KERALA TECHNOLOGICAL UNIVERSITY

(PALAKKAD CLUSTER-08)

SCHEME AND SYLLABI

Of

M.TECH. PROGRAMME

in

COMPUTER INTEGRATED MANUFACTURING

OFFERING DEPARTMENT

MECHANICAL ENGINEERING

2015

Programme Educational Objectives (PEOs)

The PROGRAMME seeks to produce PG degree holders for rewarding productive careers in production engineering profession.

PEO-1:

Graduates will develop expertise required in solving real world problems by applying fundamental knowledge in mathematics and engineering.

Aims to sharpen problem solving capabilities of graduates to meet the needs of industries and thereby shape successful career in Indian and global arena

PEO-2:

Graduates will develop research aptitude and cater to the increasing need for better solutions to complex and contemporary problems in production processes.

Aims to improve creative research in agreement with economic, environmental and safety constraints.

PEO-3:

Graduates will design and implement projects in manufacturing assessing their social, economic and environmental impacts.

Aims to create awareness in formulating well-reasoned and value-added solutions

PEO-4:

Graduates will learn to exploit multifaceted capabilities of advanced computing techniques for the design and analysis of engineering problems and enhance their technical communication skills.

Aims to prepare graduates to employ computing techniques for design and analysis for production processes and to improve communication skills which will help graduates in preparing technical reports and refine their presentation skills in corporate and public meetings

PEO-5:

Graduates will improve their awareness of professional ethics and codes of professional practice with commitment towards sustainable development.

Aims to familiarize the graduates with the issues of social and economical consequences of engineering solution and therefore should be prepared to address them with integrity and empathy for all stakeholders involved

PEO-6:

To promote student awareness of maintaining state of the art knowledge through lifelong learning.

Programme Outcomes (POs)

- Ability to apply mathematical and engineering knowledge to identify and solve real world problems.
- Ability to design a system or process to meet the needs of the society within the economic, social and environmental constraints.
- Ability to use engineering techniques to design, analyze and manufacture mechanical engineering systems.
- Ability to ascertain the impacts of new projects and developments.
- Ability to identify professional level employment/pursue higher degrees.
- Knowledge about contemporary issues and research opportunities.
- Capacity to communicate effectively and professionally in both verbal and written forms.
- Graduate will be capable of self education and realize the value of lifelong learning.
- Understanding of professional and ethical responsibility.
- Broad education to perceive the impact of engineering solutions in a global, economic, environmental and engineering context.
- Ability to function on multi-disciplinary teams.

CURRICULAM AND SCHME OF EXAMINATIONS

Of

M.Tech in COMPUTER INTEGRATED MANUFACTURING

Offered by

DEPT. OF MECHANICAL ENGINEERING

SEMESTER 1 (Credits 22)

Exam Slot	Course No:	Name	Hours per week			Int. Marks	End Semester Exam		Credits
			L	T	P		Marks	Duration (hrs)	
A	08ME 6201	Applied Computational Methods	3	0	0	40	60	3	3
B	08ME 6203	Computer Aided Design in Manufacturing	3	0	0	40	60	3	3
C	08ME 6205	CNC Machines and Control	3	1	0	40	60	3	4
D	08ME 6207	Flexible Manufacturing Systems	3	0	0	40	60	3	3
E	08ME 62X1	Elective-I	3	0	0	40	60	3	3
	08GN 6001	Research Methodology	0	2	0	100	0	0	2
	08ME 6209	Seminar	0	0	2	100	0	0	2
	08ME 6213	Advanced Manufacturing Lab 1	0	0	2	100	0	0	2
TOTAL			15	3	4	500	300		22

ELECTIVE-I

08ME6211 Advanced Finite Element Analysis
08ME6221 Rapid Prototyping Technologies
08ME6231 Precision Engineering

Note: The student has to undertake the departmental work assigned by HOD

SEMESTER -2 (Credits 19)

Exam Slot	Course No:	Name	Hours per week			Int. Marks	End Semester Exam		Credits
			L	T	P		Marks	Duration (hrs)	
A	08ME 6202	Modern Manufacturing Processes	3	0	0	40	60	3	3
B	08ME 6204	Metrology and Computer Aided Inspection	3	0	0	40	60	3	3
C	08ME 6206	Industrial Robotics	3	0	0	40	60	3	3
D	08ME 62X2	Elective-2	3	0	0	40	60	3	3
E	08ME 62X2	Elective-3	3	0	0	40	60	3	3
	08ME 6208	Industrial Training	0	0	4	100	0	0	2
	08ME 6210	Advanced Manufacturing Lab 2	0	0	2	100	0	0	2
TOTAL			15	0	6	400	300		19

ELECTIVE 2

08ME6212 Optimization techniques for Manufacturing Process
08ME6222 Production and Operations Management
08ME6232 Design of Hydraulic and Pneumatic systems

ELECTIVE 3

08ME6242 Machine Vision
08ME6252 Micro and Nano Machining
08ME6262 Enterprise Resource Planning

Note: The student has to undertake the departmental work assigned by HOD.

SEMESTER -3 (Credits 14)

Exam Slot	Course No:	Name	Hours per week			Int. Marks	End Semester Exam		Credits
			L	T	P		Marks	Duration (hrs)	
A	08ME 72X1	Elective-4	3	0	0	40	60	3	3
B	08ME 72X1	Elective-5	3	0	0	40	60	3	3
	08ME 7201	Seminar	0	0	2	100	0	0	2
	08ME 7203	Project (Phase-I)	0	0	12	50	0	0	6
TOTAL			6	0	14	230	120		14

ELECTIVE 4

08ME7211 Neural networks and Fuzzy systems
08ME7221 Composite Materials
08ME7231 Computational Fluid Dynamics and Applications

ELECTIVE 5

08ME7241 Group Technology and Cellular Manufacturing Systems
08ME7251 Mechatronics for Manufacturing Systems
08ME7261 Design of Machine Tools

Total number of Electives offered: 15

Note: The student has to undertake the departmental work assigned by HOD.

SEMESTER -4 (Credits 12)

Exam Slot	Course No:	Name	Hours per week			Int. Marks	End Semester Exam		Credits
			L	T	P		Marks	Duration (hrs)	
A	08ME 7202	Project (Phase-2)	0	0	21	70	30	0	12
TOTAL			0	0	21	70	30		12

L – Lecture, T – Tutorial, P – Practical

Note: The student has to undertake the departmental work assigned by HOD

Total number of credits for the PG Programme: 22+19+14+12 = 67

Internal Continuous Assessment for theory papers (Maximum Marks: 40)	
Assessment procedure :	**Marks**
Two internal tests	$\mathbf{15 \times 2 = 30}$
Tutorials/Assignments (In the form of seminar, group tasks, case studies, research work or in a suitable format as decided by the teacher.)	10

Syllabus & Course plan

08ME 6201 Applied Computational Methods

Credits: 3-0-0:3 **Year: 2015**

Pre-requisites: Fundamental knowledge of differential equation, matrices

Course Objectives:

To make the student capable of

1. Solution to linear equations
2. Numerical methods for differentiation and integration
3. Solutions to boundary value problems
4. Solution to PDE
5. MATLAB programmes to numerical procedures

Syllabus

Numerical procedures for solving linear and non linear equations, Curve fitting, regression analysis ,numerical integration, Boundary value problems and characteristic value problems, Numerical solution of partial differential equations-Elliptic equations, Parabolic and hyperbolic equations, heat flow and wave equations, MATLAB programming of numerical methods

Course Outcome:

Students successfully complete this course will be familiar with numerical methods for solving typical linear and non linear equations in engineering applications, They will be capable of doing curve fitting and analysis, exposure to numerical integration, numerical methods for boundary and characteristic value problems, Partial differential equations, Programming of numerical procedures in MATLAB

Text Books:

1. Steven. C. Chapra and Raymond P Canale, Numerical method for Engineers with software and programming applications ,Tata McGraw Hill Edition 2012
2. John H Mathews and Kurtis Fink, Numerical Methods using MATLAB prentice hall, 4th Ed., 2005

References:

1. Curtis F Gerald and Patrick O Wheatly, Applied numerical analysis, Pearson education, 7th Ed., 2007
2. Joe D Holman numerical method foe engineers and scientists, Yes Dee publishing Pvt. Ltd, 2010
3. Rajasekharan S, Numerical method in Science and Engineering, S. Chand. &. Company. Ltd., 2003.

COURSE PLAN

08ME6201 Applied Computational Methods (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Solving sets of linear equations, direct elimination method, LU factorization, Tridiagonal system of equations, Thoma's algorithm, iterative methods, Relaxation method, Eigen value problems, power method, system of non linear equations, Newton- Raphson method, MATLAB programs.	6	15
MODULE: 2 Curve fitting and approximation of functions, fitting of nonlinear curves by least squares, regression analysis, Bezier curves and B-Splines cubic Spline functions, MATLAB programmes	6	15
FIRST INTERNAL TEST		
MODULE : 3 Numerical integration, Newton-cotes integration formulas, trapezoidal and Simpson's rules, Composite integration Gaussian quadrature, adaptive integration, multiple integrals, MATLAB programs.	6	15
MODULE : 4 Numerical solution of partial differential equations, Laplace equation, representation as a difference equation, iterative method for Laplace equation, Poisson equation, derivative boundary conditions MATLAB programmes	6	15
SECOND INTERNAL TEST		
MODULE : 5 Parabolic partial differential equations, explicit method, crank Nicolson method, stability and convergence, applications to heat flow problems, solution of wave equations by finite difference method, MATLAB programs.	8	20
MODULE : 6 Boundary value problems and characteristic value problems, shooting method, equilibrium method, derivative boundary conditions, characteristic value problems, solution using characteristic polynomial method, power method. MATLAB programs	10	20
END SEMESTER EXAM		

08ME6203 Computer Aided Design in Manufacturing

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Fundamental knowledge computer aided drafting

Course Objectives:

To impart a general awareness about basic concept and components of Geometrical Modelling

Syllabus

Overview of CAD systems and graphics transformations, two dimensional and three dimensional Transformations, Geometrical Modeling of solids, Visual realism and computer animation, Collaborative product design and product life cycle management

Course Outcome:

At the end of the course the students will understand

The role of computer in design and manufacturing

Both hardware and software of CAD systems together with the practical discussion of their use in engineering

Computer Graphics for drafting and analysis

Reference Books:

