transformations- Metastable versus equilibrium states- Heat treatment of steels- Definition and necessity- Isothermal transformation diagrams(TTT)-Continuous cooling transformation (CCT) diagram - annealing, normalizing, hardening, spheroidizing - Tempering:- austempering, martempering and ausforming.	15	25
FIRST INTERNAL EXAM			
MODULE : 3	Maraging steel: History of maraging steel development - reaction in austenite - reaction in martensite - austenite to martensite transformation – effect of aging time - effects of	14	25

	maraging with cobalt, cobalt free, molybdenum and other alloying elements - weldability, hardness variation in welded zone - applications - special advantages and limitations. Ceramics: AX, AmXp, AmBmXp type crystal structures – imperfections in ceramics, stoichiometric defect reactions – stress strain behaviour – applications. High temperature super alloys: Characteristics of high-temperature materials- selection of materials for high temperature applications - physical metallurgy of nickel and its alloys - Composition–microstructure relationships in nickel alloys.		
SECOND INTERNAL EXAM			
MODULE : 4	Molybdenum: Ferromolybdenum -production of molybdenum – properties - effect of molybdenum alloying on hot strength, corrosion resistance, and toughness – applications - TZM, TZC. Niobium: Production of niobium - niobium alloys - niobium in steel making Ni alloys characteristics and applications. Titanium: Basic Properties, Crystal Structure- binary phase diagram classification based on alloying elements-Basic Hardening Mechanisms: Alpha Phase, Beta Phase - Sponge Production- pickling of titanium - scrap recycling- problems in machining Titanium - welding of titanium and defects. Detailed discussions on Vacuum induction melting (VIM) - Conditions for freckle formation - Vacuum arc remelting (VAR), electroslag remelting (ESR).	14	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6031	COMPUTER AIDED DESIGN IN MANUFACTURING	4-0-0-4	2015

Pre-requisites: Nil

Course Objectives:

- The course focuses on the extensive theory and tools in computer aided design and computer aided manufacturing with a focus on the integration of these tools and the automation of the product cycle and also an introduction to finite element analysis
- The course prepares the graduated to work effectively with CAD/Cam softwares by understanding the mathematical form of each and every design aspect involved in the designing using design software.
- The course gives an introduction to finite element analysis using sofwares.

SYLLABUS

Introduction to CAD system; Computer graphics and graphics transformation; Geometric modelling; Parametric design and object representation; introduction to finite element analysis.

Course Outcome:

Students who successfully complete this course will have enhanced Computer aided design and analysis expertise and better understanding of computer aided manufacturing systems.

Text Books:

1 Ibrahim Zeid, "CAD/CAM theory and practice", McGraw Hill Inc, 1991.

2 Groover M. P, "Automation, production systems and computer integrated manufacturing", Prentice Hall India (P) Ltd., 2002.

References:

1 C. S. Krishnamoorthy and S. Rajeev, "Computer aided design", Narosa Publishing House, 1991.

2 Vera B. Anand, "Computer graphics and geometric modelling for engineers", John Wiley & Sons Inc., 1993.

3 Sadhu Singh, "Computer aided design and manufacturing", Khanna Publishers, 2009.

4 R. D. Cook, "Concepts and applications of finite element analysis", 4th Edition, International Edition, 2001.

5 Daryl L. Logan, "A first course in the finite element method", Cengage Learning, 2007.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module : 1	**Overview of CAD systems**: Conventional and computer aided design processes – advantages and disadvantages – CAD hardware and software – analytical and graphics packages – networking of CAD systems. **Computer graphics and graphics transformation**: Image processing – transport of graphics data – graphic standards – display and viewing – transformations – customizing graphics softwares.	14	25
Module : 2	**Geometric modeling**: Wire frame, surface and solid modeling – applications and advantages –Boolean operations – half-spaces – filleting of edges of solids – boundary representations – constructive solid geometry – sweep representation	14	25
FIRST INTERNAL EXAM			
Module : 3	**Parametric design and object representation**: Object-oriented representation – types of co-ordinate system – parametric design – definition and advantages – parametric representation of analytic and synthetic curves – parametric representation of surfaces and solids – manipulations. Mechanical assembly – mass property calculation.	14	25
SECOND INTERNAL EXAM			
Module : 4	**Introduction to finite element analysis**: Basic steps in finite element problems formulation – element type and characteristics – element shapes – co-ordinate systems – 1D link elements and beam elements – shape functions – stiffness matrices – direct stiffness method – 2 D elements – axisymmetric elements – plane stress problem – higher order elements.	14	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6041	INDUSTRIAL AUTOMATION	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To provide an understanding of applications of hydraulics and pneumatics in automation.
- To gain knowledge about hydraulic and pneumatic circuits
- To understand essentials of programmable logic controller.
- To gain knowledge on how computers are integrated at various levels of manufacturing.

SYLLABUS

Introduction to fluid power system. Construction, operation, characteristics and graphical symbols of hydraulic components. Introduction to pneumatic system - Construction, operation, characteristics and symbols of pneumatic components.Hydraulic and pneumatic circuits-Development. Programmable logic controller-Basic PLC structure, Input / Output processing-Ladder programming.

Course Outcome:

Students who successfully complete this course will have better understanding of industrial automation systems.They will gain knowledge about hydraulic and pneumatic circuits. They will cultivate skills to develop ladder logic diagram.

Text Books:

1. Anthony Esposito, Fluid Power with applications, Prentice Hall International, 1997.
2. Majumdar S. R., Oil Hydraulics, Tata McGraw Hill, 2002.
3. W. bolton, Mechatronics, Pearson education Publication.

References:

1. Werner Deppert / Kurt Stoll, Pneumatic Application, Vogel verlag, 1986.
2. John Pippenger, Tyler Hicks, Industrial Hydraulics, McGraw Hill International Edition, 1980.
3. Andrew Parr, Hydraulics and pneumatics, Jaico Publishing House, 2003.
4. FESTO, Fundamentals of Pneumatics, Vol I, II and III.
5. Hehn Anton, H., Fluid Power Trouble Shooting, Marcel Dekker Inc., NewYork, 1984.
6. Thomson, Introduction to Fluid power, Prentcie Hall, 2004.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
MODULE : 1	Introduction to fluid power system - Hydraulic fluids - functions, types, properties, selection and application. Construction, operation, characteristics and graphical symbols of hydraulic components- pumps, actuators/motors, valves, switches filters, seals, fittings and other accessories.	10	25
MODULE : 2	Introduction to pneumatic system - Construction, operation, characteristics and symbols of pneumatic components. Air treatment - principles and components. Sensors- types - Characteristics and applications - Introduction to fluidics and MPL.	10	25
FIRST INTERNAL EXAM			
MODULE : 3	Reciprocating circuits, pressure dependant circuits, speed control circuits, pilot operated circuits, simple sequencing circuits, synchronizing circuits, circuits using accumulator, time delay circuits, logic circuits, cascading circuits, feedback control circuits.	11	25
SECOND INTERNAL EXAM			
MODULE : 4	Development of hydraulic / pneumatic circuits applied to machine tools, presses, material handling systems, automotive systems - packaging industries manufacturing automation. Programmable logic controller-Basic PLC structure, Input / Output processing- Ladder programming. Instruction lists- Latching and internal relays, sequencing, Timers and counters, Shift registers, Master and Jump Control.	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6151	INDUSTRIAL ROBOTICS	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To understand the basic principles involved in the design, analysis and synthesis of robotic systems.
- To provide an understanding about the different types of drive mechanisms involved.
- To gain knowledge on the basic computational requirements in robotic systems.
- To provide hands on session to robot programming and design concepts.

SYLLABUS

Introduction to industrial robotics: Fundamental concepts, Power transmission systems and control robot drive Mechanisms, computer vision for robotic control: Robot vision systems - imaging components - image representation - hardware aspects, Transformation and applications**:** D.H. matrices controller architecture. Robot programming of commercial robots - robot design and process specifications.

Course Outcome:

Successful completion of this course will enable the students to have a better understanding about the different robot drive mechanisms. They will be able to build simple robotic systems, which could undertake specific tasks. Students will be able to analyze the kinematics of various robotic systems.

Text Books:

1. S.K Saha, “Introduction to Robotics”, McGraw Hill Education, 2008
2. Mikell P Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, “Industrial Robotics”, McGraw Hill Book Co, NY, 2008.

References:

1. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill Book Co., 2004.
2. Fu KS, Gomaler R C and Lee C S G., "Robotics: Control Sensing, Vision, Intelligence", McGraw Hill Book Co., 1987.
3. Shuman Y No, "Handbook of Industrial Robotics", John Wiley and Sons, New York, 1985.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
MODULE : 1	History, present status and future trends, robotics and automation, laws of robotics, robot definition, robotics systems and robot anatomy, specification of robots. Resolution, repeatability and accuracy of a manipulator.	10	25
MODULE : 2	Power transmission systems and control robot drive mechanisms, mechanical transmission method, rotary-to-rotary motion conversion, rotary-to-linear motion conversion, end effectors- types, gripping problem, remote-centered compliance devices - control of actuators in robotic mechanisms. Sensors for robotic applications: devices - non-optical-position sensors - optical position sensors - velocity sensors - proximity sensors: - contact and non-contact type - touch and slip sensors - force and torque sensors - AI and robotics	10	25
FIRST INTERNAL EXAM			
MODULE : 3	Robot vision systems - imaging components - image representation - hardware aspects - picture coding - object recognition and categorization - visual inspection - software considerations - applications - commercial - robotic vision systems. Computer architecture for robots, hardware, computational elements in robotic applications - robot programming - sample programs - path planning - robot's computer system.	11	25
SECOND INTERNAL EXAM			
MODULE : 4	Homogeneous co-ordinates, co-ordinate reference frames, homogeneous transformations for the manipulator, the forward and inverse problem of manipulator kinematics, motion generation, manipulator dynamics, Jacobian in terms of D. H. matrices controller architecture. Robot programming of commercial robots - robot design and process specifications - motor selection in the design of a robotic joint - robot cell layouts - economic and social aspects of robotics, Capabilities of robots-robotics applications - obstacle avoidance - robotics in India - the future of robotics.	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6251	COMPUTER AIDED PROCESS PLANNING	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To provide the importance of CAPP and different steps involved in its implementation.
- To gain knowledge on how computers are integrated at various levels of planning and manufacturing.
- To provide an understanding of process planning complexity and supply them with objective technical knowledge.
- To introduce modern approaches in generative approach, AI and expert systems for planning process.

