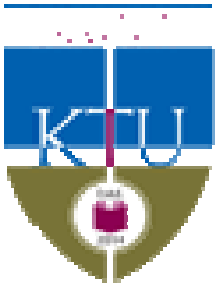
KERALA TECHNOLOGICAL UNIVERSITY



(THRISSUR CLUSTER - 07)

SCHEME AND SYLLABI

of

M. TECH.

in

PRODUCTION ENGINEERING

OFFERING DEPARTMENT

MECHANICAL ENGINEERING

CLUSTER LEVEL GRADUATE PROGRAMME COMMITTEE

1.	Dr Devdas Menon, Professor, IIT Madras, Chennai	Chairman
2	Principal, Government Engineering College Trichur, Thrissur	Convener
3	Principal, AXIS College of Engineering & Technology, East Kodaly, Murikkingal, Thrissur	Member
4	Principal, IES College of Engineering, Chittilappilly, Thrissur	Member
5	Principal, MET'S School of Engineering, Mala, Thrissur	Member
6	Principal, Royal College of Engineering & Technology, Akkikkavu, Thrissur	Member
7	Principal, Vidya Academy of Science & Technology, Thalakkottukara, Thrissur	Member
8	Principal, Thejus Engineering College, Vellarakkad, Erumappetty, Thrissur	Member
9	Principal, Universal Engineering College, Vallivattom, Konathakunnu, Thrissur	Member
10	Principal, Sahrdaya College of Engineering & Technology, Kodakara, Thrissur	Member

CERTIFICATE

This is to certify that

1. The scheme and syllabi are prepared in accordance with the regulation and guidelines issued by the KTU from time to time and also as per the decisions made in the CGPC meetings.
2. The suggestions/modifications suggested while presenting the scheme and syllabi before CGPC on 25.6.2015 have been incorporated.
3. There is no discrepancy among the soft copy in MS word format, PDF and hard copy of the syllabi submitted to the CGPC.
4. The document has been verified by all the constituent colleges.

Coordinator in charge of syllabus revision of the programme

Dr Manesh K. K.,
Associate Professor in Mechanical Engineering,
Govt. Engineering College Trichur, Thrissur

Principal of the lead college

Dr K. P. Indiradevi,
Principal,
Govt. Engineering College Trichur, Thrissur

Principals of the colleges in which the programme is offered

Name of the college	Principal's Name	Signature
Govt. Engineering College Trichur, Thrissur	Dr K. P. Indiradevi	

Date: 26/10/2015 Chairman
Place: Thrissur

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 life-long learning

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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

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SCHEME

CURRICULUM AND SCHEME OF EXAMINATIONS

M. Tech - PRODUCTION ENGINEERING,

Offered by

DEPT. OF MECHANICAL ENGINEERING

Semester - I

Exam. Slot	Course No.	Subject	Hours /Week			Internal Marks	End Semester Exam		Credits
			L	T	P		Marks	Duration	
A	07ME 6401	Computational Mathematics	3	1	0	40	60	3	4
B	07ME 6203	Advanced Welding and Casting	4	0	0	40	60	3	4
C	07ME 6205	Design of Machine Tools	3	1	0	40	60	3	4
D	07ME 6207	Production and Operations Management	3	0	0	40	60	3	3
E	07ME 62X1	Elective	3	0	0	40	60	3	3
	07GN 6101	Research Methodology	0	2	0	100	0	0	2
	07ME 6209	Production Engineering Lab	0	0	2	100	0	0	1
	07ME 6200	Introduction to Seminar	0	0	1	0	0	0	0
TOTAL			**16**	**4**	**3**				**21**

Semester - II

Exam Slot	Course No.	Subject	Hours /Week			Internal Marks	End Semester Exam		Credits
			L	T	P		Marks	Duration	
A	07ME 6202	Advanced Metal Forming	3	1	0	40	60	3	4
B	07ME 6204	Modern Manufacturing Processes	3	0	0	40	60	3	3
C	07ME 6206	Applied Materials Engineering	3	0	0	40	60	3	3
D	07ME 6XX2	Elective	3	0	0	40	60	3	3
E	07ME 6XX2	Elective	3	0	0	40	60	3	3
	07ME 6208	Seminar	0	0	2	100	0	0	2
	07ME 6214	Mini Project	0	0	4	100	0	0	2
	07ME 6216	Computational Lab	0	0	2	100	0	0	1
TOTAL			**15**	**1**	**8**				**21**

Semester -III

Exam Slot	Course No.	Subject	Hours /Week			Internal Marks	End Semester Exam		Credits
			L	T	P		Marks	Duration (hrs)	
A	07ME 72X1	Elective	3	0	0	40	60	3	3
B	07ME 72X1	Elective	3	0	0	40	60	3	3
	07ME 7201	Project (Phase-1)	0	0	12	50	0	0	6
	07ME 7203	Seminar	0	0	2	100	0	0	2
TOTAL			**6**	**0**	**14**				**14**

Semester - IV

Exam Slot	**Course No.**	**Subject**	**Hours /Week**			**Internal Marks**	**End Semester Exam**	**Credits**
			L	T	P			
	07ME 7202	Project (Phase-2)	0	0	21	70	30	12
TOTAL			**0**	**0**	**21**			**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: 21+21+14+12 = 68

LIST OF ELECTIVES OFFERED

Semester I

07ME 6211 Metrology and Computer Aided Inspection

07ME 6221 Design for Manufacturing and Assembly

07ME 6231 Precision Engineering

07ME 6241 CNC Machines and Control

Semester II

07ME 6212 Advanced Finite Element Analysis

07ME 6122 Computational Fluid Dynamics

07ME 6232 Advanced CAD

07ME 6242 Optimization techniques for Manufacturing Process

07ME 6252 Design of Hydraulic and Pneumatic systems

07ME 6262 Mechatronics for Manufacturing Systems

Semester III

07ME 7211 Soft Computing Methods

07ME 7221 Micro and Nano Machining

07ME 7231 Computational Materials Science

07ME 7241 Manufacturing Methods and Mechanics of Composites

07ME 7251 Plant Maintenance and Safety

07ME 7261 Machine Vision

Total number of Electives offered: 16

Syllabus & Course plan

07ME 6401 COMPUTATIONAL MATHEMATICS

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

Pre- requisites:

Nil

Course Objectives:

- To obtain insight into the mathematical concepts of computation
- To impart an idea of solving real life problems using computational methods

Syllabus:

Partial differential equations - Numerical solution: Euler and modified Euler methods, Runge-Kutta method- Power series solutions about ordinary point - Solution about singular points - Tensors - Symmetric and anti-symmetric tensors - Orthogonal tensor - Eigen values and Eigen vectors of a tensor - Tensor calculus - Application of finite difference methods – Discretization - Crank Nicolson scheme - Criteria for numerical stability - Finite volume method for 1-D steady state diffusion - Introduction to FEM - Computational procedures - Introduction to isoparametric elements - Matlab/Scilab tutorials to develop 1D FE codes.

Course Outcomes:

- The student will have obtained mathematical basis of computation which can be applied to Mechanical Engineering problems.

References:

1. Ervin Kreyszig, *Advanced Engineering Mathematics*, Wiley, Tenth Edition, 2010.
2. Steven Chapra, Raymond Canale, *Numerical Methods for Engineers*, McGraw-Hill Education, Seventh Edition, 2014.
3. H.K. Versteeg, W. Malalasekera, *An Introduction to Computational Fluid Dynamics*: *The Finite Volume Method*, Pearson Education, Second Edition, 2007
4. John D Anderson, *Computational Fluid Dynamics: The Basics with Application*, McGraw Hill Education (India) Private Limited, First Edition, 1995.
5. W Micheal Lai, David Rubin, Erhard Krempl, *Introduction to Continum Mechanics*, Elsevier Science, Fourth Edition, 2009.
6. P. Seshu, *Text book of Finite Element Analysis*, Prentice Hall of India, 2003.