1. Ibrahim Zeid, "CAD/CAM Theory and Practice", McGraw Hill Inc., New Delhi, 2009
2. Radhakrishnan P and Kothandaraman C P, "Computer Graphics and Design", Dhanpat Rai and Sons, 10th Ed. 2011
3. Radhakrishnan P and Subramanyan S, “CAD/CAM/CIM”, New Age International Pvt Ltd Publishers, 2009
4. Michael E Mortenson, "Geometric Modeling", John Wiley and Sons Inc., 3rd Rev. Ed., 2006
5. Vera B Anand, "Computer Graphics and Geometric Modeling for Engineers", John Wiley and Sons Inc., New Delhi, 2000
6. David Solomon, “Computer Graphics and Geometric Modeling", Springer Verlag, 1999

COURSE PLAN

08ME6203 Computer Aided Design in Manufacturing (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Conventional and computer aided design processes, subsystems of CAD-CAD hardware and software, analytical and graphics packages. Computer graphics and graphics transformation-Image Processing-transport of graphics data-graphics standards-transformations	7	15
MODULE: 2 2D representation and transformation of points-Transformation of lines, rotation, scaling, translation, reflection and combined transformation, 3D Transformations-scaling, rotation, translation, reflection, windowing, view ports, clipping	7	15
FIRST INTERNAL TEST		
MODULE: 3 Introduction, wireframe models, parametric representation of curves (analytic and synthetic), curve manipulation, Introduction to parametric representation of surfaces, design examples	6	15
MODULE: 4 Fundamentals of solid modeling, boundary representation, constructive solid geometry, Solid manipulations, solid modeling based applications	6	15
SECOND INTERNAL TEST		
MODULE: 5 Visual Realism- Model cleanup, hidden line removal, shading, Computer animation, animation systems, design applications	8	20
MODULE: 6 Collaborative Design-Traditional design, collaborative design-design principles and approaches-tools-design system, Product Life cycle Management-Introduction, Product information-PLM frame work, Benefits.	8	20
END SEMESTER EXAM		

08ME6205 CNC Machines and Control

Credits: 3-1-0: 4 **Year: 2015**

Pre- requisites:

Basic knowledge of computer integrated manufacturing

Course Objectives:

- To understand the construction, working, concepts and controls of Computer Numerical Control machines

Syllabus:

Introduction to CNC machines – Laser cutting and drilling machines– CNC inspection machines – Part programming- Constructional features of CNC machines –ATC – APC – Digital absolute measuring system – Electromagnetic analog position transducers – Programmable machine control – PLC– Adaptive control systems – Case studies

Course Outcome:

The student will have acquired

- Knowledge of CNC machine tools and machining centers
- Knowledge of CNC concepts
- Knowledge of constructional features of CNC machine tools
- Knowledge of adaptive control of CNC machines

Reference Books:

1. Yoram Koren, *Computer Control of Manufacturing Systems*, McGraw-Hill Book Company, 2005.
2. P. Radhakrishnan, *Computer Numerical Control and Computer Aided Manufacture*, New Age International Publishers, 2012.
3. P. Radhakrishnan, S. Subramanyan, V. Raju *CAD/CAM/CIM*, New Age International Publishers, 2009.
4. Madhuchandra Mitra and Samarjit Sen Gupta, *PLC and Industrial Automation*, Penram Industrial Publishing (India) (P) Ltd., 2009.
5. K. S. Narendra, *Advances in adaptive control*, Pergoman Press, 1994

COURSE PLAN

08ME6205 CNC Machines and Control (L-T-P : 3-1-0) CREDITS: 4		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Introduction to CNC machines – Machining centers-Turning centers-CNC grinding – EDM – CNC gear cutting machines	9	15
MODULE: 2 Laser cutting and drilling machines – CNC routers – CNC inspection machines – Manual and Computer aided part programming	10	15
FIRST INTERNAL TEST		
MODULE: 3 Constructional features of CNC machines – Main drive - Axes feed drives – Slide ways – Ball screws – ATC – Work tables – APC – Spindles – Beds and columns – Turrets – Feedback devices	9	15
MODULE: 4 Digital incremental displacement measuring systems – Incremental rotary encoders – Digital absolute measuring system – Electromagnetic analog position transducers	9	15
SECOND INTERNAL TEST		
MODULE: 5 Programmable machine control – PLC - CNC and PLC – Components of PLC – Architecture of PLC – Programming a PLC	10	20
MODULE: 6 Adaptive control systems – Adaptive control with optimization – Adaptive control with constraints – Variable gain adaptive control systems – Adaptive control of grinding	9	20
END SEMESTER EXAM		

08ME6207 Flexible Manufacturing Systems

Credits: 3-0-0: 3 **Year: 2015**

Pre-requisites: A basic knowledge of production processes and their planning and control.

Course Objectives:

To make the Student understand:

Expanded coverage of automation, flexible manufacturing, modern material handling, storage, support systems for both tool and work pieces and emerging trends in modern manufacturing.

Syllabus

Concept, evolution, elements, flexibilities of FMS and its measurements, Functional requirements for FMS equipments, Material handling devices-Storage systems- manufacturing support systems-Selection of pallets and fixtures, FMS Implementation, Selection of computer hardware and software .

Course Outcome:

Students who successfully complete this course will have knowledge of latest application of computer control to automate batch production manufacturing.

Reference Books:

1. D. J. Parrish, “Flexible manufacturing systems”, Butterworth Heinmann, 1990.
2. Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India, 2006.
3. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, III Edition 2005.

COURSE PLAN

08ME6207 Flexible Manufacturing System (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Introduction to FMS,FMS definition, evolution, equipment and classification of FMS - configuration of FMS-application of FMS-Automated production cycle, Need of flexibility, Concept of flexibility, Types of flexibilities and its measurement.	8	15
MODULE: 2 **FMS Equipment:** Why FMS, Factors responsible for the growth of FMS, FMS types and applications, user- host supplier flexibilities- flexibility achievement-how to develop FMS, Economic justification for FMS.	8	15
FIRST INTERNAL TEST		
MODULE: 3 Functional requirements for FMS equipments, FMS processing and QA equipment, e.g., turning and machining centers, Co-ordinate measuring machines, Cleaning and deburring machines, FMS system support equipment,	7	15
MODULE: 4 Material handling-principles- transport system-industrial truck-Automated material handling, AGV- monorail and other guided vehicle-conveyor- crane- hoist.	6	15
SECOND INTERNAL TEST		
MODULE: 5 Storage system- performance- location strategies- conventional and automated storage systems- equipments used for storage, engineering analysis. Cutting tool and tool management.	6	20
MODULE: 6 Work holding considerations, Fixture considerations in FMS environment, FMS production and its importance, Manufacturing support system- process planning for parts and assemblies- CAPP-retrieval and generative.	7	20
END SEMESTER EXAM		

08ME 6211 Advanced Finite Element Analysis

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites:

Basic knowledge of Partial differential equations, Structural Mechanics, Heat transfer, Fluid Mechanics and Elementary Finite Element Method.

Course Objectives:

- To master linear finite element procedures and programming techniques.
- To understand the basic mathematics of finite element analysis and equip the students to formulate finite element procedures for engineering problems.
- To train the students in structural, thermal and flow analysis problems using finite element software.
- To introduce finite element procedures and programming techniques for non-linear and transient problems.

Syllabus:

Review of tensors, Elasticity – Plasticity and principles of dynamics – Heat transfer and fluid flow problems – Review of computational procedures with 1D elements – 2D elements – Heat transfer and fluid flow problems – Convergence and completeness conditions – Applications – Isoparametric formulation – Coordinate transformation –Imposition of constraints – Error – Sources of error – Boundary value problems – Finite element formulation from a functional – Weighted-residual methods – Galerkin finite element formulation – Applications to structural, Thermal and fluid flow problems – Finite element formulation for non-linear problems – Solution methods – Convergence criteria –Applications – Transient finite element procedures – Integration techniques – Applications –Introduction to coupled analyses and contact problems..

Course Outcome:

- The Graduate will develop the capability to apply finite element concepts to solve engineering problems in manufacturing.

Text Books:

1. R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, *Concepts & Applications of Finite Element Analysis,* John Wiley & Sons, Fourth Edition, 2007
2. D. V. Hutton, *Fundamentals of Finite Element Analysis*, Tata McGraw Hill, 2005.
3. S. S. Rao, *The Finite Element Method in Engineering*, Butterworth Heinemann,5/E, 2010

References:

1. J. N. Reddy, *An Introduction to the Finite Element Method,* McGraw Hill International, Third Edition, 2009
2. K. J. Bathe, *Finite Element Procedures in Engineering Analysis,* Prentice Hall of India, 2014.
3. O. C. Zienkiewicz, R. L. Taylor, *The Finite Element Method*, McGraw Hill, 7/E, 2013.

COURSE PLAN

08ME6211 Advanced Finite Element Analysis (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Review of tensors, Elasticity, Plasticity and principles of dynamics –Review of computational procedures with 1-D elements –Interpolation and shape functions – 2-D elements – Simple solid elements – Element matrices for structural mechanics	6	15
MODULE: 2 Heat transfer and fluid flow problems – Choice of interpolation functions – Convergence and completeness conditions – Modeling considerations – Symmetry – Applications – Isoparametric formulation – 1-D and 2-D elements – Numerical integration –Choice in numerical integration – Patch test.	8	15
FIRST INTERNAL TEST		
MODULE: 3 Coordinate transformation – Transformation of characteristic matrix– Transformation of restraint directions– Imposition of constraints –Lagrange multiplier and penalty function methods– Error –Sources of error –Ill conditioning– Convergence–Error estimates.	7	15
MODULE: 4 Boundary value problems – Weak and strong forms – Functional –Euler-Lagrange equations – Rayleigh-Ritz method – Finite element formulation from a functional. Weighted-residual methods – Galerkin, Least-square and collocation methods – Galerkin finite element formulation – Applications to structural, Thermal and fluid flow problems.	8	15
SECOND INTERNAL TEST		
MODULE: 5 Finite element formulation for non-linear problems – Solution methods – Newton-Raphson method – Modified Newton-Raphson method – Convergence criteria – Applications.	6	20
MODULE: 6 Transient finite element procedures – FE equations and matrices –Integration techniques – Applications. Introduction to coupled analyses –Fluid-structure interaction–Thermo-mechanical problems and contact problems.	7	20
END SEMESTER EXAM		

08ME6221 Rapid Prototyping Technologies

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To impart a general awareness about basic concept, data formats and application of Rapid Prototyping.