SYLLABUS

Introduction to process planning; Typical Process Planning examples; part design representation; manufacturing system components; parts classification and coding for group technology; computer aided process planning systems and softwares; intelligent process planning in manufacturing and its applications.

Course Outcome:

Students who successfully complete this course will have enhanced process planning expertise and better understanding of computer aided process planning systems.They will know to use modern approaches in generative approach, AI and expert systems for planning process.

Text Books:

1. Gideon Halevi, "Process and Operation Planning" Revised Edition of The Principles of Process Planning: A Logical Approach, Kluwer Academic Publishers, 2003.
2. Groover M. P, "Automation, production systems and computer integrated manufacturing", Prentice Hall India (P) Ltd., 2002.

References:

1. Radhakrishnan P., Subramanyan S., Raju V., "CAD/CAM/CIM", 3rd edition, New Age International, 2008.
2. Sadhu Singh, "Computer Aided Design and Manufacturing", 5th edition, khanna publishers, 2010.
3. Rao P. N., "CAD/CAM: Principles and Applications", Tata McGraw Hill, 2004.
4. Zude Zhou, Huaiqing Wang, Ping Lou, "Manufacturing Intelligence for Industrial Engineering: Methods for System Self-Organization, Learning, and Adaptation", Engineering Science Reference, 2010.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
MODULE : 1	The role of Process Planning in Manufacturing Cycle - Process Planning and Production Planning – Technology and Methods,Process Planning and Design, Selection of operations, machines, cutting speed and tools, Study of a Typical Process Planning – drilling a hole – pocket milling, Concurrent Engineering and Design For Manufacturing.	10	25
MODULE : 2	Technical Drawings, Geometric Tolerances, Tolerancing in Production, Process Capability and Process selection,Experience-Based Planning, Components of a manufacturing system,Group Technology, Parts Classification and Coding, Features of Parts Classification and Coding Systems, OPITZ system, MICLASS system, Production Flow Analysis, Cellular Manufacturing, Application Considerations in Group Technology.	10	25
FIRST INTERNAL EXAM			
MODULE : 3	Computer-Aided Process Planning, Retrieval CAPP Systems, Generative CAPP Systems, Structure of a Process Planning Software, Operation of a Typical Computer Aided Process Planning Software, Implementation Considerations of a Process planning system, Process Planning Systems, CAM-I CAPP, MIPLAN and MULTICAPP, APPAS and CADCAM, AUTOPLAN and RPO, AUTAP System, CPPP, GARI, TIPPS.	11	25
SECOND INTERNAL EXAM			
MODULE : 4	Intelligent Manufacturing and Manufacturing Intelligence, Computational Intelligence, Artificial Neural Networks, Fuzzy System, Evolutionary Computation, Group Technology in Intelligent Manufacturing, Intelligent Process Planning: Intelligent CAPP, Application of GA to Computer-Aided Process Planning, The Implementation of ANN in CAPP System, The Use of Case-Based Reasoning in CAPP, Multi-Agent-Based CAPP.	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6351	MANUFACTURING SYSTEMS ENGINEERING	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To provide the importance of MSE and different systems involved in manufacturing.
- To gain knowledge on how effectively and economically the systems of manufacturing can be designed.
- To familiarise the various low wastage and ultra low wastage manufacturing systems.
- To understand the most modern trends in manufacturing systems engineering to redesign the existing methods and practices to obtain the most suitable way of manufacturing, both technically and economically.

SYLLABUS

Fundamentals of Manufacturing Systems - Structural, Transformational and Procedural aspect of manufacturing systems. Process systems for manufacturing- Material and Technological Information Flows in Manufacturing Systems, Logistics systems etc. Process Planning and Design. Aggregate Production Planning-Production planning - Product mix analysis- Lot-size analysis - MRP and machine loading.

Computerized Production Scheduling - Interactive group scheduling technique - Computer-aided line balancing (CALB) – On line Production Control Systems. Automation systems for manufacturing - Industrial Automation - Automatic machine tools for mass production. Computerized layout planning. Social systems for manufacturing - Social production modes, Manufacturing Strategy, CIM as a corporate strategy - Global Manufacturing. Concept of manufacturing excellence -Approaches to manufacturing excellence - Green production

Course Outcome:

Students who successfully complete this course will have the expertise and better understanding of various systems in manufacturing. They will know to use modern approaches to fulfil the low or no wastage of resources methods in manufacturing. They are also expected to have a flare in designing the manufacturing atmosphere in such a manner that possibly no wastage of resources took place in manufacturing.

Text Books:

1. KatsundoHitomi, "Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics." CRC Press; 2nd edition 1996.
2. Ronald G Askin, "Modeling and Analysis of Manufacturing Systems", John Wiley and Sons, Inc, 1993.

References:

1. A. K Gupta, S. K. Arora, "Industrial automation and robotics", Laxmi Publications, 2009.
2. R. Panneerselvam, " Production and Operations management", Prentice-Hall Of India Pvt. Limited, 2006
3. Zude Zhou, Huaiqing Wang, Ping Lou, "Manufacturing Intelligence for Industrial Engineering: Methods for System Self-Organization, Learning, and Adaptation", Engineering Science Reference, 2010.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
MODULE : 1	Definitions of production and manufacturing - Principles of manufacturing, Resources of production: inputs for production - Goods produced: outputs of production processes: transformation of inputs into outputs Production organization Fundamentals of Systems Basic concepts of systems and chaos - Definition of systems. Structural, Transformational and Procedural aspect of manufacturing systems. Integrated Manufacturing and Management Systems - Basic framework, Basic functions and structures of Integrated Manufacturing and management systems, Principles of Computer - integrated Manufacturing (CIM)	11	25
MODULE : 2	Material and Technological Information Flows in Manufacturing Systems, Logistics systems, Material flow - Technological information flow, Product Planning and Design, Product planning, Product design - Product structure and explosion. Process Planning and Design, Scope and problems of process planning - Process design, Operation design. Optimum routing analysis, Line balancing - Layout Planning and Design. Scope and problems of layout planning - Systematic layout planning (SLP) - Manufacturing Optimization, Evaluation criteria for manufacturing optimization - Optimization of single-stage and multi stage manufacturing systems.	11	25

FIRST INTERNAL EXAM			
MODULE : 3	Production planning defined -Short-term production planning - Multiple-objective production planning, Long term production planning – basics only. Computerized Production Scheduling - Interactive group scheduling technique - Computer-aided line balancing (CALB) – On line Production Control Systems - Concept & Structure. Scheduling and control of on-line production, Optimum-seeking method for on-line production control, Computer based Production Management Systems - computerized manufacturing information systems - Inventory Management - Inventory function in manufacturing - Fundamentals of inventory analysis - Inventory systems. Multiple - product inventory management - Probabilistic inventory models - Production Control - Scope and problems of production control Process control Just-in-time (JIT) production and Toyota production systems.	10	25
SECOND INTERNAL EXAM			
MODULE : 4	Industrial Automation – Meaning and kinds of automation - Development of automatic manufacturing - Automatic machine tools for mass production – Computer-controlled manufacturing systems - Flexible manufacturing system (FMS) - Automated assembly - Automatic materials handling - Automatic inspection and testing. Computer-integrated automation system: unmanned factory- Automatic operation planning: auto-programming system. Social systems for manufacturing - Social production modes, Manufacturing Strategy, Computer-integrated manufacturing as a corporate strategy - Global Manufacturing - Industrial efficiency in advanced and developing countries, International comparison of manufacturing efficiency - Manufacturing Excellence for Future Production Perspectives, Importance and dilemma of today's manufacturing - Concept of manufacturing excellence - Approaches to manufacturing excellence - Green production.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6451	MEMS & NEMS (Microelectromechanical Systems and Nanoelectromechanical systems)	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To introduce the concepts of microelectromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To introduce concepts of quantum mechanics and nano systems.

SYLLABUS

Overview and Introduction - New trends in Engineering and Science - Micro and Nanoscale systems - Applications of Micro and Nanoelectromechanical systems- Microelectromechanical systems- Materials for MEMS – Microsensors - Microsystem fabrication processes-Bulk Micro machining - Surface Packaging-Microsystems packaging- Design of Actuators- Micromechanical Motors and pumps- Case study- Comb drive actuators- Atomic Structures and Quantum Mechanics- Nanostructures and Molecular Dynamics- Electromagnetic Fields and their quantization- Molecular Wires and Molecular Circuits.

Course Outcome:

After completing this course, Students will be able to do projects on microelectromechanical devices. They will have extended knowledge in Nanoelectromechanical systems.

Text Books:

1. Marc Madou, “Fundamentals of Microfabrication”, CRC press 1997.

References:

1. Stephen D. Senturia,” Micro system Design”, Kluwer Academic Publishers,2001
2. Tai Ran Hsu,”MEMS and Microsystems Design and Manufacture”, Tata McGraw Hill, 2002.
3. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006,
4. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures” CRC Press, 2002.

Course Plan			
Module	**Contents**	**Contact hours**	**Sem. Exam Marks %**
Module : **I**	New trends in Engineering and Science: Micro and Nanoscale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Microelectromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals- Microsensors: :Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors	**11**	**25**
Module : **II**	Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micro machining, Surface Micromachining, High Aspect Ratio (LIGA and LIGA like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials	**11**	**25**
First Internal Exam			
Module : **III**	Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.	**10**	**25**
Second Internal Exam			
Module : **IV**	Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Shrodinger Equation and Wavefunction Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.	**10**	**25**
End Semester Exam			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6061	RESEARCH METHODOLOGY	0-2-0-2	2015

Pre-requisites: Nil

Course Objectives:

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.