07ME 6401 COMPUTATIONAL MATHEMATICS (L-T-P : 3-1-0) CREDITS: 4		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE: 1 First order PDE's – Linear equations – Lagrange method – Cauchy method - Charpit's method – Jacobi method. Second order PDE's – Classifications, Formulations and method of solutions of Wave equation, Heat equation, Laplace equation.	10	15
MODULE: 2 Numerical solution of ordinary differential equations: Taylor series method – Euler and modified Euler methods – Runge-Kutta methods – Solution of boundary value problems in ordinary differential equations – Finite difference methods for solving two dimensional Laplace's equation for a rectangular region.	8	15
FIRST INTERNAL TEST		
MODULE:3 Power series solutions about ordinary point – Legendre Equation – Legendre Polynomials – Solution about singular points – The method of Frobenius – Bessel equation - Bessel functions – Strum-Liouville problem – Generalized Fourier series.	8	15
MODULE: 4 Application of Finite Difference Methods, Discretization – Taylor series method – Central, Forward and Backward differencing – Estimation of truncation and discretization errors – Explicit, Implicit and semi-Implicit techniques – Crank Nicolson scheme – Criteria for numerical stability. Finite volume method for 1D steady state diffusion, FVM for 1D convection – diffusion problem.	10	15
SECOND INTERNAL TEST		
MODULE: 5 Tensors: Indicial notation – Kronecker Delta – Permutation symbol- Manipulation with indicial notation – Linear transformation – Symmetric and anti-symmetric tensors – Dyadic products of tensors – Orthogonal tensor – Eigen values and Eigen vectors of a tensor. Tensor calculus: Tensor valued function of a scalar, Vector field and gradient, Divergence of tensor field – Curl of vector field.	10	20
MODULE: 6 Introduction to FEM: Introduction – Finite element formulation techniques applied to 1D problems – Axially loaded bar and heat transfer problems. Computational procedures – Assembly of element matrices, Boundary conditions, Shape functions. Introduction to isoparametric elements, – Gaussian quadrature, Convergence, Symmetry, Sources of error. (Matlab/Scilab tutorials to develop 1D FE codes)	10	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

NOTE: *The end semester exam will consist of PART - A and PART - B which should be answered in separate answer books. PART - A consist of modules 1, 3 & 5 and PART - B consist of modules 2, 4 & 6.*

07ME 6203 ADVANCED CASTING AND JOINING

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

Pre- requisites:

Basic knowledge of welding, casting and Materials Science

Course Objectives:

- To understand the principles and operations of special and modern welding processes.
- To understand the advanced metal casting procedures and the defects on processes.
- To gain an understanding of solidification in welding and casting.

Syllabus:

Advanced Casting processes - Investment casting - Shell moulding - Squeeze casting - Vacuum casting - Counter-gravity flow pressure casting - Semisolid metal casting - Rheocasting - Centrifugal casting - Mechanism of solidification in metals and alloys - Design of gating systems - Ferrous and non-ferrous materials used in casting - CAE in casting - Advanced welding processes - Laser beam welding - Friction stir welding - Electron beam welding -Ultrasonic welding - Plasma arc welding - Welding of dissimilar metals - Advances in brazing and soldering - Weld joint inspection methods - Weld defects - Heat source models - Residual stresses and their measurement methods - Solidification of weld metal - CAE in welding.

Course Outcomes:

- The student will have obtained a good exposure to welding and casting process.
- The student will become aware of the solidification process associated with welding and casting.

References:

1. John Campbell , *Casting Practice,* Elsevier Science, 2004
2. Richard W Heine, Carl R Loper, Philip Rosenthal, *Principles of metal casting,* Tata McGraw Hill, second Edition, 2001
3. Merton C Flemmings, *Solidification Processing,* McGraw Hill.
4. Sindo Kou ,*Welding Metallurgy,* Wiley-Blackwell, Second Edition, 2002

07ME 6203 ADVANCED CASTING AND JOINING (L-T-P : 4-0-0) CREDITS: 4		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE: 1 Review of casting processes and related equipments: Investment casting- Shell moulding- Squeeze casting- Vacuum casting- Counter-gravity flow-Pressure casting.	10	15
MODULE: 2 Directional and monocrystal solidification - Semisolid metal casting- Rheocasting-Centrifugal casting. Mechanism of solidification in metals and alloys- Nucleation and grain growth- Dendritic growth- Influence of alloy composition on cast structures.	10	15
FIRST INTERNAL TEST		
MODULE: 3 Design of gating systems- Ferrous and non-ferrous materials used in casting- Experimental methods for study of microstructure in castings- Defects in castings- Inspection of castings. CAE in casting: Introduction to simulation tools in casting.	8	15
MODULE: 4 Review of welding processes- Process selection- Types of weld joint- Weldability– Laser Beam Welding: Types of lasers- Equipment- Power calculation- Applications- Dual laser beam welding- Use of fiber optics in LBW. Details and process characteristics of advanced welding methods: Friction stir welding- Electron beam welding-Ultrasonic welding- Plasma arc welding- Laser assisted cutting.	10	15
SECOND INTERNAL TEST		
MODULE: 5 Welding of dissimilar metals- Joining of ferrous and non-ferrous metals, Polymers- Advances in brazing and soldering. Weld joint inspection methods- Weld defects- Destructive and non-destructive testing of welds. Welding codes and practices.	8	20
MODULE: 6 Welding processes - Heat source models- Weld pool modelling and characteristics- Heat affected zone characteristics- Molten metal transfer in welding- Distortions- Residual stresses and their measurement methods. Solidification of weld metal - Distinct zones in a weld - Nucleation - Epitaxial growth - Competitive growth - Effect of weld pool shape on structure – Phase transformations. CAE in welding: Introduction to simulation tools in welding.	10	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 6205 DESIGN OF MACHINE TOOLS

Credits: 3-1-0: 4 **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 Outcomes:

- 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.
2. S. K. Basu, Design of Machine Tools, Allied Publishers.
3. A. Bhattacharya, G.C Sen, *Principles of Machine Tools*, New Central Book Agency, Second Edition, 2009

07ME 6205 DESIGN OF MACHINE TOOLS (L-T-P : 3-1-0) CREDITS: 4		
MODULES	**Contact hours**	**End 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.	8	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.	10	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.	10	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.	10	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.	10	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.	8	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 6207 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 Outcomes:

- 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 International Edition, 2010.
2. Edward A. Silver, David F. Pyke and Rein Peterson, *Inventory Management and Production Planning and Scheduling*, Third Edition, 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, 1998.
6. Apple, J.M., *Plant Layout and Material Handling*, Kreiger Publishing, 3rd Edition, 1991
7. Dale H Besterield, *Total quality Management*, Pearson Education, 3rd Edition, 2011
8. William J Stevenson, *Operations management*, Tata McGraw Hill, 2014.

07ME 6207 PRODUCTION AND OPERATIONS MANAGEMENT (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End 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 computerised 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		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07GN 6101 RESEARCH METHODOLOGY

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

Prerequisites: 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
- 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 method, Research design process.
Research Problem and Design - Formulation of research task, Literature review, 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.
Research proposals, Publications and ethics - Research proposals, Research paper writing, Considerations in publishing, Citation, Plagiarism and intellectual property rights.
Research methods – Modelling and Simulation, Mathematical modelling, Graphs, Heuristic optimization, Simulation modelling, Measurement design, Validity, Reliability, Scaling, Sample design, Data collection methods and data analysis.