Syllabus:

Introduction: Prototyping fundamentals, Rapid Prototyping Process Chain. Liquid-based Rapid Prototyping Systems, Solid ground curing (SGC): Solid-based Rapid Prototyping Systems, Fused Deposition Modeling (FDM): Powder Based Rapid Prototyping Systems, Rapid Tooling: Rapid Prototyping Data Formats RP Applications

Course Outcome:

At the end of the course the students will understand

- Rapid Prototype Process Chain,
- Different Rapid Prototyping Systems
- Rapid Prototyping Data formats
- Rapid Tooling

References:

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications, Third Edition, 2010.
2. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer , 2001
3. Whalers Report 2000 – Terry Wohlers, Wohlers Associates, 2000 Rapid Prototyping & Manufacturing – Paul F. Jacobs, ASME Press, 1996

COURSE PLAN

08ME6221 Rapid Prototyping Technologies (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process. Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.	7	15
MODULE: 2 Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies .Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.	7	15
FIRST INTERNAL TEST		
MODULE: 3 Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.	7	15
MODULE: 4 Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools ,Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.	6	15
SECOND INTERNAL TEST		
MODULE: 5 Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators,	8	20

Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magic's, Mimics, Solid View, View Expert, 3 D View, Velocity 2 , Rhino, STL View 3 Data Expert and 3 D doctor		
MODULE: 6 RP Applications: Application – Material Relationship, Application in Design , Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Bio molecules	7	20
END SEMESTER EXAM		

08ME6231 Precision Engineering

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: NIL

Course Objectives:

- To understand the fundamental concepts of precision manufacturing
- To acquire knowledge of measurement techniques for precision engineering

Syllabus:

Concepts of accuracy – Errors due to numerical interpolation – Displacement measurement system and velocity lags – Geometric dimensioning and tolerancing – Logical approach to tolerancing – Datum systems –Computation of translational and rotational accuracy – Datum features – Tolerance analysis – Tolerance charting techniques – Design features to facilitate machining – Fundamentals of nanotechnology – Nanotechnology and electrochemical atomic bit processing – Measuring systems processing: Mechanical and optical measuring systems.

Course Outcome:

- The graduate will have developed ability to design/work with manufacturing of precision components/systems

Reference Books:

1. Murthy R.L., *Precision Engineering in Manufacturing*, New Age International (P) limited, 2005.
2. James D. Meadows, *Geometric Dimensioning and Tolerancing*, New York: M. Dekker, 1995.
3. Norio Taniguchi, *Nano Technology: Integrated Processing Systems for Ultra-precision and Ultra-fine Products*, Oxford University Press, 1996.
4. Robert Matousek, *Engineering Design – A systematic Approach*, Blackie & Son Ltd., 1974.

COURSE PLAN

08ME6231 Precision Engineering (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Concepts of accuracy: Introduction – Concept of accuracy of machine tools – Spindle and displacement accuracies – Accuracy of numerical control systems – Errors due to numerical interpolation -Displacement measurement system and velocity lags.	5	15
MODULE: 2 Geometric dimensioning and tolerancing: Tolerance zone Conversions – Surfaces, Features - Datum features – Oddly configured and curved surfaces - Equalizing datums – Datum feature representation – Form controls, Orientation controls – Logical approach to tolerancing.	6	15
FIRST INTERNAL TEST		
MODULE: 3 Datum systems: Design of freedom, Grouped datum systems – Different types – Grouped datum system with spigot and recess, Pin and hole; Grouped datum system with spigot, recess pair and tongue– Slot pair – Computation of translational and rotational accuracy, Geometric analysis and application. Datum features – Functional and manufacturing components design – Machining considerations, Redesign for manufactured, Examples	9	15
MODULE: 4 Tolerance analysis: Process capability, Mean, Variance, Skewness, Kurtosis, Process Capability Metrics, Cp, Cpk, Cost aspects, Feature tolerances, Geometric tolerances. Review of relationship between attainable tolerance grades and different machining process, Cumulative effect of tolerances, Sure fit law, Normal law and truncated normal law.	7	15
SECOND INTERNAL TEST		
MODULE: 5 Tolerance charting techniques: Operation sequence for typical shaft – Type of components – Preparation of process drawings for different operations, Tolerance worksheets and centrally analysis, Examples, Design features to facilitate machining.	6	20
MODULE: 6 Fundamentals of nanotechnology: Systems of nanometer accuracies– Mechanism of metal Processing – Nano-physical processing of atomic bit units – Nanotechnology and electrochemical atomic bit processing. Measuring systems processing: In processing or in-situ measurement of position of processing point – Post process and on- machine measurement of dimensional features and surfaces.	9	20
END SEMESTER EXAM		

GN6001 Research Methodology

Credits: 0-2-0: 2 **Year: 2015**

Pre- requisites: NIL

Course Objectives:

The main objective of the course is to provide a familiarization with research methodology and to induct the student into the overall research process and methodologies. This course addresses:

The scientific research process and the various steps involved formulation of research problem and research design, design of experiments, thesis preparation and presentation, research proposals, publications and ethics; Important research methods in engineering.

As a tutorial type course, this course is expected to be more learner centric and active involvement from the learners are expected which encourages self-study and group discussions. The faculty mainly performs a facilitator's role.

Syllabus:

Overview of research methodology - research process - scientific methods - research problem and design - research design process - formulation of research task, literature review and web as a source - problem solving approaches - experimental research - ex post facto research. Thesis writing - reporting and presentation - interpretation and report writing - principles of thesis writing- format of reporting, oral presentation - seminars and conferences

Research proposals - research paper writing - publications and ethics - considerations in publishing, citation, plagiarism and intellectual property rights. Research methods – modelling and simulation - mathematical modeling – graphs - heuristic optimization - simulation modeling - measurement design – validity – reliability – scaling - sample design - data collection methods and data analysis

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Course Outcome:

At the end of course, the student will be able to:

Discuss research methodology concepts, research problems, research designs, thesis preparations, publications and research methods.

Analyze and evaluate research works and to formulate a research problem to pursue research

Prepare a thesis or a technical paper, and present or publish them

Apply the various research methods followed in engineering research for formulation and design of own research problems and to utilize them in their research project.

Reference Books:

1. C. R. Kothari, "*Research Methodology, Methods and Techniques"*, New Age International Publishers, 3rd Ed. 2014
2. R. Panneerselvam, *"Research Methodology"*, PHI Learning , 2014

3. K. N. Krishnaswamy, Appa Iyer Sivakumar, M. Mathirajan, "*Management Research Methodology, Integration of principles", Methods and Techniques*, Pearson Education, 2006
4. Deepak Chawla, Meena Sondhi, "*Research Methodology – concepts & cases"*, Vikas Publishing House, 2011
5. J. W. Bames, *"Statistical Analysis for Engineers and Scientists"*, McGraw Hill, New York, 2014
6. Schank Fr., "*Theories of Engineering Experiments"*, Tata Mc Graw Hill Publication., 2008
7. John W Best, James V Kahan, "*Research in Education"*, PHI Learning, 2010
8. Sinha, S. C. and Dhiman, A. K., "*Research Methodology"*, ESS Publications. (2 volumes), 2002

COURSE PLAN

GN6001 Research Methodology (L-T-P : 0-2-0) CREDITS: 2		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE 1: Overview of Research Methodology**:** Research concepts – meaning – objectives – motivation - types of research –research process – criteria for good research – problems encountered by Indian researchers -scientific method - research design process – decisional	5	15
MODULE 2: Research Problem and Design: Formulation of research task – literature review –methods – primary and secondary sources – web as a source – browsing tools - formulation of research problems – exploration - hypothesis generation - problem solving approaches-introduction To TRIZ (TIPS)-experimental research – principles – Laboratory experiment - experimental designs - ex post facto research-qualitative research	5	15
FIRST INTERNAL TEST		
MODULE 3: Thesis writing, reporting and presentation**:** Interpretation and report writing – techniques of interpretation – precautions in interpretation –significance of report writing – principles of thesis writing- format of reporting - different steps in report writing – layout and mechanics of research report -references – tables – figures – conclusions – oral presentation – preparation - making presentation – use of visual aids - effective communication - preparation for and presentation in seminars and conferences	4	15
MODULE 4: Research proposals, publications, ethics and IPR: Research proposals - development and evaluation –research paper writing – layout of a research paper - journals in engineering – considerations in publishing –scientometry -impact factor- other indexing like h-index –citations - open access publication - ethical issues -plagiarism – software for plagiarism checking- intellectual property right- patenting case studies .	5	15
SECOND INTERNAL TEST		
MODULE 5: Research methods – Modelling and Simulation**:** Modelling and Simulation – concepts of modelling – mathematical modelling - composite modelling –modelling with – ordinary differential equations – partial differential equations – graphs-heuristics and heuristic optimization - simulation modeling	5	20
MODULE 6: Research Methods – Measurement, sampling and Data acquisition: Measurement design – errors -validity and reliability in measurement - scaling and scale construction - sample design - sample size determination - sampling errors -data collection procedures - sources of data – data collection methods - data preparation and data analysis	4	20
END SEMESTER EXAM		

08ME6209 Seminar

Credits: 0-0-2: 2 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To improve debating capability of the student to present a technical topic.
- To improve communication and presentation skills of the student.

Outline and evaluation procedure:

Individual students are required to choose a topic of their interest, in consultation with any faculty member offering courses for the programme. The topic should be related to computer integrated manufacturing, preferably from outside the M. Tech syllabus. The topic should be based on a journal/conference publication within a span of last 3 years. The duration of the seminar should be limited to 30 minutes. A committee with the Head of the department as the Chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee. Each student shall submit two copies of a write up on the topic. One copy certified by the Chairman shall be returned to the student and the other will be kept in the departmental library.

Course Outcomes:

The graduate will have acquired

- Debating capability and presentation skills in a technical topic of his interest.
- Knowledge about contemporary issues and research opportunities
- Capacity to communicate effectively and professionally in both verbal and written forms
- Capability for self education and lifelong learning

08ME6209 Seminar **(L-T-P : 0-0-2) CREDITS: 2**	
A committee with the Head of the department as the Chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.	
Internal Continuous Assessment *(Maximum Marks-100)*	
Assessment Procedure	**Weightage (%)**
Report	30
Presentation	40
Answering ability	30

08ME 6213 Advanced Manufacturing Lab 1

Credits: 0-0-2: 2 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To gather knowledge regarding CNC machines and programming
- To impart training on FEM analysis
- To study assembly and mechanism design
- To gather knowledge on measurement of surface quality of machined surfaces

Exercises:

1. **Exercises on finite element analysis:** Introduction to FEM - 1D, 2D and 3D elements - shape functions – preprocessing - boundary conditions, structured and free mesh generation - analysis - linear and non linear analysis - static and dynamic analysis - post processing - display, animation, extraction of nodal data - exercises on heat conduction and elasticity may be given using commercial FEM packages

2. **Exercises on Computer aided manufacturing:** Part programming fundamentals - manual part programming and computer aided part programming - hands on training in computer controlled turning and milling operations - familiarity with windows based software packages - tool path generation and simulation - exercises on CNC lathe and machining centre /milling machines

3. **Exercises on Assembly and mechanism design:** Assembling of various parts and tolerance analysis - synthesis and design of mechanisms - animations - exercises on various mechanisms like four bar linkages and its variations - cam and follower - two and four stroke engines

4. **Practical study on surface quality of machined surfaces:** Exercises on grinding of components and measurement of surface finish and study of influence of cutting variables on surface quality

Course Outcomes:

The graduate will have acquired hands on experience Finite element analysis, Part programming, Turning and milling operations and measurement of surface roughness.