Text Books:

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			
Module	**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 relating to research design, observation and facts, laws and theories, prediction and explanation, development of models.	**7**	**25**
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 Name	L-T-P Credits	Year of Introduction
06ME6071	SEMINAR - I	0-0-2-2	2015

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6081	COMPUTER INTEGRATED MANUFACTURING LABORATORY - I	0-0-2-1	2015

Pre-requisites: Nil

Course Objectives:

- To train students in various computer aided modelling techniques using CAD softwares.
- To mould students to be an expert in the field of finite element analysis and also able to undertake problem identification, formulation and solution.
- To assist and support the design, manufacture and testing of products and components for design oriented projects.
- To emphasize the applications of DOE in the field of computer integrated manufacturing.

List of Exercises / Experiments

1. 3D solid modeling and assembly using any parametric software.
2. Synthesis of simple mechanisms using any parametric software.
3. Finite Element Analysis (FEA) :-
   - Pre-processing (solid modeling, meshing, analysis setup)solver and
   - post processing (graphical display and report)

   (Exercises include Simple Beam, Plane Stress, Strain, ax-symmetric, 3D Solids).
4. Manufacturing system simulation using software.
5. Design of experiments and analysis of data using software like SPSS, MiniTab etc (Analysis of mean and ANOVA Application of software)

Course Outcome:

- The students shall be able to model 3-D CAD renderings.
- Students shall be able to apply FEA for solving problems in various areas.
- The students should have the ability to conduct design of experiments and execute the same to an appropriate professional standard.

References:

1. Arbor text, PTC Authorized training manual (PL-830A-01), PTC University, Parametric Training Corporation, 2010.
2. K J bathe, Finite Element Procedures, Prentice Hall, 2007.
3. Abaqus 6.13, Documentation, Dassault Systèms, 2013.
4. Jacob Fish, Ted Belytschko, A First Course in Finite Elements (Paperback), Wiley, 2007.
5. Douglas C. Montgomery, Design and Analysis of Experiments: International Student Version (English) 8th Edition, Wiley.
6. Mathworks.com (1996-2015), Matlab Documentation.

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6012	COMPUTER AIDED MANUFACTURING	4-0-0-4	2015

Pre-requisites: Nil

Course Objectives:

- To provide current and essential hands-on skills with knowledge in the area of Computer Aided Manufacturing with a leading edge in the focus area of CNC programming and applications.
- To provide an understanding about therole of computer aided manufacturing in industries.
- To gain knowledge on constructional features of CNC machine tools.
- To gain an understanding about computer aided part programming andmake them able to program NC codes manually.

SYLLABUS

Introduction to Computer Aided Manufacturing;development of Numerically Controlled Machine Tools; Working principles, design features and constructional features of CNC machines; Optimizing Machining parameters; Part Programming for CNC Machines; APT Part Programming; Tooling and work holding devices.

Course Outcome:

Successful completion of this course will enable the students to have a better understanding about CNC machine tools and associated tooling and work holding devices. They will be able to program NC codes manually.

Text Books:

1. Chennakesava R Alavala, “CAD/CAM Concepts and applications”, Prentice Hall India (P) Ltd., 2008.
2. Alan Overby, “CNC Machining Handbook”, Building, Programming and Implementation, McGraw-Hill, 2011

References:

1. Peter Smid, “CNC Programming Hand Book”, 3rd Edition, Industrial Press Inc., 2007.
2. Yusuf Altintas, “Manufacturing Automation”, 2nd Edition, Cambridge University Press, 2012
3. Graham T. Smith, “CNC Machining Technology”, Springer-Verlag London Limited 1993.
4. G. E. Thyer, “Computer Numerical Control of Machine Tools”, Butterworth-Heinemann, 1991.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module : 1	Historical Perspective - the Early development of Numerically Controlled Machine Tools - Need and future of NC Systems and CAM, Advantages, Disadvantages and Applications. The Economics of CNC – CAM hierarchy - Elements of CAM systems. Understanding and Using CAM - CAM procedure-CAM Machining Parameters.Fundamentals of NC Technology, Motion Control Systems, CNC and DNC concept - Types of CNC systems - Open loop and closed loop controls.	14	25
Module : 2	Selection of CNC system - Structure of CNC machine tools – spindle design, Machine Tool Drives, actuation systems, Feedback Devices. Working principles and design features of CNC machine tools - turning centre, machining centre, Economic Optimization of Machining Operations in Computer Aided Manufacturing Systems, Optimization of Cutting Conditions in Machining Operations, Effect of feed and speed.	14	25
FIRST INTERNAL EXAM			
Module : 3	Part programming of a CNC lathe: Fundamentals of CNC Programming - ISO standards for coding G-Code, M Codes - Fixed Cycles, Subprograms, Do loop - Manual Data Input – G-Code Editors. APT Part Programming Language, macros, Parametric Programming - Features of CAD/CAM packages, CNC Control softwares.	14	25
SECOND INTERNAL EXAM			
Module: 4	Cutting Tool Technology - tool presetting – Qualifies, semi qualified tools - Tool Materials - Insert Cutting Tool geometries and their Selection - Modular Quick- change Tooling - Tool and Work piece Monitoring Systems. Types of Cutting Fluids – Selection of Cutting Fluids - Automatic Tool Changer, Automatic Pallet Changer - Advanced Work holding Methods on Turning Centres - Machining Centre Work holding Techniques, Workpiece Delivery Systems to Turning and Machining Centres.	14	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6022	MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS	3-0-0-3	2015

Pre-requisites: nil

Course Objectives:

- To provide knowledge in the area of modelling different types of manufacturing systems
- To provide an understanding about FMS systems and it's working.
- To develop problem solving ability on quantitative analysis of sequencing problems.
- To gain an understanding about the various input models and simulation software's in modelling manufacturing systems.

SYLLABUS

Types and principles of manufacturing systems, approaches to line balancing, FMS, System components – planning and control hierarchy – system design, system setup, scheduling and control, Input modelling, simulation modelling and analysis of inventory systems and pert networks. Queuing theory and networks.

Course Outcome:

Successful completion of this course will enable the students to have a better understanding about different manufacturing systems and simulation software's. Students will be able to solve sequencing and scheduling problems associated with different manufacturing systems.

Text Books:

1. Ronald G Askin, "Modeling and Analysis of Manufacturing Systems", John Wiley and Sons, Inc, 1993.
2. Viswanatham N and Narahari Y, "Performance Modelling of Automated Manufacturing Systems", Prentice Hall Inc., 1992**.**

References:

1. Jerry banks, John S Carson II, Barry Nelson, "Discrete event system simulation", second edition, Prentice Hall Inc., 2000.
2. Gordon G., "System simulation", Prentice Hall Ltd. 1991.
3. Deo, N., "System simulation with digital computer", Prentice Hall of India, 1997.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module : 1	Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building. Assembly lines - reliable serial systems - approaches to line balancing – COMSOAL, ranked positional weight heuristic, branch and bound technique (optimal solution) – sequencing mixed models – unpaced lines, transfer lines and general serial systems – paced lines without buffers, two stage paced lines with buffers, introduction to unpaced lines.	11	25
Module : 2	System components – planning and control hierarchy – system design, system setup, scheduling and control – flexible assembly systems. Group technology – coding schemes – assigning machines to groups – production flow analysis, binary ordering algorithm, single pass heuristic, similarity coefficients, graph partition - assigning parts to machines. Facility layout- systematic layout planning, quadratic assignments problem approach – VNZ heuristic, branch and bound method – graph theoretical approach – decomposition of large facilities – net aisle and department layout	11	25
FIRST INTERNAL EXAM			
Module : 3	Data collection, identifying the distribution with data, parameter estimation, goodness of fit test, Chi square, Klomogrov and Smirnov tests, selecting input model when data are not available. Simulation software for manufacturing applications, simulation modeling and analysis of inventory systems and pert networks	10	25
SECOND INTERNAL EXAM			
Module : 4	Queuing models – notations, performance measures, m/m/1 queue, m/m/m queue, batch arrival queuing systems, queues with breakdowns – queuing networks – open and closed networks, central server model.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6032	AUTOMATION AND CONTROL SYSTEMS	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To provide students with a wide and updated knowledge on the current trends in industrial automation.

SYLLABUS

Introduction to automation; Production automation; hardware components for automation and process control; control system.

Course Outcome:

Students who successfully complete this course will have enhanced expertise and better understanding of automation and control systems.

Text Books:

1. Groover M P, "Automation, production systems and computer integrated manufacturing", Prentice Hall India (P) Ltd., 2002.
2. Gopal M., "Control systems principles and design", TMH, New Delhi.

References:

1. Nagrath I. J. and Gopal M., "Control system engineering", New Age International, New Delhi.
2. Shinsky, "Process control system", Prentice Hall India, 2000.
3. A. Malov and Yu. Ivanov; translated from Russian by A. Troitsky, "Principles of automation and automated production", Mir Publishers, 1976.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**

Module : 1	**Automation:** Introduction to automation: definition, types of automation, strategies merits and criticism – manufacturing plants and operations – automation strategies – basic elements of automated system – advanced automation functions – levels of automations – automated production lines – economic and social issues – impact on labor.	10	25
Module : 2	**Production automation:** Industrial control systems – process layout for automation –discrete manufacturing industries – continuous and discrete control systems – overview of computer process control – fundamentals of automated assembly, parts feeding devices – production flow analysis: general terminology and analysis, analysis of transfer lines without storage, partial automation	10	25
FIRST INTERNAL EXAM			
Module : 3	**Hardware Components for Automation and Process Control:** Sensors-Actuators-Electric Motors, Other types of actuators-Analog to digital convertors-Digital to analog Convertors-Input/output devices for discrete data- Contact input/output interfaces, Pulse counters and generators.	11	25
SECOND INTERNAL EXAM			
Module : 4	**Control systems:** Servomechanisms – digital computer control – controller components – hydraulic systems – pneumatic systems – stepper motor-transfer functions – block diagram algebra – signal flow graphs - Feedback and non-feedback systems .	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6142	PRODUCTION AND OPERATIONS MANAGEMENT	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To gain knowledge on Production and Operations Management Techniques.
- To provide an understanding of Forecasting and Facility Location.
- To provide an understanding about inventory management.
- To introduce the concept of scheduling and project management.