Course Outcomes:

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:

- C. R. Kothari, Research Methodology, Methods and Techniques, New Age International Publishers
- K. N. Krishnaswamy, Appa Iyer Sivakumar, M. Mathirajan, Management Research Methodology, Integration of principles, Methods and Techniques, Pearson Education
- R. Panneerselvam, Research Methodology, PHI Learning
- Deepak Chawla, Meena Sondhi, Research Methodology–concepts & cases, Vikas Publication House
- J.W Bames, Statistical Analysis for Engineers and Scientists, McGraw Hill, N.York
- Schank Fr., Theories of Engineering Experiments, Tata Mc Graw Hill Publication.
- Wilkinson K. L, Bhandarkar P. L, Formulation of Hypothesis, Himalaya Publication.
- Fred M Kerlinger , Research Methodology
- Ranjit Kumar, Research Methodology – A step by step guide for beginners, Pearson Education
- John W Best, James V Kahan – Research in Education , PHI Learning
- Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co Ltd
- Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes
- Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
- Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
- Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
- Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
- Donald H.McBurney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047- 0,2006
- Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers..
- Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing
- Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
- Guidelines related to conference and journal publications

07GN 6101 RESEARCH METHODOLOGY (L-T-P : 0-2-0) CREDITS: 2		
Modules	**Contact hours**	**Int. 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 research.	5	10
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	10
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.	4	10
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	10
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	10

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	10
THIRD INTERNAL TEST		

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are three tests for the course (3 x 20 = 60 marks) and assignments (40 marks). The assignments can be in the form of seminar, group tasks, case studies, research work or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher.

07ME 6209 PRODUCTION ENGINEERING LABORATORY

Credits: 0-0-2: 1 **Year: 2015**

Pre- requisites:

Nil

Course Objectives:

- To acquaint with machine tools like copying lathe, Capstan lathe, surface grinding machine and cylindrical grinding machine.
- To acquire knowledge on various advanced welding process.
- To gather knowledge regarding NC and CNC machines.
- To impart training on copying lathe, CNC machine and TIG/MIG welding machine.
- To study metallurgical properties of welded joints.

Exercises:

1. Exercise on Copying lathe
2. Exercise on CNC machine
3. Exercise on cylindrical / surface grinding and tool grinding machines
4. Experiments on TIG welding, to find out the mechanical properties of metals
5. Experiments on MIG welding, to find out the mechanical properties of metals
6. Non-destructive tests on welded joints
7. Evaluations of tool face temperature using thermocouple
8. Roughness of machined surface- Influence of tool geometry and feed rate
9. Determination of cutting forces in turning using tool dynamometer

Course Outcomes:

The graduate will have acquired hands on experience on basic and advanced manufacturing processes.

References:

1. HMT, *Production Technology*, Tata McGraw Hill.
2. ASTME, *Tool Engineers Hand Book*.
3. Burghardt, Asilered, Anderson, *Machine Tool Operations I & II*, McGraw Hill.
4. W. A. J. Chapman, *Workshop Technology: Part 2*, CBS Publishers.
5. R. V. Rao, *Metal Cutting and Machine Tools*, S K Kataria & Sons
6. P.Radhakrishnan, *Computer Numerical Control and Computer Aided Manufacture*, New Age International Publishers, 2012.

07ME 6209 PRODUCTION ENGINEERING LABORATORY (L-T-P : 0-0-2) CREDITS: 1	
Internal Continuous Assessment *(Maximum Marks-100)*	
Assessment Procedure	**Weightage (%)**
Practical Records/outputs	40
Regular class Viva-Voce	20
Final Test (Objective)	40

07ME 6200 INTRODUCTION TO SEMINAR

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

Pre- requisites:

Nil

Course Objectives:

1. To improve the debating capability of the student to present a technical topic
2. To impart training to the student to face audience and present his ideas and thus creating self esteem and courage essential for an engineer

Outline:

Individual students are required to choose a topic of their interest and give a seminar on that topic for about 30 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar. The committee will provide feedback to the students about the scope for improvements in communication, presentation skills and body language. Each student shall submit one copy of a write up of the seminar topic.

Course Outcomes:

The graduate will have improved the debating capability and presentation skills in any topic of his choice.

07ME 6200 INTRODUCTION TO SEMINAR
(L-T-P : 0-0-1) CREDITS: 0

07ME 6202 ADVANCED METAL FORMING

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

Pre- requisites:

Knowledge of mechanics of solids and metal working processes

Course Objectives:

- To impart knowledge on various aspects of metal forming and to develop the skill to analyse various metal forming processes

Syllabus:

Theory of plasticity - Yield criteria - Von Mises, Tresca yield criteria -Fundamentals of metal forming - Modelling of metal forming processes: Slab analysis, Upper and lower bound techniques, Slip line field theory, Soft computing techniques, Numerical methods - Mechanics of metal working - Friction and lubrication. Review of metal forming processes: Forging, Rolling, Drawing and Extrusion - Forces and geometrical relationship - Analysis - Review of various sheet forming methods - Forming methods for advanced materials for aerospace and nuclear applications

Course Outcomes:

- The student will be capable of estimating loads and power requirements for specific metal forming processes.
- The student will be capable to model and simulate various metal forming processes.

Text Books:

1. Uday S. Dixit, R. Ganesh Narayanan, *Metal Forming: Technology and process modeling*, Tata McGraw Hill Education (India) Private Limited, First Edition.
2. Dieter G. E, *Mechanical Metallurgy*, Tata McGraw-Hill Co., Third Edition
3. Betzalel Avitzur, *Metal Forming - Processes and Analysis*, Kreiger Pub. Co., 1979

References:

1. CW. Rowe, *Introduction to the principles of Metal Working*, Edward Arnold, 1968
2. Kurt Lange, *Handbook of Metal Forming*, Society of Manufacturing Engineers, 1994.

07ME 6202 ADVANCED METAL FORMING (L-T-P : 3-1-0) CREDITS: 4		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE: 1 Introduction to theory of plasticity: State of stress – Principal stress and Mohr's circle representation in 3 dimensions – Constitutive equations – Flow curve – Yield criteria – Von Mises, Tresca yield criteria – Relationship between tensile and shear yield stresses – Two dimensional plastic flow.	8	15
MODULE: 2 Fundamentals of metal forming: Classification of forming processes – Mechanics of metal working – Flow stress determination – Effect of temperature, Strain rate and metallurgical factors in metal working – Friction and lubrication – Residual stresses.	10	15
FIRST INTERNAL TEST		
MODULE: 3 Modelling of metal forming processes – Slab analysis – Plane strain compression of solid billet, Axially symmetric compression of solid billet – Upper and lower bound techniques – Plane strain extrusion– Slip line field theory – Soft computing techniques -Numerical methods for working load estimation.	10	15
MODULE: 4 Forging: Review on forging process – Forging die design – Forging in plane strain – Calculation of forging loads – Forging defects – Causes and remedies – Residual stresses in forging. Rolling: Review on rolling processes – Forces and geometrical relationship in rolling – Analysis of rolling load – Torque and power – Rolling mill control – Rolling defects.	10	15
SECOND INTERNAL TEST		
MODULE: 5 Extrusion: Review on extrusion and drawing processes – Analysis of extrusion – Tube making and deep drawing – Analysis of drawing of round bars, Flat strips and thin walled tubes.	8	20
MODULE: 6 Sheet metal forming: Review on various sheet forming methods – Sheet metal formability – Formability limit criteria – Defects in formed parts –Forming methods for advanced materials for aerospace and nuclear applications.	10	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 6204 MODERN MANUFACTURING PROCESSES

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

Pre- requisites:

Fundamental knowledge on non-traditional machining practices

Course Objectives:

- To understand modern machining principles and the mechanics of non-traditional machining processes

Syllabus:

Mechanical Processes: Ultrasonic machining, Abrasive jet machining, Water jet machining - Electrochemical and chemical metal removal processes: Electrochemical machining, Electrochemical grinding - Thermal metal removal processes: Electric discharge machining (die Sinking and wire cut EDM), Laser beam machining, Plasma arc machining, Electron beam machining - High velocity forming processes: Explosive forming, Magnetic pulse forming processes - Process characteristics - Process capabilities - System design - Economic considerations - Additive manufacturing: Stereo lithography - Laminated object manufacturing, Selective laser sintering, FDM, SGC and 3D printing.