References:

1. ANSYS Lab Manual, CAD Center, Dept. of Mechanical Engineering, N.S.S. College of Engineering, Palakkad.
2. CNC Part Programming Lab Manual, CAD Center, Dept. of Mechanical Engineering, N.S.S. College of Engineering, Palakkad.
3. P. Radhakrishnan, *Computer Numerical Control and Computer Aided Manufacture*, New Age International Publishers, 2012

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08ME 6213 Advanced Manufacturing Lab 1 **(L-T-P : 0-0-2) CREDITS: 2**	
Internal Continuous Assessment (Maximum Marks-100)	
Assessment Procedure	**Weightage (%)**
Practical Records/outputs	40
Final Test (Experiments)	40
Final Viva-Voce	20

08ME6202 Modern Manufacturing Process

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Knowledge of the basic metal cutting and forming operations in manufacturing industries.

Course Objectives:

To give the Student:-

- To understand fundamental machining principles and the mechanisms in the non traditional machining processes
- To describe various advanced metal cutting and forming operations.
- An introduction to experimental methods using various computational methods;

Syllabus

Fundamental concepts and overview of modern manufacturing processes; Basic metal cutting and forming processes and their detailed analysis of various parameters included; Basic equations in metal cutting for cutting force analysis; Dimensional analysis and optimisation of parameters both input and output; detailed analysis of forming processes and their application and analysis of parameters and explanation of various processes with constructional details of equipments involved.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of modern manufacturing including metal cutting and forming; Apply the basic equation of metal cutting to determine cutting forces; A clear understanding of the various input and output parameters involved in the process and their optimisation and getting familiar with the constructional details of the equipments involved in the metal cutting and forming processes and a study of the application software's for the same.

Text Books:

1. Ghosh and Mallik, Manufacturing Science, East West Press, 2nd Ed. 2010

References:

1. HMT, Production Technology, Tata McGraw Hill, New Delhi. (2005)
2. P. C .Pandey, H. S. Shan, Modern Machining Processes, Tata McGraw Hill, (2008)
3. Mc Geongh J. A., Advanced Methods of Machining, Chapman and Hall, (2006)

COURSE PLAN

08ME6202 Modern Manufacturing Process (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Mechanical Processes: Ultrasonic Machining- Elements of process, cutting tool system design, effect of parameters, economic considerations, applications, limitations of the process, advantages and disadvantages. Abrasive Jet Machining- Variables in AJM, metal removal rate in AJM. Water Jet Machining- Jet cutting equipments, process details, advantages and applications.	7	15
MODULE: 2 Electrochemical and Chemical Metal Removal Processes: Electrochemical Machining- Elements of ECM process, tool work gap, chemistry of the process, metal removal rate, accuracy, surface finish and other work material characteristics, economics, advantages, applications, limitations. Electrochemical Grinding–Material removal, surface finish, accuracy, advantages, applications.	7	15
FIRST INTERNAL TEST		
MODULE: 3 Thermal Metal Removal Processes: Electric Discharge Machining (EDM) or spark erosion machining processes, mechanism of metal removal, spark erosion generators; electrode feed control, dielectric fluids, flushing, electrodes for spark erosion, selection of electrode material, tool electrode design, surface finish, machining accuracy, machine tool selection, applications.	7	15
MODULE: 4 Wire cut EDM. Laser beam machining (LBM)- Apparatus, material removal, cutting speed and accuracy of cut, metallurgical effects, advantages and limitations Plasma Arc Machining (PAM): Plasma, non thermal generation of plasma, mechanism of metal removal, PAM parameters, equipments for D.C. plasma torch unit, safety precautions, economics, other applications of plasma jets.	7	15
SECOND INTERNAL TEST		
MODULE: 5 Electron Beam Machining (EBM) – Generation and control of electron beam, theory of electron beam machining, process capabilities and limitations. High Velocity Forming Processes:- Conventional versus High velocity forming methods – Material behaviour – stress waves and deformation in solids – Stress wave induced fractures – Applications.	7	20
MODULE : 6 Explosive Forming Processes:- Principles – Explosives – Length of reactions – Energy in plastic deformations – Expression for change in size required for deforming a flat disc into a bulged form – Effect of process in material properties – Types of Explosive forming – die construction. Magnetic Pulse Forming Processes: - General principles – Applications.	7	20
END SEMESTER EXAM		

08ME6204 Metrology and Computer Aided Inspection

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To acquire knowledge on concepts of metrology and contact and non contact measuring methods.

Syllabus:

Metrological concepts – High precision measurements – Standards for length measurement – Method of coincidence – Slip gauge calibration – Measurement of errors –Various tolerances and specifications – Comparators – Angular measurements – Thread measurements – Surface and form metrology – Computer aided metrology – Interfacing software – Laser metrology – Laser interferometer – Laser scanners – Co-ordinate measuring machine – Application – Non-contact CMM – Electro optical sensors for dimensional metrology – Image processing and its application in metrology..

Course Outcome:

- The student will have gained the knowledge on modern concepts of dimensional metrology.

Text Books:

1. G. N. Gayler, F.W and C. R. Shotbolt, "Metrology for Engineers ", ELBS Edn, 1990

2. Ted Busch, *Fundamentals of Dimensional Metrology*, Delmar Publishers, Third Edition.1998.

Reference Books:

1. *ASME - Hand book of Industrial Metrology, 2013*

2. D. J. Whitehouse, Handbook of Surface Metrology, CRC Press, 2nd Edition, 2010

COURSE PLAN

08ME6204 Metrology and Computer Aided Inspection (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Metrological concepts - Abbe principle – Need for high precision measurements – Problems associated with high precision measurements.	6	15
MODULE: 2 Standards for length measurement – Shop floor standards and their calibration –Light interference – Method of coincidence – Slip gauge calibration – Measurement errors.	6	15
FIRST INTERNAL TEST		
MODULE: 3 Various tolerances and specifications - Gauging principles selective assembly - Comparators - Angular measurements: Principles and instruments – Thread measurements - Surface and form metrology –Flatness – Roughness – Waviness – Roundness - Cylindricity etc.	8	15
MODULE: 4 Laser metrology – Application of lasers in precision measurements –Laser interferometer, Speckle measurements, Laser scanners..	6	15
SECOND INTERNAL TEST		
MODULE: 5 Co-ordinate measuring machine – Types of CMM – Probes used - Application – Non-contact CMM electro optical sensors for dimensional metrology – Non contact sensors for surface finish measurements.	7	20
MODULE: 6 Image processing and its application in metrology – Automated machine vision applied to assembly and inspection tasks traditionally performed by human operators - Micro and nano metrology	9	20
END SEMESTER EXAM		

08ME6206 Industrial Robotics

Credits: 3-0-0: 3 **Year: 2015**

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- To impart a general awareness about the structure and components and operation of robots
- To familiarize an understanding about different types of drives and sensors
- To develop analysis skills in kinematics and trajectory generation
- To impart programming skills and awareness about the role of a robot in an industry

Syllabus

Classification and structure of robots; components of robots; Control schemes in robotics; Spatial descriptions and transformations; Forward Kinematics; Inverse kinematics; Velocity and static forces; Trajectory planning; robot programming; Role of a robot in an industry

Course Outcome:

Students who successfully complete this course will have an ability to understand the structure and components of robots; Apply the mathematical techniques to determine position and velocity of the end-effector, and determination of the forces and joint torques; Basic need and method of path planning is imparted; In addition to the fundamentals of robot programming; they also knows the role of robots in an industry.

References Books:

1. John J Craig, *Introduction to Robotics, Mechanics and Control*, Third edition, Pearson Education International, 2005
2. Mark W. Spong & M. Vidyasagar, *Robot Dynamics and Control*, John Wiley & Sons, 2004
3. Mikell P. Groover et al, "Industrial Robots-Technology, Programming and Application", McGraw Hill Publishing Company-2013.
4. Yoram Koran, *"Robotics for Engineers*", McGraw-Hill International Student Edition, 2009

COURSE PLAN

08ME6206 Industrial Robotics (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Introduction to robotics-Classification and structure of robots, Drives systems: AC and DC servo motors, Stepper motors, Pneumatic and Hydraulic actuators, Sensors: Proximity sensors, range sensors, Encoders, Force and torque sensors, Vision sensors, basic control schemes	7	15
MODULE: 2 Spatial descriptions and transformations: Basic rotation matrices, general transformations, Workspace analysis, Euler angles, Forward Kinematics: DH Convention for affixing frames to links, Link parameters, Derivation of direct kinematic equations	7	15
FIRST INTERNAL TEST		
MODULE: 3 Inverse manipulator kinematics, Solvability, algebraic and geometric solutions, Pipers solution when three axes intersect, Repeatability and accuracy	7	15
MODULE : 4 Velocities and static forces- Linear and rotational velocity of rigid bodies, Velocity propagation from link to link, Jacobians, Singularities, Static forces in manipulators, Jacobians in force domain, Cartesian transformation of velocities and static forces,	7	15
SECOND INTERNAL TEST		
MODULE : 5 Trajectory generation: General considerations in path descriptions and generation, Joint space schemes, Cubic polynomials, Linear function with parabolic blends, Cartesian space schemes, Robot programming: Teach by showing, Textual Language Programming using AL, AML, VAL etc.,	8	20
MODULE: Industrial applications: Spry painting, Spot welding, Arc welding, drilling, Assembly operations, loading unloading, Role of a robot in a manufacturing cell, Safety considerations.	6	20
END SEMESTER EXAM		

08ME6212 Optimization Techniques for Manufacturing Process

Credits: 3-0-0: 3 Year: 2015

Pre- requisites:

- Basic knowledge of related mathematical concepts and manufacturing processes

Course Objectives:

- To understand the theory of simplex method, non-linear programming, algorithms for unconstrained optimization and sequential decision making.

Syllabus:

Theory of simplex method - Bounded variables algorithm - Sensitivity analysis -Parametric programming - Integer programming - Non-linear programming problems - Theory of unconstrained and constrained optimization – Inequality constraints - Algorithms for unconstrained and constrained optimization – Multi-objective decision models – Goal programming formulation, Weighting method of solution – Analytic hierarchy process - Sequential decision making (stochastic case) - Algorithms for solving Markov decision problems - Finite and infinite stage models – Metaheuristics - Complexityof algorithms.

Course Outcome:

- The student will have obtained knowledge of advanced optimization methods applicable to production processes.