SYLLABUS

Systems concept of production, capacity planning and investment decisions, just in time manufacturing, forecasting , facility location and layout, master production schedule and inventory control, scheduling and project management.

Course Outcome:

Students who successfully complete this course will have better understanding about production and operations management techniques. They will learn essentials of forecasting and inventory management techniques. Students will also have knowledge in scheduling methods and project management.

Text Books:

1. Panneerselvam R., 'Production and Operations Management', Prentice Hall India, 2012.
2. Vollman T.E., 'Manufacturing Planning & Control Systems', McGraw-Hill, 2006.

References:

1. Dilworth. B. James., 'Operations Management – Design, Planning and Control for Manufacturing and services', McGraw Hill Inc., New Delhi, 1992.
2. Bedworth D.D., 'Integrated production control systems: management, analysis, design, John Wiley & Sons, New York, 1987.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**

MODULE : 1	Functional sub systems in organizations, Systems concept of production, Types of production systems, Productivity, Strategic management. Product Design and Analysis: New product development, Process Planning and Design, Value analysis and Value Engineering, Standardization, Simplification, Make or Buy decisions, Ergonomic considerations in Product design. Capacity Planning and Investment Decisions: Capacity planning and strategies, Investment formulas and comparisons of alternatives. Just In Time (JIT) – Introduction, elements, pull and push method, KANBAN systems, Small lot size, quick inexpensive set up, Continuous improvement, optimized production technology, CIM and FMS.	10	25
MODULE : 2	Forecasting: Introduction, Nature and use of forecasting, Measures of Forecasting, factors affecting forecasting, Types and models of forecasting. Facility Location and Lay out: Factors influencing plant location, location evaluation methods, Differenttypes of lay outs for operations and production, arrangement of facilities within the department, CRAFT, ALDEP, CORELAP etc.	10	25
FIRST INTERNAL EXAM			
MODULE : 3	Aggregate Planning and Master Production Scheduling: Nature of aggregate planning, Methods of aggregate planning, Approaches to aggregate planning - Development of MPS,MRPI and MRP-II.Inventory Analysis and Control: Definitions, ABC inventory systems, Inventory models, EOQ models for purchased and manufactured parts, lot sizing techniques.	11	25
SECOND INTERNAL EXAM			
MODULE : 4	Scheduling and Controlling: Objectives in scheduling, Major steps involved, Information systems linkages in production planning and control , Production control in repetitive, flow shop and job shop scheduling environment -SPT, EDD, WMFT. Project Planning and Management: Phases of project planning, Evolution of network planning techniques - Critical Path Method (CPM) and Project Evolution and Review Technique (PERT).	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6242	GLOBAL OPTIMIZATION ALGORITHMS	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To study the principles of optimization and various techniques which can be used for solving Mechanical Engineering optimization applications.
- To study various optimization techniques.

SYLLABUS

A Classification of Optimization Algorithms, Fitness Assignment - Tournament Selection, Genetic Algorithms - Areas of Application, Genotype-Phenotype Mappings and Artificial Embryogeny, Ant Colony Optimization, Particle Swarm Optimization, Simulated Annealing, Tabu Search, State Space Search, Greedy Search.

Course Outcome:

At the end of the course the students should be able to:

i) Understand the logic behind various optimization algorithms.

ii) Understand the applications of various algorithms

iii) Apply these algorithms in the appropriate research situations.

Text Books:

1. Thomas Weise, “Global Optimization Algorithms – Theory and Application”, Thomas Weise, 2009, http://www.it-weise.de/

References:

1. Rao, S.S., “Optimization – Theory and Applications”, Wiley Eastern, New Delhi, 2009.
2. Hans Paul Schwefel., “Evolution and Optimum Seeking”, Wiley-Interscience, 1995.
3. Roy, Samir and Chakraborty, Udit, "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms", Pearson Education.
4. Goldberg, David. E, "Genetic Algorithms in search, Optimization and Machine learning", Pearson Education.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks%**
Module : 1	Introduction - A Classification of Optimization Algorithms - The Structure of Optimization Evolutionary Algorithms – Introduction - The Basic Principles from Nature - The Basic Cycle of Evolutionary Algorithms - The Basic Evolutionary Algorithm Scheme - Classification of Evolutionary Algorithms - Configuration Parameters of evolutionary algorithms - Fitness Assignment - Tournament Selection - Ranking Selection - VEGA Selection – Simple Convergence Prevention.	12	25
Module : 2	Genetic Algorithms - Areas of Application – Genomes - Fixed-Length String Chromosomes - Variable-Length String Chromosomes - Schema Theorem -The Messy Genetic Algorithm - Genotype-Phenotype Mappings and Artificial Embryogeny.	11	25
FIRST INTERNAL EXAM			
Module : 3	Ant Colony Optimization- Areas of Application, Particle Swarm Optimization - Areas of Application, Simulated Annealing- Temperature Scheduling- Multi-Objective Simulated Annealing, Tabu Search.	10	25
SECOND INTERNAL EXAM			
Module : 4	State Space Search - Uninformed Search - Breadth-First Search - Depth-First Search - Depth-limited Search - Iterative Deepening Depth-First Search -Random Walks Informed Search - Greedy Search- A* search - Adaptive Walks.	9	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6342	COMPUTER INTEGRATED QUALITY MANAGEMENT	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To provide the students the knowledge about importance of Quality management and different systems involved in Quality management.
- To gain knowledge on how effectively one can use computer technology in quality management so that the rejection rate is made theoretically zero.
- To familiarise the various tools and systems used in modern quality management
- To understand the most modern trends in quality management and the application of computer technology in quality management.

SYLLABUS

Historical review, definitions & terminology, Q.A., TQC & CWQIP, TQM, Global standards like ISO 9001, ISO14000, S16949/QS9000.

Process Control for variables – SQC - Quality cost - Variation in process causes of variation – Theory of control chart. Six Sigma concepts. Lot by lot sampling – probability of acceptance in single, double, multiple sampling techniques – O. C. curves – producer's Risk and consumer's Risk. AQL, LTPD.

Modern management trends and concepts-Productivity & reliability as angles of quality. Kaizen, 5-S, Poka-yoke, JIT, Kanban, QFD, Taguchi approach to robust designs, Concurrent engineering, FMEA, Process evaluation by DOE. Introduction to RSM, Kaneisi method, World class manufacturing.

Course Outcome:

Students who successfully complete this course will have the expertise and better understanding of various systems in quality management. They will know to use modern computer systems in the field of quality management. They are also expected to have a flare in designing the manufacturing atmosphere in such a manner that possibly no rejection of product took place due to quality constraints.

Text Books:

1. Sid Kemp, Quality Management Demystified, McGraw-Hill Education, 2005.
2. Donna C. Summers, "Quality"- Prentice Hall 2009.
3. Larry Webber, "Quality Control for Dummies", John Wiley & Sons.

References:

1. Geoff Vorley MSc MCQI and Fred Tickle BA Ceng, Quality Management - Principles & Practice.
2. Thomas Pyzdek, "The Handbook for Quality Management, Second Edition: A Complete Guide to Operational Excellence", McGraw-Hill Professional.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module : 1	Historical review, definitions & terminology, Q.A., TQC & CWQIP, pillars of TQM, System approach to TQM, introduction to TQM models , top management role, global standards like ISO 9001, ISO14000, S16949/QS9000, Introduction to current addition to ISO standards, various quality 'gurus'& their contribution, management & operator oriented quality issues. Quality of design - Quality of conformance & performance - Quality tasks - organizing for quality - quality costs & means to control them - Quality leadership & Quality strategic planning. .	11	25
Module: 2	Definition of SQC, Q.A., TQC & CWQIP benefits and limitation of SQC, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σchart -process capability – process capability studies and simple problems - Six Sigmaconcepts	10	25
FIRST INTERNAL EXAM			
Module : 3	Control chart for attributes–control chart for non conforming– p chart and np chart –control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study. Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts – Standard sampling plans for AQL and LTPD- uses of standard sampling plans	11	25
SECOND INTERNAL EXAM			

Module : 4	Productivity & reliability as angles of quality, basic & modern tools in total quality improvement, process capability, OC curves, innovative Kaizen,5-S, Poka-yoke, JIT, Kanban, QFD, Taguchi approach to robust designs, Concurrent engineering, FMEA, Process evaluation by DOE, introduction to RSM, Kaneisi method, World class manufacturing. Monitoring and quality control-Types of production monitoring system, process control & strategies, direct digital control - Supervisory computer control - computer aided quality control - objectives of CAQC, QC and CIM, contact, non-contact inspection methods, CMM and Flexible Inspection systems. Integration of CAQC with CIM.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6442	SUPPLY CHAIN MANAGEMENT	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To attain a solid understanding of the analytical tools necessary to solve supply chain problems.
- Make an understanding of strategic role and key strategic drivers of supply chain.
- Learn the importance of good supply chain design, planning and operation for every firm.
- To understand how good supply chain management can be competitive.

SYLLABUS

Introduction to supply chain management-uncertainties in supply chain, Supply chain coordination, bullwhip effect- role of information technology in supply chain- Demand forecasting in supply chain- Holt's model, Winter's model, measures of forecast error- Role of aggregate planning in supply chain - managing supply and demand in supply chain- Supply chain inventory-lot sizing -quantity discounts-Role of safety stock in supply chain- Sourcing decisions in supply chain-Transportation decisions Routing and scheduling in transportation- Logistics- green supply chain.

Course Outcome:

Successful completion of this course will enable the students to plan and operate a competitive supply chain.

Text Books:

1. Sunil Chopra and Peter Meindl, "Supply chain management - strategy planning and operation", PHI.

References:

1. Handfield R. B., Nichols Jr. E. L., "Introduction to supply chain management", Pearson Education.
2. Raghuram R. and Rangaraj N., "Logistics and supply chain management", Macmillan, 2001.
3. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., "Designing & managing the supply chain: concepts, strategies & case studies." 2nd Edition, Tata McGraw-Hill, 2003.
4. Agarwal D. K., "A text book of logistics and supply chain management", Macmillan, 2003.
5. Srinivasan, G., "Quantitative models in operations and supply chain management", PHI.