Course Outcomes:

- The student will be capable of selecting suitable machining process for specific application.

Text Books:

1. V. K. Jain, *Advanced Machining Processes*, Allied publishers Pvt.ltd, First Edition.
2. Mc Geough J. A., *Advanced Methods of Machining*, Springer, 2011
3. Chua C. K., Leong K. F., and Lim C. S., *Rapid prototyping: Principles and applications*, 4th edition, World Scientific Publishers, 2014.

References:

1. Benedict G.F, Marcel Dekker, *Non Traditional Manufacturing Processes*, Taylor & Francis, 1987
2. *Non-traditional machining processes*, Society of Manufacturing Engineers.
3. HMT, *Production Technology*, Tata Mc. Graw Hill, New Delhi.
4. ASTME, *High Velocity Forming of metals*, Prentice Hall of India.

07ME 6204 MODERN MANUFACTURING PROCESSES (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE: 1 Mechanical processes-I: Ultrasonic machining, Abrasive jet machining, Water jet machining – Review of the process principle - Process characteristics - Process capabilities - System design - Economic considerations	6	15
MODULE: 2 Mechanical processes-I: Electrochemical and chemical metal removal processes: Electrochemical machining - Electrochemical grinding - Process principle review- Process characteristics - Process capabilities - System design - Economic considerations	6	15
FIRST INTERNAL TEST		
MODULE: 3 Thermal metal removal processes-I: Electric Discharge Machining (EDM) - Laser beam machining: Review of the process principle - Process characteristics - Process capabilities - System design - Economic considerations.	8	15
MODULE: 4 Thermal metal removal processes-II: Plasma arc machining & Electron beam machining - Review of the process principle - Review process characteristics - Process capabilities - System design - Economic considerations	7	15
SECOND INTERNAL TEST		
MODULE: 5 High velocity forming processes: Explosive forming, & Magnetic pulse forming processes - Process review – Material behavior – Stress waves and deformation in solids – Stress wave induced fractures – Applications - Recent advancements	7	20
MODULE: 6 Additive manufacturing**:** Introduction – Classification – Principle, Advantages, Limitations and applications - Stereo lithography – Laminated object manufacturing – Selective laser sintering – FDM, SGC, 3D printing.	8	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15X2=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

07ME 6206 APPLIED MATERIALS ENGINEERING

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

Pre- requisites:

- Basic knowledge of Materials Science

Course Objectives:

- To provide knowledge in the areas of industrial metallurgy, chemical properties, heat treatment, advanced materials and selection of materials for important applications

Syllabus:

Plastic behaviour & strengthening - Yield stress - Shear strength of perfect and real crystals - Poly phase mixture - Super plasticity - Fracture behaviour - Toughening mechanisms - Ductile-brittle transition in steel - Larson-Miller parameter - Deformation and fracture mechanism maps - Fatigue tests - Fracture of non metallic materials - Failure analysis - Selection of materials for surface durability, Corrosion and wear resistance - Case studies in materials selection - Processing of engineering materials - Process induced defects - Monitoring and control - Modern materials and treatment - Nano materials - Testing of advanced materials.

Course Outcomes:

1. The student will gain insight into the concepts of behaviour of advanced materials.
2. The student will be capable to select suitable material for specific applications.

Text Books:

1. George E.Dieter, *Mechanical Metallurg*y, McGraw Hill, 3rd Edition, 2013.
2. *Materials Selection in Mechanical Design*, Michael F. Ashby, Butterworth-Heinemann, 4th Edition, 2011
3. William D. Callister, *Materials Science and Engineering: An Introduction*, David G. Rethwisch, 9th Edition, 2013

References:

1. James K.Wessel , *The Hand book of Advanced Materials: Enabling new designs*, John Wiley &Sons Inc., 2004.
2. Tadeusz Burakowski and Tadeusz Wierzchon, *Surface Engineering of Materials: Principles, Equipment, Technologies*, CRC Press, 1998.
3. Burakonsa & T.Wierzchan. Thoas h. Courtney, *Mechanical Behaviour of Materials*, McGraw Hill, Second Edition, 2000.
4. Flinn R.A. and Trojan ,P.K., *Engineering Materials and their Applications*, Jaico, 4th Edition, 1990
5. *Metals hand book: Failure Analysis and Prevention*, Vol 10, Tenth Edition.
6. Charles, J.A., Crane, F.A.A and Furness, J.A.G., *Selection and use of Engineering Materials*, Butterworth – Heinemann, Third Edition, 1997

07ME 6206 APPLIED MATERIALS ENGINEERING (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE: 1 Plastic behaviour & strengthening: Mechanism of Plastic deformation - Dislocations - Yield stress –Strengthening mechanism, Work hardening, Solid solutioning, Grain boundary strengthening, Poly phase mixture, Precipitation, Particle fibre and dispersion strengthening – Effect of temperature, Strain and strain rate on plastic behaviour – Super plasticity.	8	15
MODULE: 2 Fracture behaviour: Griffith's theory, Stress intensity factor and fracture toughness, Toughening mechanisms – Ductile, Brittle transition in steel, High temperature fracture, Creep – Larson-Miller parameter – Deformation and fracture mechanism maps.	7	15
FIRST INTERNAL TEST		
MODULE: 3 Fatigue – Low and high cycle fatigue test, Crack initiation and propagation mechanisms and Paris law – Effect of surface and metallurgical parameters on fatigue – Fracture of non metallic materials – Failure analysis, Sources of failure and procedure of failure analysis.	6	15
MODULE: 4 Selection of materials: Cost basis and service requirements – Selection for mechanical properties: Strength, Toughness, Fatigue and creep – Selection for surface durability: Corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with reference to aero, auto, marine and nuclear applications.	8	15
SECOND INTERNAL TEST		
MODULE: 5 Material processing: Processing of engineering materials – Primary and secondary processes – Castability, Weldability, Forgeability and malleability criteria – Process induced defects – Monitoring and control. Modern materials and treatment I: Dual phase steels, High strength low alloy (HSLA) - Steel transformation included plasticity (TRIP), Steel, Maraging steel.	6	20
MODULE: 6 Modern materials and treatment II: Shape memory alloys, Engineering plastics, Composites materials and advanced structural ceramics – WC, TiC, TaC, Al_2O_3, Sic, Si_3N_4, CBN diamond, Heat treatment of alloys and tool steels- Vapour deposition – Plasma, PVD – Thick and thin film deposition – Nano materials - Production of nano sized materials- Testing of advanced materials.	7	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 6208 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 production engineering, 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

07ME 6208 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

07ME 6214 MINI PROJECT

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

Pre- requisites:

Nil

Course Objectives:

- To practice the steps involved for the selection, execution, and reporting of the project

Outline and evaluation procedure:

Individual students are required to choose a topic of their interest in the field of production engineering. The subject content of the mini project shall be from emerging / thrust areas, topics of current relevance having research aspects. The choice of topic shall preferably be analytical in nature.