Text Books:

1. Rao S.S, Optimization: Theory and Applications, Wiley Eastern, Fourth edition, 2009.
2. Ravindran A., Philips D.T. and Solberg J.J., Operations Research: Principles and Practice, John Wiley & Sons, 4th Edition, 2009.
3. Taha H.A., Operations Research: An Introduction, Pearson Education, 9th Edition, 2013
4. Deb K., Optimization for Engineering Design: Algorithms and Examples, Prentice-Hall of India, 2nd 2012
5. Papadimitriou C.H. and Steghtz K., Combinatorial Optimization: Algorithms and Complexity, Dover Publications Inc, 2000

References:

1. Hillier F.S. and Liberman G.J., *Introduction to Operations Research,* McGraw-Hill International, 10th edition, 2014
2. Reklatis G.V., Ravindran A. and Ragsdell K.M., *Engineering Optimization: Methods and applications, John* Wiley and Sons, 2nd Edition, 2006

COURSE PLAN

08ME6212 Optimization Techniques for Manufacturing Process (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Theory of simplex method, Duality Theory, Duality theorems, Dual simplex method, Revised simplex method – Bounded variables algorithm, Sensitivity analysis, Parametric programming. Integer programming: Cutting plane method, Branch and bound method.	7	15
MODULE: 2 Non-linear programming problems: General non-linear programming problems; Convex, Quasi-convex, Concave and uni-modal functions, Theory of unconstrained optimization – Necessary and sufficient conditions for extrema, Theory of constrained optimization –Lagrange multipliers and Lagrangian optimization, Inequality constraints, Kuhn-Tucker conditions.	8	15
FIRST INTERNAL TEST		
MODULE: 3 Algorithms for unconstrained optimization: Fibonacci search method, Golden section search method, Cauchy's (steepest descent) method. Algorithms for constrained optimization: Quadratic programming, Separable convex programming	7	15
MODULE: 4 Multi-objective decision models: Introduction to multi-objective decision making, Concept of pareto-optimality, Goal programming formulation, The weighting method of solution, Analytic hierarchy process.	7	15
SECOND INTERNAL TEST		
MODULE: 5 Sequential decision making (stochastic case): Stochastic processes, Markov processes, Markov chains, Markov decision problems, Algorithms for solving Markov decision problems, Finite-stage models and infinite stage models.	7	20
MODULE: 6 Metaheuristics: Nature of metaheuristics, Tabu search, Simulated annealing, Genetic algorithm. Complexity of algorithms: Complexity of algorithms for combinatorial optimization problems.	6	20
END SEMESTER EXAM		

08ME6222 Production and Operations Management

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To understand the comprehensive thought of manufacturing planning and control such as forecasting, sales and operations planning, MPS, MRP, shop floor control, facility location and layout and line balancing.

Syllabus:

Manufacturing Planning and Control (MPC) - Type of configurations – Forecasting framework - Errors in forecasting - Sales and operation planning - Master production schedule - Structuring BOM - Final assembly schedule - Material Requirement Planning (MRP) - Lot sizing methods - Buffering concepts - System nervousness - Enterprise resource planning - Production activity control - Gantt chart - General shop scheduling – Computerized layout planning - Construction and improvement algorithms - Line balancing algorithms - Quality management systems - Basic concepts of TQM and TPM - Quality performance measures - Quality costs - Quality Function deployment - Taguchi's quality engineering - Elements of JIT manufacturing - Introduction to lean and agile manufacturing..

Course Outcome:

- The student will have acquired ability to handle real production situations.
- The student will have acquired ability to resolve production cycle time related issues in manufacturing.
- The student will have acquired ability to design production lay out

References:

1. Thomas E. Vollmann, William L. Berry, D Clay Whybark, and F. Robert Jacobs, Manufacturing Planning and Control for Supply Chain Management, Mc Graw Hill Int. Ed., 2010.
2. Edward A. Silver, David F. Pyke and Rein Peterson, "Inventory Management and Production Planning and Scheduling", 3rd Ed., John Wiley & Sons, 1998.
3. S N Chary, Production and Operations Management, Tata McGraw-Hill, 2012
4. R Panneerselvam, Production and Operations Management, PHI Learning pvt Ltd., 2012
5. Francis, R.L. and White, J.A., Facility Layout and Location: An Analytical Approach Prentice-Hall Inc., New Jersey, 2010.
6. Apple, J.M., Plant Layout and Material Handling, Kreiger Publishing, 3rd Edition, 2005
7. Dale H Besterield, Total quality Management, Pearson Education, 3rd Edition, 2011
8. William J Stevenson, Operations management, Tata McGraw Hill, 2014.

COURSE PLAN

08ME6222 Production and Operations Management (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Manufacturing Planning and Control (MPC): MPC system framework, Type of configurations Forecasting framework: Time series analysis –Individual–Item, Short-term forecasting models - Forecast errors	6	15
MODULE: 2 Sales and operation planning: Nature of sales and operation planning, Relevant costs, Sales and operation planning methods. Master Production Schedule (MPS): Nature of MPS, MPS Techniques, Time fencing and MPS stability, Structuring BOM, Final assembly schedule, Managing MPS.	6	15
FIRST INTERNAL TEST		
MODULE: 3 Material Requirement Planning (MRP): Nature of MRP, MRP records, MRP logic, Technical issues, System dynamics, Lot sizing methods, Buffering concepts, System nervousness. Enterprise Resource Planning (ERP): ERP and functional units, Performance measures	7	15
MODULE: 4 Production activity control: Shop floor control concepts, Techniques, Performance measures, Gantt chart, Finite loading systems, Priority sequencing rules, General shop scheduling - Static, Deterministic shop - Dynamic, Probabilistic shop	7	15
SECOND INTERNAL TEST		
MODULE: 5 Computerized layout planning: Basic philosophy in computerized layout planning, Construction and improvement algorithms- ALDEP, CRAFT – Line balancing algorithms: COMSOAL, Moodie and Young method Quality systems – Basic concept of TQM and TPM, ISO 9001 Quality management systems – Elements, Procedures and quality audits.	8	20
MODULE: 6 Quality performance measures – Quality costs – Direct and indirect costs – Defectives and its significance – Traditional model and emerging model of cost of quality - Quality function deployment – Kaizen – Benchmarking – Taguchi's quality engineering –Lean principles — Elements of JIT manufacturing – Lot size reduction -Introduction to lean and agile manufacturing	8	20
END SEMESTER EXAM		

08ME6232 Design of Hydraulic and Pneumatic Systems

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To impart knowledge on components of hydraulic and pneumatic systems
- To impart knowledge on design and application of fluid power systems.

Syllabus:

Hydraulic power generators – Linear and rotary actuators – Pressure, Direction and flow control valves – Hydraulic circuits – Accumulator circuits – Design and selection of components – Safety and emergency mandrels – Pneumatic fundamentals – Logic circuits –Switching circuits – Comparative study of pneumatic and hydraulic systems – Installation, Maintenance and special circuits – Fault finding – Design of pneumatic systems –Compound circuit design – Combination circuit design.

Course Outcome:

The student will have acquired

- Capability to select hydraulic and pneumatic components for various fluid power applications
- Capability to design hydraulic and pneumatic components for specific fluid power applications

References:

1. John Pippenger, Tyler Hicks," Industrial Hydraulics", Mc Grow Hill Inc., 2005

2. Andrew Par, "Hydraulic and Pneumatics", (HB), Butterworth-Heinemann, 2011

3. Antony Espossito, "Fluid Power with Applications", Pearson India, 2014

4. Bolten W, "Pneumatic and Hydraulic System", Butterworth-Heinman, 2003

5. Dudleyt A, Peace and John J Pippenger, "Basic fluid Power", Prentice Hall 2010

COURSE PLAN

08ME6232 Design of Hydraulic and Pneumatic Systems (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Hydraulic power generators – Selection and specification of pumps, Pump characteristics, Hydraulic symbols- Linear and rotary actuators– Selection, Specification and characteristics– Pressure – Direction and flow control valve – Relief valve, Non return and safety valve –Actuation systems.	7	15
MODULE: 2 Hydraulic circuits- Reciprocation, Quick return, Sequencing, Synchronizing circuits – Accumulator circuits – Industrial circuits –Press circuits – Hydraulic milling machine – Grinding, Planning, Copying, Forklift and earth mover circuits	7	15
FIRST INTERNAL TEST		
MODULE: 3 Design and selection of components – Safety and emergency mandrels – Electro hydraulic circuits and cascade circuits in manufacturing.	6	15
MODULE: 4 Pneumatic fundamentals – Symbols - Control elements, Position and pressure sensing – Logic circuits – Switching circuits – Fringe conditions modules and their integration – Cascade method –Mapping methods - Step counter method– Comparative study of pneumatic and hydraulic systems.	8	15
SECOND INTERNAL TEST		
MODULE: 5 Installation, Maintenance and special circuits – Pneumatic equipments – Selection of components – Design /calculations – Application – Fault finding	7	20
MODULE: 6 Hydro pneumatic circuits – Pneumatic safety circuit – Pilot control circuits, Sequential circuits - Work piece holding circuits for production, Design of pneumatic control, Compound circuit design –Combination circuit design	7	20
END SEMESTER EXAM		

08ME7242 Machine Vision

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To study the problems associated with image acquisition, processing, and interpretation.
- To learn tools for solving vision problems in industry and various scientific disciplines.
- To impart knowledge in practical integration of machine vision systems in robotic applications.

Syllabus:

Image and imaging devices - Non perspective imaging models - Dyadic and spatial operations - Mathematical morphology - Image feature extraction - Stereo vision -Application perspective correction - Vision based control - OPENCV examples - Robot arm kinematics - Velocity relationship dynamics and control localization - Matlab examples -Application of machine vision in robotics - Advanced visual servoing - IBVS for spherical camera - ARM type robot , Mobile robot and ariel robot.

Course Outcome:

The student will have acquired

- An idea of advanced computer vision techniques used in industries.
- Ability to develop small sized machine vision projects using OPEN CV.
- The course will set a background for higher studies / Research in this area.