Course Plan			
Module	**Contents**	**Contact hours**	**Sem. Exam Marks %**
Module : **I**	**Introduction to supply chain management:** Supply chain basics, decision phases in supply chain, supply chain flows, supply chain efficiency and responsiveness, supply chain integration, process view of a supply chain, uncertainties in supply chain, key issues in supply chain management, drivers of supply chain performance. Supply chain coordination, bullwhip effect, developing relationships in the supply chain, resolving conflicts in supply chain relationships, role of information technology in supply chain	**11**	**25**
Module : **II**	**Demand forecasting in supply chain:** Role of forecasting in supply chain, components of a forecast, forecasting methods, estimating level, trend and seasonal factors, Holt's model, Winter's model, measures of forecast error. **Role of aggregate planning in supply chain:** Aggregate planning strategies, managing supply and demand in supply chain.	**10**	**25**
First Internal Exam			
Module : **III**	**Supply chain inventory:** Role of cycle inventory in supply chain, economies of scale, lot sizing for a single product, lot sizing for multiple products, quantity discounts, trade promotions, price discrimination. Role of safety stock in supply chain, determining appropriate level of safety inventory, inventory replenishment policies, measures of product availability.	**10**	**25**
Second Internal Exam			
Module : **IV**	**Sourcing decisions in supply chain:** Supplier selection and contracts, design collaboration, making sourcing decisions in practice. **Transportation decisions:** Role of transportation in supply chain, factors affecting transportation decisions. Routing and scheduling in transportation. **Logistics:** Definition, logistics and SCM, international considerations, inbound logistics, internal logistics and outbound logistics. Reverse logistics, green supply chain.	**11**	**25**
End Semester Exam			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6152	CORROSION AND SURFACE ENGINEERING	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To understand knowledge on the scientific principles of corrosion and methods that underlie the cause, detection, measurement and prevention of corrosion problems in engineering practices.
- To impart knowledge on the hands-on approaches for matching surface treatments with design and performance requirements.

SYLLABUS

Mechanisms and types of corrosion; Principles of Corrosion phenomenon; classification of corrosion - Factors influencing corrosion- corrosion damage – corrosion cost; Testing and prevention of corrosion; Protective surface coatings; Corrosion behaviour of materials and its control; Selection of material for various corrosive environments; Surface coatings; types of wear; Diffusion coatings; Thin layer engineering processes; Vapour deposition processes, Implantation technique.

Course Outcome:

After completion of the course students can able to provide solution for the typical Industrial corrosion and surface Engineering problem.

Text Books

1. Fontana M G, Corrosion Engineering, Tata McGraw Hill, 3rd Edition, 2005.
2. Jones D A, Principles and Prevention of Corrosion, 2nd Edition, Prentice Hall, 1996.

References:

1. Pierre R Roberge, “Handbook of corrosion engineering”, McGraw-Hill.
2. Sudarshan T S, “Surface modification technologies - An Engineer’s guide”, Marcel Dekker, New York, 1989.
3. Schweitzer, P.A., “Fundamentals of corrosion, Mechanisms, causes and preventive methods”, Taylor and Francis, Indian reprint, 2012.
4. Review, R. U., “Corrosion”, Hand Book 2nd Edition, John Wiley, 2000.
5. ASM Metals Hand Book – Volume 13, Corrosion, 1999.
6. ASM Metals Hand book – Volume 5, Surface Engineering, 1999.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
MODULE : 1	Mechanisms and types of corrosion; Different forms of corrosion: Principles of Corrosion phenomenon – classification of corrosion – form of corrosion, general, localized, atmospheric/uniform, pitting crevice, intergranular, stress corrosion, corrosion fatigue, dealloying, high temperature oxidation-origin and mechanism with specific examples- metallurgical influenced, mechanically assisted, environmentally induced corrosions– Factors influencing corrosion- corrosion damage – corrosion cost.	10	25
MODULE : 2	Testing and prevention of corrosion; Planning and preparation of corrosion tests – In-service monitoring, simulated service, laboratory testing corrosion testing and monitoring– Non-Electrochemical and Electrochemical methods: weight loss method, & field tests, susceptibility test. Evaluation of corrosion - Prevention of Corrosion, suitable designing and modifications of corrosive environment, corrosion inhibitors – Cathodic Protection - Anodic protection – Protective surface coatings. Corrosion behaviour of materials and its control:- Corrosion & its control in industries: Power, Process, Petrochemical, ship building, marine and fertilizer industries. Some case studies-Corrosion and its control in different engineering materials: concrete structures, duplex, super duplex stainless steels, nickel and titanium alloys. ceramics, composites and polymers. Selection of material for various corrosive environments.	11	25
FIRST INTERNAL EXAM			
MODULE : 3	Surface coatings; Surface degradation, types of wear Solid surface significance, surface properties, superficial layer – changing surface metallurgy, chemistry and adding a surface layer or coating - Diffusion coatings- Chemical and electrochemical polishing, significance, specific examples, chemical conversion coatings, phosphating, chromating, chemical colouring, Electro and Electro less Plating- Hot dip coating-Hard facing-Metal spraying, Plasma spraying.	11	25
SECOND INTERNAL EXAM			
MODULE : 4	Thin layer engineering processes; Laser and Electron Beam hardening- Thermal evaporation, Arc Vaporization, Sputtering, Ion plating- Vapour deposition processes, Implantation technique – Coating of tools, TiC, TiN, Al_2O_3 and Diamond coating – Properties and applications of thin coating.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6252	COMPOSITE MATERIAL TECHNOLOGY	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To provide knowledge of various manufacturing methods of different composite materials, their properties, and their applications.
- To understand machining characteristics of various composite materials.

SYLLABUS

Introduction to fibre reinforcements - Fabrication, properties and applications; Matrix materials; Polymer matrix composites; Processing of PMCs; Metal matrix composites; Ceramic matrix composites; Machining of composites; Traditional and non-traditional machining of Composites.

Course Outcome:

At the end of this course the student will be able to select appropriate composite materials for specific applications.

Text Books :

1. Autar K. Kaw, "Mechanics of Composite Materials'', CRC press.
2. Chawla K.K., "Composite Materials: Science and Engineering", Springer, New York.
3. Jahanmir S., Ramulu, M. and Koshy, P., "Machining of Ceramics and Composites", Marcel Dekker Inc, New York, 1999.

References:

1. Mallick P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", CRC Press, New Delhi.
2. Sheikh-Ahmad J.Y., "Machining of Polymer Composites", Springer.
3. Hull D. and Clyne T.W., "An Introduction to Composite Materials", Cambridge University Press.
4. American Society of Metals, "Composites - ASM Handbook", Volume -21.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
MODULE : 1	Introduction – Fibre reinforcements – Fabrication, properties and applications of Glass fibres, Boron fibres, Carbon fibres, Aramid fibres, Ceramic fibres – Whiskers – Comparison of fibres: particulate and whisker reinforcements – Matrix materials – Polymers, Metals, Ceramics and their properties.	10	25
MODULE : 2	**Polymer matrix composites** – Processing of PMCs – Thermoset matrix composites: Hand layup, spray, filament winding, pultruion, resin transfer moulding, auctoclave moulding – Thermoplastic matrix composites : Film stacking, diaphragm forming, thermoplastic tape laying, Injection moulding – Interfaces in PMCs: Glass fibre/polymer interface, Aramid fibre/polymer interface – Structure, applications and mechanical properties of PMCs – Recycling of PMCs.	10	25
FIRST INTERNAL EXAM			
MODULE : 3	**Metal matrix composites** – Types, Metallic matrices: Aluminium, Titanium, Magnesium, copper Alloys – Processing of MMCs: Solid state, Liquid state, Vapour state ,In-situ – Interface/Interphase in MMCs – Interfacial bonding in MMCs – Mechanical properties, coefficient of thermal expansion, environmental effects, moisture effects – Applications of MMCs – Recycling of MMCs.	11	25
SECOND INTERNAL EXAM			
MODULE : 4	**Ceramic matrix composites:** Introduction – Types – Toughening Mechanism- Processing of CMCs: Cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – In-situ chemical reaction techniques: Chemical vapour deposition, Chemical vapour impregnation, Sol-gel, C-C Composites. Interface in CMCs. Mechanical Properties and Applications of CMCs – Fatigue behaviors and S-N curves of particle and whisker reinforced CMCs – Hybrid composites – Thermal fatigue – Creep. **Machining of composites-** Traditional (turning, milling, drilling, abrasive machining) and non-traditional (abrasive water jet machining, electric discharge machining, ultrasonic, laser–assisted) machining of Composites.	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6352	INDUSTRIAL WELDING TECHNOLOGY	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To impart knowledge on advances in welding technology, weld design and advanced welding processes and automation in welding.
- To understand idea about various welding codes and standards used in industry.
- To provide the concepts of metallurgical changes that occurs during welding processes.
- To get the knowledge about various advanced Non-destructive evaluation techniques of weldments.

SYLLABUS

Welding metallurgy; Pre and Post weld heat treatments; Design of Weldments; Welding residual stresses; Automation of welding; Welding codes and standards; Advanced welding processes; Non Destructive evaluation of weldments- Principles, types, applications, advantages and limitations. Case studies:

Course Outcome:

At the end of this course the students are expected to produce useful research output in welding and use this knowledge in advancing the welding process and will get application of design knowledge to understand and to overcome defects in welding. They will understand the various standard procedures for welding used in industries and can apply accordingly.

Text Books :

1. Sindo kou – “welding metallurgy – second edition ” A john wiley & sons, inc., publication
2. ASME Section VIII - Division 1, Section IX, ASME Section II Part A and C
3. Parmar R.S., “Welding Processes and Technology”, Khanna Publishers, 1997.

References:

1. Welding Inspection – codes and standards – TWI – Welding Institute.
2. Bhattacharya M, ‘Weldment Design’, Association of Engineers,1991
3. Timings R., " Fabrication and Welding Engineering", Elsevier Newnes,2008
4. American Society of Metals, “Metals Hand Book", 9th Edition, Vol.V, 1989 & "Hand book of Welding", Vol. I to V.