The final evaluation of mini project will be carried out by a committee with the Head of the department as the Chairman and two faculty members from the department as members. The students should bring the report duly authenticated by the respective guide. Students individually will present their work before the committee. The report complete in all respects should be submitted to the Head of the department.

Course Outcomes:

- The graduate will have acquired skills to select and execute projects.
- The graduate will have acquired technical report writing skills.

07ME 6214 MINI PROJECT (L-T-P : 0-0-4) CREDITS: 2	
Internal Continuous Assessment *(Maximum Marks-100)*	
The subject content of the mini project shall be from emerging / thrust areas, topics of current relevance having research aspects. The choice of topic shall preferably be analytical in nature. The final evaluation of mini project will be carried out by a committee with the Head of the department as the Chairman and two faculty members from the department as members.	
Assessment Procedure	**Weightage (%)**
Report	30
Relevance and Content of the project	40
Answering ability	30

07ME 6216 COMPUTATIONAL LABORATORY

Credits: 0-0-2: 1 **Year: 2015**

Pre- requisites: Nil

Course Objectives:

1. To acquire a better understanding of computation using numerical methods.
2. To obtain exposure to soft computing tools.

Syllabus:

FEA - Introduction to FEA software's:

- One dimensional problem using Matlab
- Two dimensional problem using FEA software
- Heat transfer problem using FEA software
- Coupled problems using FEA software
- Non linear problems using FEA software

CFD - Introduction to CFD software's:

- 2D simulation of internal and external flow
- 3D simulation of flow with heat transfer
- Simulation of natural convection problem

Soft Computing**:** Development of algorithms and computer programs using C /C++/Matlab for decision problems using soft computing techniques.

- Genetic Algorithm
- Simulated Annealing
- Tabu search
- Fuzzy logic
- Artificial Neural Network

Course Outcomes:

The graduate will have acquired knowledge on computational procedures to solve engineering problems.

References:

1. Saeed Moaveni, *Finite Element Analysis: Theory and application with ANSYS*, Pearson Education, 2011
2. W.Y.Yang, W.Cao, T. Chung and J. Morris, Applied Numerical Methods Using Matlab, Wiley, 2007
3. J.Tu, G.Yeoh and C. Liu, *Computational Fluid Dynamics: A Practical Approach*, Butterworth Heinemann, 2012
4. Deb, K, *Optimization for Engineering Design*, Prentice Hall of India (P) Ltd., New Delhi, 2004

07ME 6216 COMPUTATIONAL LABORATORY (L-T-P : 0-0-2) CREDITS: 1	
Internal Continuous Assessment *(Maximum Marks-100)*	
Assessment Procedure	**Weightage (%)**
Practical Records/outputs	40
Regular class Viva-Voce	20
Final Test (Objective)	40

07ME 7201 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 production engineering. 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.

07ME 7201 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

07ME 7203 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 production engineering, 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

07ME 7203 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

07ME 7202 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.

07ME 7202 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.	

ELECTIVES OFFERED

FOR SEMESTER I

07ME 6211 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 Outcomes:

- 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.

Reference Books:

1. *ASME - Hand book of Industrial Metrology*
2. D. J. Whitehouse, Handbook of Surface Metrology, CRC Press, 2nd Edition, 2010

07ME 6211 METROLOGY AND COMPUTER AIDED INSPECTION (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE:1 Metrological concepts - Errors in Dimension Measurement - Error Estimate - Standards and calibration procedures - Need for high precision measurements – Problems associated with high precision measurements	6	15
MODULE:2 Standards for length measurement – Slip gauges – Gauging principles, selective assembly – Light interference – Comparators - Angular measurements - Thread measurements	7	15
FIRST INTERNAL TEST		
MODULE:3 Various tolerances and specifications Surface and form metrology: Straightness - Flatness - Squareness – Roundness - Cylindricity – Roughness - Waviness	7	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 Micro and Nano metrology	9	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2
Tutorials/Assignments (In the form of seminar, group tasks, case studies, research work or in a suitable format as decided by the teacher.)		10

07ME 6221 DESIGN FOR MANUFACTURING AND ASSEMBLY

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

Pre- requisites:

Fundamental knowledge about manufacturing processes and design

Course Objectives:

- To enable the students to understand the aspects of design for various manufacturing and assembly processes

Syllabus:

Embodiment design: Steps – Basic rule – Principles – Guidelines – Tolerance analysis: Process capability – Mean – Variance – Skewness – Kurtosis – Review of relationship between attainable tolerance grades and different machining process – Selective assembly: Interchangeable post manufacture and selective assembly – Control of axial play – Introducing secondary machining operations – Datum Systems – True position theory**:** Comparison between co-ordinate and convention method of feature location– Tolerance charting technique: Preparation of process drawings for different operations - Design features to facilitate machining – Case Studies: Redesign to suit manufacture of typical assemblies.

Course Outcomes:

The graduate will have acquired

- Ability to understand the quality aspect of design for manufacture (DFM) and assembly.
- Ability to understand the method of DFM for product design and assembly.
- Ability to apply the concept of DFM for manufacturing and assembly.
- Ability to identify the design factors and processes as per customer specifications.
- Ability to apply the DFM method for a given product.

References:

1. Harry Peck, *Designing for Manufacture*", Pitman Publications, 1983.
2. James G Bralla, *Hand book of Product Design for Manufacturing*, McGraw Hill Publication, 1998.
3. A K Chitale and R C Gupta ,*Product Design and Manufacturing*, PHI, New Delhi, 2011.
4. George E Deiter, *Engineering Design*", Mc Graw Hill (India) Education Private Limited, 2013
5. Boothroyd G, Dewhurst P and Knight W, *Product Design for Manufacture and Assembly*, Marcell Dekker, 2010.
6. Poka – Yoke, *Improving Product Quality by Preventing Defects*, Productivity Press, 1992.

07ME 6221 DESIGN FOR MANUFACTURING AND ASSEMBLY (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE:1 Embodiment design: Steps – Basic rule – Principles – Guidelines – Design for ease of assembly – Design for standards – Design for maintenance – Recycling – Minimum risk – Evaluation – Design for minimum cost – DFMA approach and Processes – DFMA guidelines	6	15
MODULE:2 Tolerance analysis: Process capability – Mean – Variance – Skewness – Kurtosis – Metrics – Cp, Cpk cost aspects – Feature and geometric tolerances – Surface finish – Relationship between attainable tolerance grades and different machining process – Cumulative effect of tolerances – Sure fit law – Normal law and truncated normal law.	6	15
FIRST INTERNAL TEST		
MODULE:3 –Selective assembly: Interchangeable post manufacture – Total and group tolerances for hole – Total and group tolerances for shaft – Control of axial play – Introducing secondary machining operations - Laminated shims - Examples.	7	15
MODULE:4–Datum Systems: Degrees of freedom – Grouped datum systems –Types – With spigot and recess pair and tongue - Two and three mutually perpendicular grouped datum planes – Pin and hole – Slot pair computation of translational and rotational accuracy – Geometric analysis and applications.	8	15
SECOND INTERNAL TEST		
MODULE:5 True position theory**:** Comparison between co-ordinate and convention method of feature location – Tolerancing and true position tolerancing – Virtual size concept – Floating and fixed fasteners – Projected tolerance zone – Assembly with gasket – Zero true position tolerance –Functional gauges – Paper layout gauging – Compound assembly – Examples.	7	20
MODULE:6 Tolerance charting technique: Preparation of process drawings for different operations – Tolerance worksheets and centrality analysis -. Design features to facilitate machining; Datum features – Functional and manufacturing component design – Machining considerations- Redesign for manufacture – Case Studies: Redesign to suit manufacture of typical assemblies – Tolerance design of a typical drive system– Design of experiments: – Value analysis - Computer aided DFMA – Poka yoke principle.	8	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2
Tutorials/Assignments (In the form of seminar, group tasks, case studies, research work or in a suitable format as decided by the teacher.)		10

07ME 6231 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 Outcomes:

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

References:

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.