Text Books:

1. Peter Corke, Robotics: Vision and Control: Fundamental Algorithms in MATLAB, Springer, 2011
2. Herbert Freeman, Machine Vision (Perspectives in Computing), Academic Press, 2001

References:

1. Davis, E. R. Machine Vision: Theory, algorithms, practicalities (Signal Processing and it's applications), Morgan Kaufmann Pub., 3rd Revised Edition, 2005
2. Jain R. J., R. Kasturi and B. G. Schunck. Machine Vision, McGraw-Hill Inc, 1995.
3. Haralick R. M. and L. G. Shapiro, Computer and Robot Vision. Vol. 1 & 2, Addison-Wesley Publishing Company Inc., 2000

COURSE PLAN

08ME6242 Machine Vision (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Images and imaging devices: Light and colour absorption and reflection, Image formation, Perspective transform, Lens distortion and camera calibration, Non perspective imaging models, Unified Imaging. .	8	15
MODULE: 2 Image processing - Monadic, Dyadic and spatial operations, Mathematical morphology, Noise removal shape changing.	6	15
FIRST INTERNAL TEST		
MODULE: 3 Image feature extraction – Region line and point features using multiple images, Feature correspondence , Geometry of multiple view ,Stereo vision, Image rectification , Structure and motion.	6	15
MODULE: 4 Application perspective correction– Vision based control, Position based visual servoing, Camera and image motion, Depth mapping , OPENCV examples.	6	15
SECOND INTERNAL TEST		
MODULE: 5 Robot arm kinematics– Forward, inverse kinematics, Trajectories, Application, Simple walking robot – Velocity relationship -Dynamics and control localization –Matlab examples.	8	20
MODULE: 6 Application of machine vision in robotics – Advanced visual servoing – XY/Z partitioned image based visual servoing – Path planning – IBVS for spherical camera – Application –ARM type robot, Mobile and aerial robot.	8	20
END SEMESTER EXAM		

08ME6252 Micro and Nano Machining

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To impart knowledge on micro machining processes
- To impart knowledge on nano fabrication processes
- To provide knowledge metrological aspects of micro and nano manufacturing

Syllabus:

Introduction: Meso, micro and nano machining – Top down and bottom up approaches – Nanotechnology – Scale down approach for macro machining – Micro machining: Mask-based methods – Tool based micro-machining methods – Nano mechanical, Nano-physical and nano-chemical process – Nano-physical and chemical processing of atomic bits – Nano processing systems: Diamond turning, Nano-grinding, Precision polishing.

Course Outcome:

The student will have acquired

- Knowledge on micro and nano machining processes
- Capability to select suitable manufacturing process suited to specific applications

References:

1. J. Mc Geough, Micromachining of engineering materials, CRC press, 1st Edition, 2002
2. N. Taniguchi, Nanotechnology: Integrated processing systems for ultra-precision and ultra-fine products, Oxford University Press Inc, 1996
3. V. K. Jain, Introduction to micro machining, Narosa publishing house, 2014
4. Mark J Jackson, Micro and Nano manufacturing, Springer, 2nd Edition, 2008

COURSE PLAN

08ME6252 Micro and Nano Machining (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Introduction: Meso, micro and nano machining – Definition of micro-machining and nano-machining – Nanotechnology – Requirements of micro-machining systems – Scale down approach and bottom up approach for micro machining	6	15
MODULE: 2 Micro machining: Mask-based methods – Wet etching, Ion beam machining – LIGA – Laser beam machining – Plasma etching – Electroforming.	7	15
FIRST INTERNAL TEST		
MODULE: 3 Tool based micro-machining methods: Cutting - Grinding – Milling – Punching - Pressing – EDM - ECM - Laser beam machining -Electron beam machining - Ion beam machining.	8	15
MODULE: 4 Electrochemical, Nano-mechanical, Nano-physical and nano-chemical process – Benefits – Methods and mechanism of nano-mechanical processing of atomic clusters	7	15
SECOND INTERNAL TEST		
MODULE: 5 Size effect - Specific energy - Atomic bit processing – Nano-indentation – Nano-physical and chemical processing of atomic bits Electron and ion beam processing - Plasma surface processing	7	20
MODULE: 6 Principles of chemical and electro-chemical processing – Nano processing systems: Diamond turning – Nano-grinding – Precision polishing.	7	20
END SEMESTER EXAM		

08ME6262 Enterprise Resource Planning

Credits: 3-0-0: 3 **Year: 2015**

Pre-requisites: Basic programming skills and computer knowledge

Course Objectives:

- To provide awareness about the ERP concepts and the technologies that bridges gap between business associates and customers.
- To emphasize the fitting requirements of ERP packages in different industrial domains.
- To understand how companies have implemented ERP successfully.

To give the Student:-

- A foundation in the fundamentals of Enterprise Resource Planning;
- Design and implement the various ERP modules as per the requirements of the clients;
- An introduction to cloud ERP;

Syllabus

Evolution**,** fundamental concepts and an overview of Enterprise resource planning; Common myths and failure reasons of ERP implementation, Enabling technologies of ERP such as Business process reengineering, Supply chain management, Management Information systems, ESS, Data Warehousing, Data mining, OLAP, Customer and supplier relationship management etc. Module design of ERP; Data base management systems and data base models, Pre and post implementation methodologies related to ERP and problem analysis; Study of ERP providers and cloud ERP concept and client server architecture.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of enterprise resource planning. Apply the basic knowledge of the subject to design various modules as well as an integrated ERP system for an enterprise. The specific module includes materials module, Human resource module, financial modules etc, to name a few.

Text Books:

1. Rajesh Ray "Enterprise Resource Planning'', Tata McGraw Hill Education Private Limited, New Delhi.

References:

1. Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning-Concepts and Practice". PHI, 2006
2. David L. Olson, "Managerial issues of Enterprise Resource Planning systems" TMH Edition 2008.

COURSE PLAN

08ME6262 Enterprise Resource Planning (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Introduction of ERP: Concept of Enterprise, ERP Overview, Integrated information system, The role of Enterprise, Business Modelling, Myths about ERP, Basic ERP Concepts	7	15
MODULE: 2 Enabling Technologies, Conceptual Model of ERP, Structure of ERP, Intangible benefits of ERP, Justifying ERP investment, Risks of ERP, Benefits of ERP.	7	15
FIRST INTERNAL TEST		
MODULE: 3 ERP and related Technology: Business Process Reengineering (BPR), Management Information System(MIS), Data base Management System (DBMS), Decision Support Systems (DSS), Executive Support Systems (ESS), Data Warehousing and Data Mining, Online Analytical Processing (OLTP), Supply Chain Management(SCM), Customer Relationship Management (CRM).	7	15
MODULE: 4 Modules of ERP: Basic modules of ERP Package-Human Resources Management, Financial Management, Inventory Management, Quality Management, Sales and Distribution.	7	15
SECOND INTERNAL TEST		
MODULE: 5 ERP packages and Cases: ERP for manufacturing Industries, ERP for Service Industries. Performance measures for ERP, Cloud ERP.	7	20
MODULE: 6 ERP Implementation: ERP Implementation Strategies, ERP Implementation Life Cycle, Implementation Methodologies, ERP package selection, ERP Projects Teams, Vendors and Consultants, Reasons for failure and reasons for success of ERP implementation, Dealing with employee resistance, Training and Education, data migration, Project Management and monitoring, Post Implementation activities.	7	20
END SEMESTER EXAM		

08ME6208 Industrial Training

Credits: 0-0-4: 2 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To provides confidence, overall personality development to the students to get into a practical environment. It also provides an insight on how companies work and also useful information about the companies. Students get to know academic point of exposure about the practical aspects of the course.

Outline and evaluation procedure:

The students have to undergo an industrial training of minimum two weeks in an industry preferably dealing with production engineering / manufacturing engineering during second semester and complete within 15 calendar days at the end of second semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee.
The evaluation committee should consist of the Head of the department as the Chairman and two faculty members from the department as members. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.

Course Outcomes:

The graduate will capable of

- Knowing what is happening in a manufacturing industry, how their knowledge can be applied in an actual industry.
- Encouraging Industry-institutional Interaction at external level
- Improving the knowledge through technology talks and updates during training and preparing and submitting reports about the experience

08ME6208 Industrial Training (L-T-P : 0-0-4) CREDITS: 2	
A committee with the Head of the department as the Chairman and two faculty members from the department as members shall evaluate the quality and authenticity of contents of the report and ability to answer the questions put forward by the committee and award the marks at the end of the semester.	
Internal Continuous Assessment *(Maximum Marks-100)*	
Assessment Procedure	**Weightage (%)**
Report	40
Presentation	40
Answering ability	20

08ME 6210 Advanced Manufacturing Lab 2

Credits: 0-0-2: 2 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To acquaint with various machine tools and machining processes
- To acquire knowledge on various non- traditional machining processes
- To impart training on solid modeling
- To study robot and CMM applications

Exercises:

1. **Exercises on solid modeling:** Introduction to computer graphics - viewing transformations, curves and surfaces generation, curve fitting and curve fairing techniques - 2D, wire frame, 3D shading - familiarity with Boolean operations - sweep, revolve, loft, extrude, filleting, chamfer, splines etc. - windowing, view point, clipping, scaling and rotation transformations using commercial solid modeling packages

2. **Exercises on Programming of industrial robots:** Introduction to robotics - structure, workspace analysis and various components - actuators - sensors - encoders - end effectors - applications - hands on training on industrial robots - manual and programmed path planning

3. **Exercises on Computer aided inspection and quality control:** Introduction to CMM - classification - structure - components - familiarity with measurement software packages and its modules - demonstration of the capability of coordinate measuring machine using a sample component e.g. - engine block – concepts of reverse engineering and rapid prototyping technology

Course Outcomes:

- The graduate will have acquired hands on solid modeling, Robot programming, Computer aided inspection.

References:

1. Computer aided modeling Manual, CAD Center, Dept. of Mechanical Engineering, N.S.S. College of Engineering, Palakkad.

2. Mikell P. Groover et al, “Industrial Robots-Technology, Programming and Application”, McGraw Hill Publishing Company-2013.

08ME 6210 Advanced Manufacturing Lab 2 (L-T-P : 0-0-2) CREDITS: 2	
Internal Continuous Assessment (Maximum Marks-100)	
Assessment Procedure	**Weightage (%)**
Practical Records/outputs	40
Final Test (Experiments)	40
Final Viva-Voce	20

08ME7211 Neural Networks and Fuzzy Systems

Credits: 3-0-0: 3 **Year: 2015**

Pre-requisites: Nil

Course Objectives:

To give the Student:

The aim of this course is to provide students with an understanding of the fundamental theory of neural networks and fuzzy systems. The objective is intended for students to apply neural networks and fuzzy systems to model and solve complicated practical problems such as prediction pattern, recognition and artificial intelligence.

Syllabus

Model of a biological neuron, Different Type of Neuron models, Activations functions, Learning paradigms, Architecture of Perceptron, Backpropagation learning, Hopfield Network, Self-organizing Network, Fuzzy sets and operations, Fuzzy associative memories, Practical applications of fuzzy logic control and fuzzy pattern recognition.

Course Outcome:

On successfully complete this course, students should able to:

Explain the learning and adaptation capability of neural and fuzzy systems; Describe the learning and retrieval procedures of various neural networks; Apply the rules of fuzzy logic for fuzzy control; Implement neural networks and fuzzy systems to solve practical problems.