5. Practical Non – Destructive Testing, Baldev raj, Narosa Publishing House (1997).

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module : 1	Welding metallurgy; Heat flow - temperature distribution-cooling rates - Epitaxial growth - weld metal solidification - columnar structures and growth morphology- Phase transformations- weld CCT diagrams - carbon equivalent- Welding of Cu, Al, Ti and Ni alloys – processes, difficulties, microstructures, defects and remedial measures- weldability tests - Hydrogen embrittlement - Pre and Post weld heat treatments.	10	25
Module : 2	Design of Weldments; Weld joint design - Type of joints, joint efficiency, factor of safety, symbols, selection of edge preparation, design considerations, types of loading - Welding residual stresses - causes, occurrence, effects and measurements. Automation of welding and foundry; Use of robots in welding- weld positioner and manipulators weld seam tracking - arc sensing-vision system. Welding codes and standards; introduction to welding codes and standards- ASME II, V, VIII and IX - Welding procedure specification, procedure qualification records, performance qualification, variables; welding inspection, post weld heat treatment and hydro testing.	11	25
FIRST INTERNAL EXAM			
Module : 3	Advanced welding processes; Friction welding process - effects of speed and pressure – Types- Explosive welding – Process – Parameters - Plasma arc welding - Electron beam welding - High frequency induction welding - Diffusion bonding – Types - Cold pressure welding - Ultrasonic welding - Laser beam welding - Plasma welding; Concepts, processes and applications, keyhole and puddle-in mode of operation, low current and high current plasma arc welding and their applications; Magnetically impelled arc butt (MIAB) welding, pulsed and synergic MIG welding - Resistance welding, Concepts, types and applications, Flash butt welding, Stud welding and under water welding.	11	25
SECOND INTERNAL EXAM			

Module : 4	Non Destructive evaluation of weldments; Magnetic particle inspection- principles, applications, advantages and limitations Ultra sonic testing(UT) - Various methods of ultrasonic wave generation, types of UT Principles, applications, advantages, limitations, A, B and C scan. Radiography testing (RT) – Principles, applications, advantages and limitations of RT. Principles and applications of Fluoroscopy/Real-time radioscopy - advantages and limitations - recent advances. Thermography -Principles, types, applications, advantages and limitations. Optical & Acoustical holography- Principles, types, applications, advantages and limitations. Case studies:	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6452	MATERIAL CHARACTERISATION	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- On completion of the course the students are expected to be knowledgeable in microstructure evaluation, crystal structure analysis, electron microscopy, Chemical, Thermal analysis.
- To impart knowledge of various mechanical testing of metals.

SYLLABUS

Micro structural evaluation; Crystal structure analysis; Electron microscopy – various Imaging Techniques – Applications; Chemical and thermal analysis; Mechanical testing; Hardness –and Micro Hardness Test – Tensile Test– Impact Test. Fatigue – Creep Tests– Applications of Dynamic Tests.

Course Outcome:

At the end of this course the student will be able to apply various material characterization techniques for research and analysis.

Text Books:

1. Smallman R. E., 'Modern Physical Metallurgy', 4th Edition, Butterworths, 1985
2. Philips V. A., 'Modern Metallographic Techniques and their Applications', Wiley Interscience, 1971
3. American Society of Metals, Material Characterization handbook – Volume 10th edition.
4. Davis, H.E., Hauck, G. and Troxell, G.E., "The Testing of engineering Materials", (4th Edition), McGraw Hill, College Divn., 1982.

References:

1. Cherepin and Malik, "Experimental Techniques in Physical Metallurgy", Asia Publishing Co. Bombay, 1968.
2. Culity B.D., Stock, S.R. and Stock, S., "Elements of X ray Diffraction", (3rd Edition). Prentice Hall, 2001.
3. Newby, J., "Metals Hand Book- Metallography & Micro Structures", (9th Edition), ASM International, 1989.
4. Loretto M. H., 'Electron Beam Analysis of Materials', Chapman and Hall, 1984.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module : 1	Micro structural evaluation, Principles of Optical Microscopy, Specimen Preparation Techniques, Polishing and Etching, Polarization Techniques, Quantitative Metallography, Estimation of grain size, ASTM grain size numbers, Microstructure of Engineering Materials. Crystal structure analysis, Elements of Crystallography - X- ray Diffraction - Bragg's law- Techniques of X-ray Crystallography - Debye - Scherer camera - Geiger Diffractometer - analysis of Diffraction patterns - Inter planer spacing - Identification of Crystal Structure, Elements of Electron Diffraction.	11	25
Module : 2	Electron microscopy; Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF & DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction & working of SEM – various Imaging Techniques – Applications- Atomic Force Microscopy- Construction & working of AFM - Applications.	10	25
FIRST INTERNAL EXAM			
Module : 3	Chemical and thermal analysis; Basic principles, practice and applications of X-ray spectrometry, Wave dispersive X- ray spectrometry, Auger spectroscopy, Secondary ion mass spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR) – proton induced X-ray Emission spectroscopy, Differential thermal analysis, Differential Scanning Calorimetry (DSC) and Thermo Gravimetric Analysis (TGA).	11	25
SECOND INTERNAL EXAM			
Module : 4	Mechanical testing; Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test – Tensile Test – Stress – Strain plot – Proof Stress – Ductility Measurement – Impact Test – Charpy & Izod. Fatigue – Low & High Cycle Fatigues – Rotating Beam & Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – Applications of Dynamic Tests.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6062	MINI PROJECT	0-0-4-2	2015

SYLLABUS

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME6072	COMPUTER INTEGRATED MANUFACTURING LABORATORY - II	0-0-2-1	2015

Pre-requisites: Nil

Course Objectives:

- To provide high quality laboratory experience for post graduate students in areas of manufacturing automation and computer assisted and computer controlled manufacturing.
- To familiarize students with the interdisciplinary nature of the course and embellish their experience in the field of instrumentation.
- To equip students with the current tools for design & manufacturing.
- To expertise students in the field of reverse engineering and PLC programming.

List of Exercises / Experiments

1. Programming of CNC lathe using software.
2. Programming of machining centre using software.
3. Study of process control simulator.
4. PLC programming and implementation.
5. Transducer interface with PC.
6. Stepper motor and servo motor interface with PC.
7. Study of Reverse Engineering using CMM, Rapid prototyping techniques and Robot programming.
8. Study experiments on arduino and raspberry pi basics.

Course Outcome:

Students who successfully complete this course will have enhanced knowledge in computer integrated manufacturing systems and better understanding of various aspects of CAM systems. They will know to use modern technologies in their academic and future life.

References:

1. Arbor text, PTC Authorized Training Manual (pl-830a-01), PTC University, Parametric Training Corporation, 2010.
2. L.A. Bryan, Programmable Controllers Theory and Implementation, second edition, Industrial Text Publication.
3. Kevin Otto, Product Design: Techniques in Reverse Engineering and New Product Development (english) 1st Edition, Pearson.
4. Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, Springer, 2008.
5. Margolis, Arduino Cookbook, Oreilly, 2012.
6. Simon Monk, Raspberry Pi Cookbook: Software and Hardware Problems and Solutions, Oreilly, 2014.

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7111	RAPID PROTOTYPING	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To understand the importance of rapid methods of making prototype.
- To familiarise with various rapid prototyping techniques, its advantages and drawbacks.
- To have an idea of present day applications of Rapid Prototyping.

SYLLABUS

Importance of being rapid – data processing for rapid prototype- stereo lithography (SL) - selective laser sintering(SLS- selective laser cladding (SLC)- laminated object manufacturing- Fused deposition modelling (FDM) - 3D printing - shape deposition manufacturing - Rapid tooling (RT) - applications of RP.

Course Outcome:

After the successful completion of this course, students will be able to identify the methods of rapid manufacturing to make the prototype of a newly designed product.

Text Books:

1. Patrik Venuvinod, Weiyuyin Ma, “Rapid prototyping”, Kluwer Academic Publishers.

References:

1. T. A. Grimm & Associates, “Users guide to rapid prototyping”, Society of Manufacturing Engineers (SME).
2. Frank W. Liou, “Rapid prototyping & engineering applications”, CRC Press.
3. Ali K. Kamarani, “Rapid Prototyping theory & practice”, Manufacturing System Engineering Series, Springer Verlag.
4. J. A. McDonalds, C. J. Ryall, “Rapid prototyping - case book”, Wiley Eastern.
5. C. E. Bocking, AEW Rennie, “Rapid & virtual prototyping and applications”, Wiley Eastern.

Course Plan			
Module	**Contents**	**Contact hours**	**Sem. Exam Marks %**
Module I	Importance of being rapid – data processing for rapid prototype (RP): CAD model preparation and data interfacing for RP – stereo lithography (SL): SL process, photo polymerization of SL resins, absorption of laser radiation by the resin, recoating.	**11**	**25**
Module II	SL curing and its implications, part quality and process planning – selective laser sintering (SLS): principle, indirect and direct SLS, process accuracy - selective laser cladding (SLC) - laminated object manufacturing.	**11**	**25**
First Internal Exam			
Module III	Fused deposition modeling (FDM) – 3D printing and desktop processes – shape deposition manufacturing – vacuum casting – electroforming – freeze casting – 3D welding.	**10**	**25**
Second Internal Exam			
Module IV	Rapid tooling (RT): Classification of RT – indirect RT – applications of RP: - heterogeneous objects, assemblies, MEMS and other small objects, medicine and art.	**10**	**25**
End Semester Exam			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7211	TRIBOLOGY	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To provide basics of tribological system and related science.
- To provide knowledge in various modes of wear and types of friction.
- To provide knowledge in mechanics of solid elastic and elastoplastic contacts.
- To gain knowledge in tribological mechanisms in coated surfaces.

SYLLABUS

Introduction to tribology; Mechanics of solid contacts, laws of friction, friction measuring methods, wear mechanism and wear analysis, types of lubrication: hydrodynamic, hydrostatic and boundary lubrication. Introduction to coating methods and coatings tribology.

Course Outcome:

Tribology is a multidisciplinary course which deals in surface contact, friction, wear, lubrication etc. On successful completion of course student will become able to design a mechanical system considering tribological issues.