07ME 6231 PRECISION ENGINEERING (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End 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		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 6241 CNC MACHINES AND CONTROL

Credits: 3-0-0: 3 **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 - 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 Outcomes:

The student will have acquired

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

References:

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.

07ME 6241 CNC MACHINES AND CONTROL (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End.Sem. Exam Marks; %**
MODULE: 1 Introduction to CNC machines – Machining centres-Turning centres-CNC grinding – EDM – CNC gear cutting machines	6	15
MODULE: 2 Laser cutting and drilling machines – CNC routers – CNC inspection machines - Other CNC machines	7	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	7	15
MODULE: 4 Digital incremental displacement measuring systems – Incremental rotary encoders – Digital absolute measuring system – Electromagnetic analog position transducers	7	15
SECOND INTERNAL TEST		
MODULE: 5 Programmable machine control – PLC – CNC and PLC – Components of PLC – Architecture of PLC – Programming a PLC	8	20
MODULE: 6 Adaptive control systems – Adaptive control with optimization – Adaptive control with constraints – Variable gain adaptive control systems – Adaptive control of grinding	7	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

ELECTIVES OFFERED

FOR SEMESTER II

07ME 6212 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.

07ME 6212 ADVANCED FINITE ELEMENT ANALYSIS (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End.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		

Internal Continuous Assessment *(Maximum Marks: 40)*	
Assessment procedure:	**Marks**
Two internal tests	15x2=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

07ME 6122 COMPUTATIONAL FLUID DYNAMICS

Credits: 3–0–0: 3 **Year: 2015**

Pre- requisites:

A basic course on fluid mechanics/dynamics

Course Objectives:

- To impart knowledge on computational methods in fluid flow and heat transfer
- To provide exposure on discretization using FDM and FVM
- To give insights into the concepts of fluid flow modelling and simulation
- To provide an introduction to turbulence modelling

Syllabus:

Governing equations in fluid flow and heat transfer - Classification of physical behaviour - Discretization using finite difference method - Implicit and explicit techniques - Numerical stability and convergence - Finite volume method applied to steady state diffusion problems - Steady state convection with diffusion problems and unsteady diffusion problems - Implementation of boundary conditions, Turbulence modelling.

Course Outcomes:

- The Graduate will have developed the capability to apply computational fluid dynamics concepts to solve engineering problems in manufacturing.

References:

1. H.K. Versteeg and W Malalasekera, *An introduction to computational fluid dynamics,* Pearson Education Limited, Second Edition, 2007.
2. Suhas V. Patankar, *Numerical heat transfer and fluid flow,* Butter-worth Publishers, 1980.
3. John D. Anderson, *Computational fluid dynamics*, Basics with applications, Mc Graw Hill, 1995.
4. K. Muralidhar & T Sundararajan, *Computational Fluid Flow and Heat Transfer,* Narosa Publishing House ,1995
5. C.A.J.Fletcher, *Computational Technique for Fluid Dynamics*, Volume 1, Springer-Verlag, 1988
6. Klaus A Hoffmann, *Computational Fluid Dynamics for Engineer,* Engineering Education System, 1993

07ME 6122 COMPUTATIONAL FLUID DYNAMICS (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE:1 Conservation laws of fluid motion – Governing equations of fluid flow and heat transfer – Mass conservation – Momentum equation – Energy equation – Equation of state – Navier-Stokes equation for a Newtonian fluid – Conservative form of the governing equations – Classification of fluid flow equation.	7	15
MODULE:2 Turbulence models: Turbulent flow – Effect of turbulence on the time averaged Navier-Stokes equation– Characteristics of simple turbulent flows– Turbulent model– Mixing length turbulent model, k-ε model – Reynolds stress equation model – Algebraic stress equation model.	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, Other higher order schemes.	7	15
MODULE:4 Solution algorithm for pressure velocity coupling in steady flow – The SIMPLE algorithm – Staggered grid – Momentum equations – The SIMPLER algorithm –The SIMPLEC algorithm – The 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.	6	20
MODULE:6–Boundary Conditions (BCs) : Inlet and outlet BCs – Slip and no-slip BCs – Pressure BCs – Symmetry periodic BCs – Advanced topics and applications ,Combustion modelling: The simple chemical reacting system –Laminar flamelet model – Calculation of buoyant flows –The use of body filled co-ordinates in CFD –Advanced examples.	8	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2
Tutorials/Assignments (In the form of seminar, group tasks, case studies, research work or in a suitable format as decided by the teacher.)		10

07ME 6232 ADVANCED CAD

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

Pre- requisites:

Nil

Course Objectives:

- To gain knowledge on concepts of Computer Aided Design.

Syllabus:

Principles Of Computer Graphics - Bresenham's circle algorithm - Transformation in graphics - 2D and 3D transformation – Definition of CAD tools - CAD/CAM system evaluation criteria - Functional areas of CAD - Geometric modelling - Wire frame models - Parametric representation of synthetic curves hermite cubic splines - Bezier curves B-splines rational curves - Surface modelling: Parametric representation of surfaces - Tabulated cylinder - Parametric representation of synthetic surfaces - Surface manipulation - Intersection, Transformations (both 2D and 3D) - 3D geometric modelling - Constructive solid geometry (CSG) - CAD/CAM exchange - IGES data representations and structure - ACIS & DXF - Design applications - Finite element modelling - Mechanical assembly - Collaborative engineering.

Course Outcomes:

- The student will have acquired the knowhow of 3D geometric modelling concepts.

Text Books:

1. Ibrahim Zeid, R Sivasubramanian, *CAD/CAM Theory and Practice*, McGraw-Hill Education (India) Private Limited, Second Edition, 2009
2. P.N.Rao, *CAD/CAM Principles and Applications*, Mc Graw-Hill Education (India) Private Limited, Third Edition, 2010
3. Groover M.P., Zimmers E., *CAD/CAM* , Pearson Education, First Edition, 2003

References:

1. Ibrahim Zeid , *Mastering CAD/CAM*, Mc Graw Hill Education (India) Private Limited, Second Edition, 2006
2. P. Radhakrishnan and S. Subramanyam, *CAD / CAM / CIM*, New Age International Pvt. Ltd., 2009
3. Farid Amirouche, *Principles of Computer Aided Design and Manufacturing*, Prentice Hall India, Second Edition, 2004.
4. Warren S. Seames, *Computer Numerical Control Concepts and programming*, Delmar Cengage Learning, Fourth Edition, 2001.