Reference Books:

1. S. Kumar, "Neural Networks: A Classroom Approach," McGraw Hill, 2005.
2. S. Haykin, "Neural Networks: A Comprehensive Foundation", 2nd Ed, Prentice-Hall, 1999
3. B. Kosko, "Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence", Prentice-Hall, 2005
4. J.M. Mendel, "Uncertain Rule-Based Fuzzy Logic Systems", Prentice-Hall, 2001.

COURSE PLAN

08ME7211 Neural Networks and Fuzzy Systems (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Characteristics of ANN and Fuzzy Systems; Biological Neuron; Artificial Neuron; Artificial Neural Networks; Phases in ANN Operation; Network Classification; Unsupervised Learning (Hebbian Learning, Competitive Learning & Boltzmann Learning); Supervised Learning (Error-Correction learning); Reinforcement Learning	7	15
MODULE: 2 Architecture of a Perceptron; Perceptron convergence algorithm; Generalized delta rule for weight adjustment, Theory of Backpropagation Training Algorithm; Rate of Learning, Training Considerations; Characteristics of BP Learning Algorithm; Limitations of BP Learning; Accelerated convergence of BP through learning-rate adaptation	7	15
FIRST INTERNAL TEST		
MODULE: 3 Basic Concepts; Hopfield Network; Operation Features of Hopfield Network; Error Performance of Hopfield Network; Storage Capacity of Hopfield Network	7	15
MODULE: 4 Computational Maps in the Cerebral Cortex; Modification of Stimulus by Lateral Feedback; Self-organizing Feature-Mapping Algorithm; Properties of SOM algorithms; Examples of Feature Maps; Applications	7	15
SECOND INTERNAL TEST		
MODULE: 5 Fuzziness versus Randomness; Geometry of Fuzzy Sets: Sets as Points; Fussy arithmetic, Linguistic variables, Fuzzy membership functions, Fuzzy entropy; Fuzzy subset hood theorem; Entropy subset hood theorem	7	20
MODULE: 6 Fuzzy Representation of Structured Knowledge; Fuzzy Associative Memories (FAM); Fuzzification; Fuzzy Association; Defuzzification; fuzzy pattern recognition, fuzzy logic controllers Example: Inverted Pendulum; Practical Examples	7	20
END SEMESTER EXAM		

08ME7221 Composite Materials

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To impart a general awareness about basic concept and Manufacturing of Composite materials

Syllabus:

Reinforcements, Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers Mechanical behavior of composites, Manufacturing of Metal Matrix Composites Manufacturing of ceramic matrix composites Manufacturing of Carbon – Carbon composites, Manufacturing of Polymer Matrix Composites, Strength-lamina failure criteria.

Course Outcome:

At the end of the course the students will understand

- The role of composite materials in Manufacturing
- Manufacturing of different composite materials
- Strength analysis of composite materials

References:

1. Hand Book of Composite Materials-ed-Lubin, Springer; 2nd Ed. (June 30, 1982)
2. K. K. Chawla, "Composite Materials", Springer (sie) (2006)
3. Deborah D. L. Chung, "Composite Materials Science and Applications", Springer; 2nd ed. 2010 edition (29 March 2010)
4. Danial Gay, Suong V. Hoa, and Stephen W. Tasi, "Composite Materials Design and Applications", CRC Press; 2 edition (April 25, 2007)

COURSE PLAN

08ME7221 Composite Materials (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement; Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance	7	15
MODULE: 2 REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements	7	15
FIRST INTERNAL TEST		
MODULE: 3 Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions. Laminate strength-ply discount truncated maximum strain criterion;	7	15
MODULE: 4 Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic presses. Properties and applications; Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications	7	15
SECOND INTERNAL TEST		
MODULE: 5 Manufacturing of Polymer Matrix Composites: Preparation of Molding compounds and prepregs –hand layup method – Autoclave method – Filament winding method – Compression molding –Reaction injection molding. Properties and applications.	6	20
MODULE: 6 Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; strength design using caplet plots; stress concentrations.	8	20
END SEMESTER EXAM		

08ME7231 Computational Fluid Dynamics and Applications

Credits: 3-0-0: 3 **Year:** 2015

Pre-requisites: Fundamental knowledge of fluid mechanics

Course Objectives:

To make the student understand

Various governing equations for fluid flow and use Computational fluid dynamics. Application of CFD in practical cases especially in manufacturing steps like melting, freezing of casting flows of cutting fluids and rheological fluids like plastics

Syllabus

Conservation laws of fluid motion and boundary conditions. Governing equations of fluid flow and heat transfer. Principles of discretization & fluid flow modelling- Classification of PDE. Finite volume method for convection diffusion problems. Solution of viscous incompressible flows by the stream function-vorticity formulation. SIMPLE, The solution of discretised equations. Finite volume method for unsteady flows. Implementation of boundary conditions- inlet and outlet boundary conditions. Case studies- Practical problems like use of commercial CFD packages for simulation of casting. Use of CFD in the manufacturing of rheological fluids-plastics

Course Outcome

Students successfully complete this course will be familiar with selection of various governing equations for fluid flows in engineering problems .They will be capable of modelling and solving a practical fluid flow problem by proper discretization They will be able to use finite volume method for convection diffusion problems. They get familiar with stream function-vorticity approach and SIMPLE algorithm. Get familiarised with selection of boundary conditions. Students will be able use commercial CFD packages for solving manufacturing problems like freezing of a casting and manufacture of plastic.

Text Books:

1. H. K Versteeg, An introduction to computational fluid dynamics, Longman Scientific
2. Muralidhar. K and Sundararajan. T, “Computational fluid flow and heat transfer”, Narosa publications, 2003

References:

1. Suhas V. Patankar, *Numerical heat transfer and fluid flow*, Butter-worth, 2010
2. John. D. Anderson, *Computational fluid dynamics*, Basics with applications, M Graw Hill.2005

COURSE PLAN

08ME7231 Computational Fluid Dynamics and Applications (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Conservation laws of fluid motion and boundary conditions. Governing equations of fluid flow and heat transfer. Mass conservation in three dimension. Momentum equation in three dimension. Energy equation in 3D. Equation of state. Navier stokes equation for a Newtonian fluid. Conservative form of the governing equations. Differential and integral form	7	15
MODULE: 2 Classification of fluid flow equation. Principles of discretization & fluid flow modelling-Classification of PDE-Elliptical, hyperbolic and parabolic equations. Finite difference method for solving PDE-explicit and implicit methods-error and stability analysis. Applications in heat conduction and convection.	7	15
FIRST INTERNAL TEST		
MODULE: 3 Finite volume method for convection diffusion problems- steady one dimensional convection and diffusion. The central difference scheme. Properties of discretization scheme. The upwind differencing scheme. The hybrid differencing scheme. Power law scheme. Quick scheme	7	15
MODULE: 4 Solution of viscous incompressible flows by the stream function-vorticity formulation. Solution of Navier-stokes equation for incompressible flows by SIMPLE algorithm. -The SIMPLER algorithm. The SIMPLEC algorithm. And PISO algorithm The solution of discretized equations. The tridiagonal matrix algorithm.	7	15
SECOND INTERNAL TEST		
MODULE: 5 Finite volume method for unsteady flows. One dimensional unsteady heat equations- explicit and implicit schemes.-Implicit method for 2d and 3d problems. Discretization of transient convection-diffusion equations. Solution procedure for Unsteady flow calculation	7	20
MODULE: 6 Implementation of boundary conditions- inlet and outlet boundary conditions- slip and no-slip boundary conditions – pressure boundary condition-symmetry periodic boundary conditions- Turbulence modelling-One equation model,k-ω and k-ε model. Case studies-Practical problems like use of commercial CFD packages for simulation of casting solidification and for cutting fluid mist formation. Use of CFD in the manufacturing of rheological fluids-plastics	7	20
END SEMESTER EXAM		

08ME7241 Group Technology and Cellular Manufacturing

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

To give the Student:-

- To emphasis the importance of group technology and cellular manufacturing systems and their significance & impact in manufacturing areas.

Syllabus:

Manufacturing systems; Classification of manufacturing systems; Group Technology; Classification; PFA analysis; Cellular Manufacturing; Types of machine cells; Applications of Group Technology; examples.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of Group Technology and Cellular Manufacturing with examples; understand the fundamental concept of Production Flow Analysis.

References:

1. Mikell P. Groover, “Automation, Production systems and Computer integrated manufacturing”, Prentice hall of India private limited., 2006
2. Ali Kamrani, Hamid R Parsaei, Donald H Liles, “Planning, Design and Analysis of cellular manufacturing system”, Elsevier, 2003
3. Manua Singh, “Systems approach to Computer Integrated Design and Manufacturing”, John Wiley & Sons Inc, 1996
4. Irani.S.A, “Cellular Manufacturing Systems”, Hand Book, Wiley-Interscience; 1 edition (April 15, 1999)
5. Kamrani, A.K, and Nasr, E.A. (Eds), "Collaborative Engineering: Theory and Practice Springer science, business media, 2008.

COURSE PLAN

08ME7241 Group Technology and Cellular Manufacturing (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Limitations of traditional manufacturing systems, Introduction to Group Technology, GT concepts, Advantages of GT, Part family formation –Part classification and coding systems. GT and Economics of GT.	6	15
MODULE: 2 Features of part classification and coding- examples- opitz-multiclass coding system, Benefits of GT and issues in GT. Design attributes, manufacturing attributes, characteristics and design of groups, PFA, FFA.	6	15
FIRST INTERNAL TEST		
MODULE: 3 Part machine group analysis, Methods for cell formation, Use of different algorithms, mathematical programming and graph theoretic model approach for part grouping.	8	15
MODULE: 4 Cellular Manufacturing- composite part concept- examples-machine cell design- types of machine cell and layout, Types of manufacturing cell, Design of cellular manufacturing systems, determination of best cell arrangement, key machine concept.	7	15
SECOND INTERNAL TEST		
MODULE: 5 Cell formation approach- Machine component group analysis, similarity coefficient based approach, exceptional parts and bottleneck machines, Problems in GT/CMS - Design of CMS - Models, traditional approaches and nontraditional approaches - Genetic Algorithms, Simulated Annealing, Neural networks.	8	20
MODULE: 6 Quantitative analysis in cellular manufacturing- arranging machines in GT cell- examples. Inter and Intra cell layout, cost and non-cost based models, batch sequencing and sizing, life cycle issues in GT/CMS. Measuring CMS performance - Parametric analysis - PBC in GT/CMS, Human aspects of GT/CMS.	7	20
END SEMESTER EXAM		

08ME7251 Mechatronics for Manufacturing Systems

Credits: 3-0-0: 3 **Year: 2015**

Pre-requisites: Fundamental knowledge of manufacturing processes and exposure to electrical and electronics engineering concepts

Course Objectives:

- To provide insight about Mechatronic system components
- To provide basic knowledge on embedded system concepts
- To develop capacity to design mechatronic system for specific applications

Syllabus:

Mechatronic system: Elements, levels of Mechatronic system – Mechatronics design process – Electronic devices for Mechatronics and functions: Signal conditioning – Micro processors and micro controllers: Programming and interfacing – Process controllers: Programmable logic controllers – Introduction to embedded systems – System interfacing and data acquisition – Design of Mechatronic systems & future trends – Hydraulic and pneumatic actuating systems: Fluid systems – Application – Robotics: Review on motion control system and components – Robot programming: Lead through programming.