Text Books:

1. Bhushan B, "Principles and Applications of Tribology", John Wiley & Son, 2nd edition.

References:

1. Shizhu Wen, Ping Huang, "Principles of Tribology", John Wiley & Son, 2012.
2. Sahoo Prasanta, "Engineering Tribology", PHI, 2005.
3. K. Holmberg, A. Matthews, "Coatings Tribology properties, techniques and application in surface engineering". Tribology series 28, Elsevier.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module : 1	Introduction to tribology: History of tribology, Tribology in design, Tribology in industry and its economic benefits. Production of engineering surface, surface roughness, RMS value, average value and ten point average of surface roughness. Non conforming surface contact geometry-cylinder on cylinder, cylinder on rigid flat, sphere on sphere and sphere on rigid flat. Contact stress -sphere on sphere.	10	25
Module : 2	Friction: causes of friction, laws of friction, friction at dry sliding condition, friction measuring methods. Wear: wear mechanism, types of wear, wear measurement, wear analysis	10	25
FIRST INTERNAL EXAM			
Module : 3	Lubrication: types of lubrication, importance of lubrication. Hydrodynamic lubrication: Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, Generalized Reynolds Equation, Simplification of Full Reynolds Equation. Hydrostatic lubrication, boundary lubrication: Basic concept, advantages and limitations.	11	25
SECOND INTERNAL EXAM			
Module : 4	Coatings tribology: Introduction to surface coating methods, gaseous state processes, solid state processes, molten and semi molten processes. Tribological mechanisms in coated surfaces - macromechanical friction and wear mechanism, micromechanical tribological mechanism, mechanism of material transfer.	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7311	PRECISION AND MICRO MACHINING	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To understand the principles of various micro and nano manufacturing methods.
- The student will be able to understand the striving need for precision and application.
- To motivate the students to learn about the advanced concepts of precision and ultra precision machining and advanced finishing methods.
- In addition, the student will enhance his/her knowledge in Precision Engineering and its applications.

SYLLABUS

Accuracy and Precision, Introduction to Meso, Micro and Nano manufacturing; Material deposition; Traditional micromachining; Mechanical Micromachining; Theory of Micromachining; Micromachining Tool Design; Advanced machining process; Introduction - Nanometric machining; Advanced Finishing Processes; Micromachining by Photonic Beams; Micromanufacturing for Document Security.

Course Outcome:

At the end of this course the student will be able to apply knowledge in micro and nano manufacturing methods, synthesis of nano materials and characterization techniques. They can operate high precision machineries with ease.

Text Books:

1. Murthy, R.L., "Precision Engineering in Manufacturing", New age International Publications, New Delhi, 2005.
2. Jain V.K., "Introduction to micromachining", Narosa publishing house, New Delhi.
3. Paulo Davim J, "Nontraditional Machining Processes", ISBN 978-1-4471-5179-1, Springer-Verlag London 2013.

References:

1. Hong Hocheng, Hung-Yin Tsai, "Advanced Analysis of Nontraditional Machining", Springer.
2. N P Mahalik, "Micromanufacturing and Nanotechnology", Springer-Verlag Berlin Heidelberg 2006.

3. Joseph Mc Geough, "Micromachining of Engineering Materials Mechanical Engineering" ISBN: 0-8247-0644-7.M.
4. Mark J. Jackson, "Micro and nanomanufacturing", Springer; 1st ed. 2006.
5. Kahrizi, "Micromachining Techniques for Fabrication of Micro, Nano Structures", Intech, 2012.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module: 1	Accuracy and Precision– Need for high precision – concept of accuracy - accuracy of manufacturing processes – materials for precision engineering - Precision grinding: IC chip manufacturing- ELID process – aspherical surface generation - Grinding wheel - Design and selection of grinding wheel-High-speed grinding - High-speed milling – Micromachining.	10	25
Module : 2	Introduction to Meso, Micro and Nano manufacturing- Material deposition – PVD, CVD, LIGA, Micro stereo lithography, Electro discharge deposition, Traditional micromachining- micro turning, micro drilling, micro milling, micro grinding, Diamond turn machining. Mechanical Micromachining- Microfluidic Systems - Theory of Micromachining; Micromilling force analysis, Initial Chip Curl Modeling, Burr Formation in Micromachining - Micromachining Tool Design.	10	25
FIRST INTERNAL EXAM			
Module : 3	Advanced machining- Introduction to mechanical and beam energy based micro machining processes- Ultrasonic micro machining, micro-electric discharge micromachining - Electro chemical spark micromachining, abrasive jet micromachining – Laser Beam micromachining - Electron beam micromachining – applications. Nanomachining; Introduction, Nanometric machining, Theoretical Basis of Nanomachining, Cutting Force and Energy, Cutting Temperature, Chip Formation and Surface Generation, Minimum Undeformed Chip Thickness, Critical Cutting Edge Radius, Properties of Workpiece Materials, Comparison of Nanometric Machining and Conventional Machining.	11	25

SECOND INTERNAL EXAM			
Module : 4	Advanced Finishing Processes (AFPs), Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magnetorheological Finishing (MRF), Magnetorheological Abrasive Flow Finishing (MRAFF), Magnetic Float Polishing (MFP), Elastic Emission Machining (EEM), Ion Beam Machining (IBM), and Chemical Mechanical Polishing (CMP). Micromachining by Photonic Beams; Excimer Laser- Model Construction of Laser Dragging- Numerical Simulation of Dragged Profile. Micromanufacturing for Document Security; Optically Variable Device: - OVD Foil Microstructures- Generic OVD Microstructures- NanoCODES.	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7411	NANOTECHNOLOGY	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To understand the concept of nanoscale.
- To familiarise with the microscopes used at nanoscale.
- To have a knowledge on the nanostructures used in the engineering field.
- To introduce nanoelectromechanical systems.

SYLLABUS

Introduction to nanotechnology – Introduction to solid state physics – Microscopy- Nanopowders and nanomaterials - Carbon nanostructures - Bulk Nanostructured materials -Nanostructured crystals - Nanostructured ferromagnetism - Nano tribology characterization studies – Mechanical properties of nano structures- Nanoelectromechanical systems- Molecular and supramolecular switches.

Course Outcome:

After the successful completion of this course, students will be able to work on nanomaterials and nanostructures. They will be able to apply nanotechnology in the latest developments in engineering.

Text Books:

1. Charles P Poole, Frank J Owens, Introduction to Nanotechnology, Wiley Interscience, A John Wiley & sons, Inc. Publication,NewJersey.
2. PradeepT., IIT Madras - NANO: The Essentials, Tata McGraw Hill.

References:

1. Mick Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, “Nanotechnology- Basic science and Emerging Technologies”, Overseas Press India Private Ltd. New Delhi.
2. Bhushan, “Springer Handbook of Nano technology”.
3. Busnaina,“Nano manufacturing Handbook”, CRC press.

Course Plan			
Module	**Contents**	**Contact hours**	**Sem. Exam Marks %**
I	Introduction to nanotechnology – Introduction to solid state physics - Microscopy: Transmission electron microscope (TEM), Scanning microscopy, Scanning electron microscope (SEM), Scanning Probe Microscopy (SPM), Atomic force Microscopy (AFM), Scanning tunneling microscope (STM)	**10**	**25**
II	Nanopowders and nanomaterials : Preparation- Plasma arcing-Chemical vapour deposition- Sol Gels – Electro deposition-Ball milling-Applications of nanomaterials Carbon nanostructures: Carbon molecules-Carbon clusters-Carbon nanotubes, types, Fabrication, structure, properties, applications. Bulk Nanostructured materials : Methods of synthesis, properties- Nanostructured crystals	**11**	**25**
First Internal Exam			
III	Nanostructured ferromagnetism: Basics of ferromagnetism, effect of bulk nanostructuring on magnetic properties-Dynamics of nanomagnets- Nanocarbon ferromagnets-Giant and colossal magnetoresistance- Ferrofluids Nano tribology characterization studies – friction and wear on the atomic scale – nano mechanical properties of solid surface and thin films. Nano boundary lubrication – kinetics and energetic in nano lubrication - Nanotribology for data storage application - nanotribology of ultra thin and hard amorphous carbon films.	**11**	**25**
Second Internal Exam			
IV	Mechanical properties of nano structures: - experimental techniques, indentation and scratch tests, bending tests; experimental results and discussion Nanoelectromechanical systems:Fabrication-Nanodevices and nanomachines-Molecular and supramolecular switches	**10**	**25**
End Semester Exam			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7121	FINITE ELEMENT ANALYSIS	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To provide general steps of finite element methods.
- To provide knowledge in stiffness matrix, boundary condition and interpolation function.
- To provide knowledge in 1D, 2D, 3D elements.
- To gain knowledge plane stress and plane strain problems.

SYLLABUS

Basic concepts of FEM; Strain energy method, minimum potential energy method, Truss structures, Flexure elements, Method of weighted residuals, Galerikin's method, isoparametric formulations, axisymmetric elements, Applications in solid mechanics, general three dimensional stress, Introduction to FEM software.

Course Outcome:

Students will be able to understand the basic finite element formulation techniques and to derive equations in finite element methods for 1D, 2D and 3D problems.

Text books :

1. David V Hutton, "Fundamentals of finite element analysis", McGraw Hill

References :

1. Klaus-Jürgen Bathe, "Finite element procedures", Prentice Hal, 1993.
2. Singiresu S Rao, "The finite element method in engineering", Elsevier; Fifth edition.
3. Daryl L. Logan, "First course in finite element method", Cengage Learning, Singapore.
4. J. N. Reddy, "An introduction to the finite element method", McGraw Hill, 3rd edition.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
MODULE : 1	Basic concepts of FEM – a general procedure for finite element analysis, brief history of finite element method, linear spring as a finite element, elastic bar, spar/link/truss element. Strain energy method, Castigliano's first theorem, minimum potential energy.	10	25
MODULE : 2	Truss structures: The direct stiffness method – Nodal equilibrium equation, element transformation and direct assembly of global stiffness matrix, boundary conditions, constraint forces, element strain and stress, three dimensional trusses. Flexure - elements – elementary beam theory, flexure element, flexure element stiffness matrix and element load vector, work equivalence for distributed loads, flexure element with axial loading.	10	25
FIRST INTERNAL EXAM			
MODULE : 3	Method of weighted residuals – introduction, method of weighted residuals, the Galerikin finite element method, application of Galerikin's method to structural elements - bar element, beam element. Interpolation function for general element formation – compatibility and completeness requirements, polynomial forms- one dimensional elements, triangular elements, rectangular elements, three dimensional elements, isoparametric formulations, axisymmetric elements	11	25
SECOND INTERNAL EXAM			
MODULE : 4	Applications in solid mechanics – plane stress, plane strain – rectangular element, isoparametric formulation of plane quadrilateral element, axisymmetric stress analysis, general three dimensional stress – finite clement formulations, strain and stress computations, practical considerations. Torsion – boundary condition, torque. Introduction to FEM software.	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7221	FRACTURE MECHANICS	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To introduce the mathematical and physical principles of fracture mechanics and their applications to engineering design.
- To provide knowledge in principles of linear elastic and elastic-plastic fracture mechanics and their application to engineering design.
- To provide knowledge in computing stress intensity factor, strain energy release rate, and the stress and strain fields around a crack tip for linear and non linear materials.
- To provide knowledge in experimental methods to calculate fracture toughness.