07ME 6232 ADVANCED CAD (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE:1 Principles of computer graphics : Introduction - Graphic primitives - Point plotting - Lines - Bresenham's circle algorithm – Ellipse - Transformation in graphics - Co-ordinate systems - View port - 2D and 3D transformation - Hidden surface removal – Reflection - Shading and generation of characters.	7	15
MODULE:2 CAD tools: Definition of CAD tools - Types of system - CAD/CAM system evaluation criteria - Brief treatment of input and output devices - Graphics standard - Functional areas of CAD - Modeling and viewing - Software documentation - Efficient use of CAD software.	6	15
FIRST INTERNAL TEST		
MODULE:3 Geometric modelling: Types of mathematical representation of curves - Wire frame models - Wire frame entities - Parametric representation of synthetic curves hermite cubic splines - Bezier curves B - Splines rational curves. Surface modelling: Mathematical representation surfaces - Surface models – Surface entities - Surface representation - Parametric representation of surfaces - Plane surface - Rule surface - Surface of revolution - Tabulated cylinder	8	15
MODULE:4 Parametric representation of synthetic surfaces: Hermite - Bicubic surface - Bezier surface – B-Spline surface - COONs surface, Blending surface - Sculptured surface - Surface manipulation - Displaying – Segmentation – Trimming - Intersection, Transformations (both 2D and 3D).	7	15
SECOND INTERNAL TEST		
MODULE:5 Geometric modelling-3D: Solid modelling - Solid representation - Boundary representation (13-rep) - Constructive Solid Geometry (CSG). CAD/CAM exchange: Evaluation of data - Exchange format - IGES data representations and structure - STEP architecture – Implementation - ACIS & DXF.	7	20
MODULE:6 Design applications: Mechanical tolerances - Mass property calculations - Finite element modeling and analysis - Mechanical Assembly– Collaborative engineering: Collaborative design – Principles – Approaches – Tools – Design -Systems.	7	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 6242 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 - Network models and solutions - 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 - Complexity of algorithms.

Course Outcomes:

- 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

07ME 6242 OPTIMIZATION TECHNIQUES FOR MANUFACTURING PROCESS (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End 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. Network models and solutions: Shortest route problems, Minimal spanning tree problems, Maximal flow problems.	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		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 6252 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 Outcomes:

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, 1997
5. Dudleyt A, Peace and John J Pippenger, *Basic fluid Power*, Prentice Hall 1987

07ME 6252 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End 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		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 6262 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 Outcomes:

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

Text Books:

1. W Bolton, *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, Pearson Education Press, 2011.
2. Devdas Shetty, Richard Thomson, *Mechatronics System Design*, Thomson-Engineering, Second Edition, 2010

References:

1. Godfrey C. Onwubolu , *Mechatronics – Principles and Application*, Elsevier, 2006
2. Groover M P, *Industrial Robotics*, Mc Graw Hill Education, 1987
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

07ME 6262 MECHATRONICS FOR MANUFACTURING SYSTEMS (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End 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		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

ELECTIVES OFFERED

FOR SEMESTER III

07ME 7211 SOFT COMPUTING METHODS

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

Pre- requisites:

Nil

Course Objectives:

- To understand the established soft computing techniques such as Genetic algorithm, Simulated annealing, Tabu search, Fuzzy logic, and Artificial neural networks and practical applications of these techniques.

Syllabus:

Introduction to Genetic Algorithms (GA) - Differences and similarities between GA and traditional methods - Terminology of GA - Simulated Annealing: Simulated annealing acceptance function – Applications - Tabu Search: Comparison with genetic algorithm and simulated annealing- Applications - Fuzzy Logic: Major components of a fuzzy logic system - Applications of fuzzy logic - Artificial Neural Networks**:** Basics of artificial neural networks (ANN) – Terminology - ANNs learning approaches - Applications of ANN in optimization - Simple examples.

Course Outcomes:

- The student will gain insight into various soft computing techniques that can be applied to production processes.

Text Books:

1. Deb K., *Optimization for Engineering Design,* Prentice Hall of India (P) Ltd., 2nd Edition, 2012
2. Goldberg, D.E., *Genetic Algorithms in Search, Optimization, and Machine Learning,* Pearson Education, 2002
3. Schalkoff , R.J., *Artificial Neural Networks,* McGraw-Hill Education Pvt. Ltd., 2011
4. Sundareswaran, K., *A Learner's Guide to Fuzzy Logic Systems,* Jaico Publishing House, 2005
5. Yegnanarayanan, B., *Artificial Neural Networks,* Prentice Hall of India, 1999

07ME 7211 SOFT COMPUTING METHODS (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE:1 Genetic Algorithms (GA)**:** Introduction to GA – Goals of optimization – Differences and similarities between GA and traditional methods – Schemata – Terminology of GA – Strings, Structure, Parameter set – Coding – Fitness function – Data structures – GA operators – Algorithm.	8	15
MODULE:2 Simulated annealing: Introduction – Analogy with thermodynamics- Algorithm – Evaluation- Simulated annealing acceptance function - The probability of acceptance - Applications.	7	15
FIRST INTERNAL TEST		
MODULE:3 Tabu Search: Introduction - Algorithm – Comparison with GA and simulated annealing- Applications	6	15
MODULE:4 Fuzzy logic**:** The concept of uncertainty and associated solutions – Fuzzy sets – Basic properties and characteristics of fuzzy sets – Fuzzy set operations – Fuzzy reasoning – Major components of a fuzzy logic system – Design aspects of fuzzy systems – Applications of fuzzy logic.	7	15
SECOND INTERNAL TEST		
MODULE:5 Artificial Neural Networks (ANN)**:** Basics of ANN – Characteristics of ANN – Historical development – Terminology - Models of neuron – Topology – Basic learning laws	6	20
MODULE:6 – Overview of neural computing – Neural approaches to computing – Engineering approaches to computing – Relationship of ANNs to other technologies - ANNs learning Approaches – Training set and test set - Generalization - Learning curves -Applications of ANN in optimization - Simple examples.	8	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 7221 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 Outcomes:

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

07ME 7221 MICRO AND NANO MACHINING (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End 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		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 7231 COMPUTATIONAL MATERIALS SCIENCE

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

Pre- requisites:

Nil

Course Objectives:

- To introduce important materials science simulation methods to students.
- To familiarise tools like molecular dynamics, density functional theory, and Monte Carlo methods.

Syllabus:

Structures – Understanding of material properties in crystal structures, Non-crystalline solids and liquids - Calculation of the energy of a system of atoms - Pair potentials – Deficiencies of pair potentials - Many body central force potentials for metallic materials – Molecular statics: Minimization of the energy – Molecular Dynamics (MD) – Monte Carlo: Brief overview of necessary statistical mechanics and equilibrium thermodynamics.

Course Outcomes:

- The graduate will demonstrate a sound understanding of computational methods in Materials Science such as Monte Carlo methods and molecular dynamics (MD) theory.
- The course will set a background for higher studies / research in this area.

Text Books:

1. D. C. Rapaport, *The Art of Molecular Dynamics Simulation*, Cambridge University Press, Second Edition, 2011
2. Daan Frenkel and Berend Smit, *Understanding Molecular Simulations: From Algorithms to Applications (Computational Science),* Academic Press, Second Edition.
3. M. E. J. Newman and G. T. Barkema,*Monte Carlo Methods in Statistical Physics*, Clarendon Press, 1999.

References:

1. J.P. Hansen and I. R. Mc Donald, *Theory of simple liquids*, Academic Press, 2006.
2. M. P. Allen and D. J. Tildesley, *Computer Simulation of Liquids*, Clarendon Press, 1987.
3. A.P. Sutton, *Electronic Structure of Materials*, Clarendon Press, 1994.