Course Outcome:

- The graduate will develop the capability to design mechatronic systems for specific Applications

References:

1. Godfrey C. Onwubolu , Mechatronics – Principles and Application, Elsevier, 2006
2. Groover M. P., Industrial Robotics, Mc Graw Hill Education, 2005
3. Asada and Slotine , Robot Analysis and Intelligence , Wiley India pvt. Ltd., 2013
4. Mark W. Spong and M. Vidyasagar, Robot Dynamics & Control, John Wiley India Pvt. Ltd., 2008

COURSE PLAN

08ME7251 Mechatronics for Manufacturing Systems (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Mechatronic systems: Elements, Levels of Mechatronic system, Mechatronic design process, Measurement systems, Control systems, Microprocessor-based controllers – Sensors and transducers: Displacement, Position, Proximity, Velocity, Motion, Force, Acceleration, Torque, Fluid pressure, Liquid flow, Liquid level, Temperature and light sensors.	8	15
MODULE: 2 Electronic devices for Mechatronics and functions: Signal conditioning - Digital logic control- Micro processors and micro controllers: Programming and interfacing- Process controllers: Programmable logic controllers – Introduction to embedded systems:, Embedded system applications, Block diagram of embedded systems, Basic embedded system Models	8	15
FIRST INTERNAL TEST		
MODULE: 3 System interfacing and data acquisition: DAQS, SCADA, A to D and D to A conversions – Dynamic models and analogies, System response – Design of Mechatronic systems & future trends.	6	15
MODULE: 4 Hydraulic and pneumatic actuating systems: Fluid systems, Hydraulic and pneumatic systems - Components, Control valves, Electro-pneumatic, Hydro-pneumatic, Electro-hydraulic servo systems – Mechanical and electrical actuating systems.	7	15
SECOND INTERNAL TEST		
MODULE: 5 Application-Robotics: Review on motion control system and components - Motion analysis and control: Manipulator kinematics - Position representation - Transformations, Manipulator path control, Robot dynamics, Configuration of robot controller	7	20
MODULE: 6 Robot programming: Lead through programming – Robot programming as a path in space- Motion interpolation and commands - Branching capabilities and limitations – Textual robot Languages, Generation, Robot language structures – Elements in function.	6	20
END SEMESTER EXAM		

08ME7261 Design of Machine Tools

Credits: 3-0-0: 3 **Year: 2015**

Pre- requisites: Knowledge of metal cutting practices and various machine tools

Course Objectives:

- To make the students understand the concepts & broad principles of machine tool design, speed regulation, design of machine tool structure and dynamics of machine tools.

Syllabus:

Developments of machine tools - Types of machine tools surface - Features of construction and operations of basic machine tools - Tool wear - Force analysis – Machine tool drives - Devices for intermittent motion, Reversing and differential mechanisms - Couplings and clutches - Elements of hydraulic transmission system - Kinematics of machine tools - Regulation of speed and feed rates - Speed chart - Design of feed box - Step less regulation of speed and feed in machine tool - Design of machine tool structure: Design of bed, column and housing - Design of guide ways and power screws - Design of spindle & spindle supports – Layout of bearings, Selection of bearings in machine tools - Dynamics of machine tools - Chatters in machine tools - Control Systems - Basics of numerical controls -Machine tool testing.

Course Outcome:

- The graduate will have acquired knowledge of machine kinematics.
- The graduate will have developed capability to design machine tools for specific purposes.

References:

1. N.K. Mehta, Machine Tools Design & Numerical Controls, McGraw Hill Education (India) Private Limited, Third Edition, 2004.
2. S. K. Basu, Design of Machine Tools, Allied Publishers, 2006
3. A. Bhattacharya, G.C Sen, Principles of Machine Tools, New Central Book Agency, Second Edition, 2009

COURSE PLAN

08ME7261 Design of Machine Tools (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE: 1 Introduction: Developments of machine tools, Types of machine tools surface, Profiles and paths produced by machine tools – Features of construction and operations of basic machine tools – General requirement of machine tool design, Machine tool design processes – Tool wear, Force analysis.	6	15
MODULE: 2 Machine Tools Drives: Classification of machine tool drives, Selection of electric motor - Devices for intermittent motion, Reversing & differential mechanisms – Couplings and clutches - Elements of hydraulic transmission system – Kinematics of machine tools.	7	15
FIRST INTERNAL TEST		
MODULE: 3 Regulation of speed and feed rates: Laws of stepped regulation, Selection of range ratio, Standard progression ratio, Selection of best possible structural diagram - Speed chart - Design of feed box, Developing gearing diagrams – Step less regulation of speed and feed in machine tool - Speed and feed control.	8	15
MODULE: 4 Design of Machine Tool Structure: Requirements and design criteria for machine tool structures, Selection of material - Basic design procedure for machine tool structures, Design of bed, column and housing. Design of power screws - Basic guide way profiles -Designing guide way for stiffness and wear resistance – Hydrostatic and antifriction guide ways – Design of sliding friction power screws.	8	15
SECOND INTERNAL TEST		
MODULE: 5 Design of spindlier & spindle supports -Layout of bearings, Selection of bearings in machine tools. Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process, Closed loop system, Chatters in machine tools.	7	20
MODULE: 6 Control Systems: Functions, Requirements & types of machine tool controls, Controls for speed & feed change, Automatic and manual Controls, Basics of numerical controls – Machine tool testing.	6	20
END SEMESTER EXAM		

08ME7201 Seminar

Credits: 0-0-2: 2 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To improve debating capability of the student to present a technical topic.
- To improve communication and presentation skills of the student.

Outline and evaluation procedure:

Individual students are required to choose a topic of their interest, in consultation with any faculty member offering courses for the programme. The topic should be related to computer integrated manufacturing, preferably from outside the M. Tech syllabus. The topic should be based on a journal/conference publication within a span of last 3 years. The duration of the seminar should be limited to 30 minutes. A committee with the Head of the department as the Chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee. Each student shall submit two copies of a write up on the topic. One copy certified by the Chairman shall be returned to the student and the other will be kept in the departmental library.

Course Outcomes:

The graduate will have acquired

- Debating capability and presentation skills in a technical topic of his interest.
- Knowledge about contemporary issues and research opportunities
- Capacity to communicate effectively and professionally in both verbal and written forms
- Capability for self education and lifelong learning

08ME7201 Seminar (L-T-P : 0-0-2) CREDITS: 2	
A committee with the Head of the department as the Chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.	
Internal Continuous Assessment *(Maximum Marks-100)*	
Assessment Procedure	**Weightage (%)**
Report	30
Presentation	40
Answering ability	30

08ME7203 Project (Phase-I)

Credits: 0-0-12: 6 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes.
- The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Outline and evaluation procedure:

The student is required to undertake the project phase-I during the third semester and is continued in the 4th semester (Phase-II). The project work can be a design/experimental project and/or computer simulation project on a topic related to Computer Integrated Manufacturing. A project guide is allotted to each student based on the student's field of interest and the topic is finalised in consultation with the guide. The students shall be encouraged to do their project work in the parent institute itself. Provision is available to carry out the project in an industry/institute of repute. This is only possible in the fourth semester and the topic of investigation should be in line with the project part planned in the 3rd semester. Department will constitute an Evaluation Committee to review the project work with the Head of the department as the Chairman, guide and two faculty members from the department as members.

Phase-I consists of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review should highlight the topic, objectives, methodology and expected results. In the second review, progress of the work will be evaluated by the committee and marks will be awarded. A preliminary report consisting of the work completed and scope of the work for the 4th semester should be submitted to the Head of department.

Course Outcomes:

The graduate will have acquired

- Knowledge about contemporary issues and research opportunities
- Capacity to communicate effectively and professionally in both verbal and written forms
- Capability of self education and lifelong learning
- Understanding of professional and ethical responsibility.

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08ME7203 Project (Phase I) (L-T-P : 0-0-12) CREDITS: 6	
Internal Continuous Assessment (Maximum Marks-50)	
Project progress evaluation	Marks
Progress evaluation by guide	20
Presentation and evaluation by the committee	30

08ME7202 Project (Phase-II)

Credits: 0-0-21: 12 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

- To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes.
- The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Outline and evaluation procedure:

Project phase-II is a continuation of project phase-I started in the third semester. Before the end of the fourth semester, there will be two reviews, one at middle of the fourth semester and other towards the end to assess the progress of the work. The review will be conducted by the same committee constituted in the third semester. This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis.

Final evaluation of the project will be taken up only on completion of the project in the fourth semester. This shall be done by a committee constituted for the purpose by the principal of the college. The concerned head of the department shall be the chairman of this committee. It shall have two senior faculty members from the same department, project supervisor and the external supervisor, if any, of the student and an external expert either from an academic/R&D organization or from Industry as members. Final project grading shall take into account the progress evaluation done in the third semester and the project evaluation in the fourth semester.

If the quantum of work done by the candidate is found to be unsatisfactory, the committee may extend the duration of the project up to one more semester, giving reasons for this in writing to the student. Normally further extension will not be granted and there shall be no provision to register again for the project. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

Course Outcomes:

The graduate will have acquired

- Knowledge about contemporary issues and research opportunities
- Capacity to communicate effectively and professionally in both verbal and written forms
- Capability of self education and lifelong learning
- Understanding of professional and ethical responsibility.

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08ME7202 Project (Phase II) (L-T-P : 0-0-21) CREDITS: 12	
Project Evaluation	**Marks**
Internal Continuous Assessment (Maximum Marks-70)	
Progress evaluation by guide	30
Presentation and evaluation by the committee	40
End Semester Evaluation *(Maximum Marks-30)*	
Final evaluation of the project will be taken up only on completion of the project in the fourth semester. This shall be done by a committee constituted for the purpose by the principal of the college. The concerned head of the department shall be the chairman of this committee. It shall have two senior faculty members from the same department, project supervisor and the external supervisor, if any, of the student and an external expert either from an academic/R&D organization or from Industry as members.	