SYLLABUS

Introduction to fracture mechanism ; Theory of Elasticity and Plasticity, LEFM and EPFM, Fatigue Crack Growth Model, Griffith's approach , energy release rate (G) and Resistance (R). Plane stress and plane strain situations, Airy's stress function, Computational Fracture Mechanics, Fracture Toughness testing of metals.

Course Outcome:

On completion of the course the student should be able to predict failure of material under stress and also able to estimate conditions for failure. Students would be able to predict life of structure using techniques like photo elasticity.

Text books :

1. T. L. Anderson, "Fracture Mechanics Application" , CRC press, 1998.

References :

1. Timoshenko, S.P. and J.N. Goodier, "Theory of Elasticity", McGraw Hill, 1970.
2. Prashant Kumar, "Elements of Fracture Mechanics", McGraw Hill Education, 2009.
3. Michael Janssen, Jan Zuidema," Fracture Mechanics", Second Edition, CRC Press.
4. David Broek, "Elementary engineering fracture mechanics", Springer; 1982 edition.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module : 1	Introduction to Mechanisms of Fracture, a crack in structure. Theory of Elasticity and Plasticity, Principal Stresses and Principal Coordinates, Maximum Shearing Stress, Hydrostatic and Deviatoric Stress Tensors, Equilibrium Equations and Boundary Conditions Definition of failure, yield criteria, buckling as a failure mode.	10	25
Module : 2	LEFM and EPFM, Fatigue Crack Growth Model, Crack Growth and Fracture Mechanisms. Surface energy, Elastic strain energy, Griffith's approach, Definition of energy release rate (G) and Resistance (R).	10	25
FIRST INTERNAL EXAM			
Module : 3	Displacement and stress formulations, Compatibility conditions, Plane stress and plane strain situations, Airy's stress function, Forms of stress functions in Cartesian co-ordinates and polar co-ordinates. Relation between K_I and G_I.	11	25
SECOND INTERNAL EXAM			
Module : 4	Computational Fracture Mechanics: Overview of numerical methods, traditional methods in computational fracture mechanics – stress and displacement marching, elemental crack advance, the energy domain integral, finite element implementation. Limitations of numerical fracture analysis. Fatigue test, introduction to photo elasticity. Fracture Toughness testing of metals: Fracture testing in shear modes.	11	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7321	SUSTAINABLE MANUFACTURING	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To introduce the use of industrial ecology approaches integrating relevant social issues, economics and environmental principles in the design and implementation of products, processes and engineering systems.
- To identify the link between manufacturing process models and sustainable manufacturing metrics for product and process improvement.
- To Use Life Cycle Assessment techniques to evaluate environmental impacts of product design, manufacturing processes, product use-phase, and product end-of-life.

SYLLABUS

Introduction to Sustainable Manufacturing; ISO 14000 series standards; Environmental Management System; Environmentally Conscious Manufacturing; Green Manufacturing; Principles of Sustainability; Zero Emission Strategy; Eco Labelling Schemes;Recycling & life cycle assessment; Industrial Ecology; Life Cycle Assessment; environmental attributes of manufacturing; Footprint Analysis; Value Stream Mapping to Eliminate Waste.

Course Outcome:

At the end of the course the students should be able to:

iv) Assess social, economical and environmental impacts of products and processes

v) Differentiate among the different types of environmental impacts

vi) Understand the implications and use of life cycle assessment as a design & evaluation tool.

It is expected that students should gain expertise to be able to assess in terms of environmental, economic and socialindicators that an acceptable balance exists between the effects of undertaking engineering activities and the benefits that those activities deliver.

Text Books:

[1] Madu, C.N., “Handbook of Environmentally Conscious Manufacturing”, Kluwer Academic Publisher, 2001.

[2] Myer Kutz, “Environmentally Conscious Manufacturing”, John Wiley & Sons, 2007.

References:

[1] Kutz, M.,” Environmentally Conscious Mechanical Design”, John Wiley & Sons, 2007.

[2] Davim, J.P., "Sustainable Manufacturing", John Wiley & Sons, 2010.

[3] Green manufacturing fundamentals and application, edited by David A. Dornfeld, springer publication, (2012).

[4] Ken Whitelaw, ISO 14001- Environmental Systems Handbook, Elsevier Butterworth-Heinemann, Second edition, 2004.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks%**
Module : 1	Sustainable Manufacturing - Strategies for Sustainable Manufacturing – Evolution of Sustainable Manufacturing - Product Design for Sustainability – introduction to ISO 14000 series standards - Concepts and spirit of ISO 14001 - implementation of ISO 14001 – Environmental Management System – frame work and benefits - Environmentally Conscious Manufacturing.	9	25
Module : 2	Introduction to Green Manufacturing - Motivations and Barriers to Green Manufacturing - Strategies for Green Manufacturing - The Social Environment - Present Atmosphere and Challenges for Green Manufacturing - Applying Principles of Sustainability – 5 Principles of Green Manufacturing - Mapping Five Principles to Other Methods and Solutions.Green Manufacturing Through Clean Energy Supply - Zero Emission Strategy - Environmental Impact of Manufacturing - The Development of Eco Labelling Schemes – guiding principles.	11	25
FIRST INTERNAL EXAM			
Module : 3	Industrial Ecology - key concepts - System Tools to Support Industrial Ecology - case studies in Industrial Ecology - Life Cycle Assessment - Life cycle improvement analysis - Reclamation and Recycling of steel - postconsumer and preconsumer recycled material - life cycle of an Aluminium product - Bio degradable material (coir, bamboo) converted into wood substitutes.	10	25
SECOND INTERNAL EXAM			
Module: 4	Environmental Footprint Analysis - Carbon and water footprint analysis -need to reduce the carbon footprint of manufacturing operations - adoption of low carbon technologies-Application of Value Stream Mapping to Eliminate Waste - Methods for Valuing Environmental Goods - Taxonomy of Valuation Methods - Techniques for non-market valuation.	12	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7421	CONCURRENT ENGINEERING	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

- To gain knowledge about the basics of Concurrent Engineering.
- To understand the tools and methodologies available in Concurrent Engineering.
- To familiarize with the various approaches to Concurrent Engineering.

SYLLABUS

Concurrent Engineering - Basic Concepts; Tools and Techniques of Concurrent Engineering; Quality function deployment; DFA &DFX; Economics of Concurrent Engineering; Artificial Intelligence in Concurrent Engineering; expert systems, Neuro-computing and Software solutions; Future Trends.

Course Outcome:

Towards the end of this course the student will understand:

1. The current trends in Concurrent Engineering.
2. The potential scope of Concurrent Engineering within an organization.
3. The importance of rapid cross-departmental communication.
4. The role of computers in implementing Concurrent Engineering.

Text Books:

1. G.Q. Huang, Design for X Concurrent engineering imperatives, Chapman & Hall, 1996
2. Chanan S. Syan, Concurrent Engineering - Concepts implementation and practice, Chapman & Han, 1994

References:

1. H.-J. Bullinger and J. Warschat, Concurrent Simultaneous Engineering Systems - The Way to Successful Product Development, Springer-Verlag, London Ltd, 1996.
2. Hamid R. Parsaei, Concurrent Engineering Contemporary issues and modern design tools, Chapman & Hall, 1993
3. D. M. Anderson, Design for Manufacturability, CRC Press, 2014.
4. Edward J. Haug, Concurrent Engineering: Tools and Technologies for Mechanical System Design, NATO ASI Series, 1993.

COURSE PLAN			
MODULE	**CONTENTS**	**Contact hours**	**Sem. Exam Marks %**
Module : 1	Introduction to concurrent engineering, Organizational and managerial issues - Design maturity - Concurrent engineering case studies: lessons from Ford Motor Company experience, World-Class Concurrent Engineering**.**	9	25
Module : 2	Quality function deployment - Design for manufacture - Roles and Focus- Creative Product Development – Brainstorming - Design for assembly - Design for Everything (DFX) - Rapid prototyping of physical parts - methodology for evaluating manufacturability - Evaluating product machinability for concurrent engineering.	11	25
FIRST INTERNAL EXAM			
Module : 3	Designing to cost - Economic design in concurrent engineering - Minimizing Total Cost by Design - Half-Cost Product Development – Defect Preventive Quality Control in Manufacturing - Design for competitiveness - Design for Quality - Design for Modularity - Design for Optimal Environmental Impact - Design for the Life Cycle - GRAI Approach to Product Development.	12	25
SECOND INTERNAL EXAM			
Module: 4	Application of expert systems to engineering design - Neuro-computing and concurrent engineering –Computer based concurrent engineering systems -The role of knowledgebased systems in concurrent engineering - Software solutions for concurrent engineering - CONSENS Platform - Future Trends in Concurrent Simultaneous Engineering.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7031	SEMINAR - II	0-0-2-2	2015

SYLLABUS

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7041	Project (Phase 1)	0-0-12-6	2015

SYLLABUS

Course No.	Course Name	L-T-P Credits	Year of Introduction
06ME7012	Project (Phase 2)	0-0-21-12	2015

SYLLABUS