07ME 7231 COMPUTATIONAL MATERIALS SCIENCE (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE: 1 Structures – Review on crystalline and non-crystalline materials – Atomic clusters and nano-structures – Lattice defects, Surfaces, Interfaces – Nano-crystals – Electron microscopy, Scanning tunneling microscopy – Atomic force microscopy - Lattice vibrations –Phase transformations - Bulk, Surface and interfacial diffusion – Deformation and fracture Catalysis.	6	15
MODULE: 2– Calculation of the energy of a system of atoms - Pair potentials – Deficiencies of pair potentials - Many body central force potentials for metallic materials – Embedded atom method – Potentials for covalent solids – Semiconductors – Basics of the density functional theory.	6	15
FIRST INTERNAL TEST		
MODULE: 3 General aspects of atomistic computer modelling– Boundary conditions: Periodic and semi-periodic – Energy of a system of particles – Equations of motion and equilibrium conditions – Concept of stress and its evaluation in systems of particles – Radial distribution function – Voronoi polyhedra atomic level stresses.	7	15
MODULE: 4 Molecular statics: Minimization of the energy –Steepest descent– Conjugate gradient – Molecular Dynamics (MD): Verlet algorithm, Predictor-corrector algorithm – Constant volume and constant pressure simulations - Basic concepts of statistical physics - Physical interpretation of MD using statistical physics: – Fluctuations - Correlations -Autocorrelations.	8	15
SECOND INTERNAL TEST		
MODULE: 5 Monte Carlo: Brief overview of necessary statistical mechanics and equilibrium thermodynamics, Metropolis method, Canonical ensemble: Constant volume, Temperature, Number of particles, Grand canonical ensemble: Constant volume, Temperature, Variable number of particles	7	20
MODULE: 6 Isothermal-isobaric canonical ensemble: Constant pressure, Temperature, Number of particles – Modified grand canonical ensemble: Study of segregation and order/disorder, Kinetic Monte Carlo diffusion in crystalline materials, Lattice dynamics, Lattice vibration-Phonons Link with thermo dynamical properties of materials	8	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 7241 MANUFACTURING METHODS AND MECHANICS OF COMPOSITES

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

Pre- requisites:

Nil

Course Objectives:

- The objective for this course is to develop an understanding of the linear elastic analysis of composite materials. This understanding will include concepts such as anisotropic material behaviour and the analysis of laminated plates.
- The students will undertake a design project involving application of fibre reinforced laminates.

Syllabus:

Composite materials - Classification - Raw materials - Properties - Lamina Constitutive Equations – Manufacturing processes - Processing conditions - Metal matrix composites - Ceramic matrix composites - Nano composite processes - Flat plate laminate constitutive equations - Evaluation of lamina properties from laminate tests - Determination of lamina stresses within laminates - Lamina strength analysis - Failure mechanisms and failure Criterions - Modification of laminate constitutive equations - Analysis of laminated flat plates - Free vibrations - Environmental degradation of composites.

Course Outcomes:

Students who successfully complete the course will demonstrate the following outcomes:

- An ability to identify the properties of fibre and matrix materials used in commercial composites, as well as some common manufacturing techniques.
- An ability to predict the elastic properties of both long and short fibre composites based on the constituent properties.
- An ability to predict the failure strength of a laminated composite plate.

Text Books:

1. Gibson, R.F., *Principles of Composite Material Mechanics*, McGraw-Hill, 2/E
2. Mukhopadhyay.M, " Mechanics of Composite Materials and Structures", University Press, India, 2004
3. Daniel and Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press, 2005

References:

1. *Bharath Bhusan, Springer Handbook of Nanotechnology, 3rd edition, Springer-Verlag (2009)*
2. Mechanics *of Composite Materials (Materials Science & Engineering Series),* CRC Press, Second Edition, 2015.

07ME 7241 MANUFACTURING METHODS AND MECHANICS OF COMPOSITES (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE: 1 Composite materials: Definition –Need – General characteristics Matrices: Thermoplastics-Raw materials, Thermosets, Unsaturated polyester resin, Alkyd resin, Vinyl ester, Polyamides', Metal and ceramic matrix composites, Nanocomposites *Reinforcements:* Types, Properties, Uses of silica, Titanium dioxide, Talc, Mica, etc., Flake, Fibres -Structure, Property and applications of various types of fibres, Coupling agents, Repairs and maintenance, Composite joints. Application of Composites - Aerospace, Transport, Marine, Structural, Chemical, Sports, Electrical, Electronic, Communication, Biomedical applications	7	15
MODULE: 2 *Processing* : Thermoplastic, Thermosets, etc., Types of methods, Processing conditions advantages and disadvantages, Film forming, Lamination, Sandwich, etc., Hand layup methods, compression and transfer molding, Pressure and vacuum bag process, Filament winding, Spin coating, Pultrusion, Injection molding of thermosets, Reinforced RIM (reaction IM), SMC (sheet moulding) and DMC (dough moulding).	6	15
FIRST INTERNAL TEST		
MODULE: 3–Liquid and solid state and in-situ processes for metal matrix composite, Ceramic matrix composite & nano composite processes - Mechanical Properties	6	15
MODULE:4–Evaluations of lamina properties from laminate tests – Quasi-isotropic laminates. Determination of lamina stresses within laminates, Lamina strength analysis: Introduction – Maximum stress and strain criteria – Von-Misses yield criterion for isotropic materials	7	15
SECOND INTERNAL TEST		
MODULE: 5 Generalized Hill's criterion for anisotropic materials – Tsai-Hill's failure criterion - Tensor polynomial (Tsai-Wu) failure criterion – First ply failure theory, Mesoscale composite damage theory based on continuum damage mechanics - Prediction of laminate Failure - Environmental degradation of composites	8	20
MODULE: 6 Orthotropic lamina.–Unidirectional off-axis, Symmetric balanced laminates, Thermally quasi-isotropic laminates. Analysis of laminated flat plates - Energy formulations - Static bending analysis - Buckling analysis, Free vibrations – Natural frequencies.	8	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 7251 PLANT MAINTENANCE & SAFETY

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

Pre- requisites:

Nil

Course Objectives:

- To understand types of maintenance, concepts of various corrosions, failure data analysis and the concept of safety and measurement of safety performance.

Syllabus:

Types of maintenance - Vibration monitoring and analysis - Condition monitoring of rolling element bearing - Basic concepts of corrosion - Corrosion monitoring techniques - Corrosion Prevention Industrial Lubrication - Reliability, Availability, Maintainability - Failure data analysis - MTTF, MTTR, Fault tree analysis, FMEA, FMECA - Reliability estimation - Introduction to the concept of safety - Hazards, Types of industrial hazards - Logics of consequence analysis - Emergency planning and preparedness.

Course Outcomes:

The graduate will have acquired knowledge on failure data analysis and interpretation, condition monitoring techniques and safety practices that follows in industries

References:

1. Collacott, Ralph A., *Mechanical Fault Diagnosis and Condition Monitoring*, Springer, 2011
2. Mars Guy Fontana, *Corrosion Engineering*, McGraw-Hill, Third Edition, 2005
3. L. S. Srinath, *Reliability Engineering,* Affiliated East West Press, 2005
4. Ian T. Cameron & Raghu Raman, *Process Systems Risk Management*, ELSEVIER Academic press, 2005

07ME 7251 PLANT MAINTENANCE & SAFETY (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End Sem. Exam Marks; %**
MODULE: 1 Types of Maintenance – Break down, Routine, Planned, Preventive, Diagnostic maintenance. Condition monitoring – Principles and methods. Contaminant monitoring, Spectral oil analysis procedure, Ferrography.	7	15
MODULE: 2 Vibration monitoring and analysis – Transducer selection, Frequency analysis. Condition monitoring of rolling element bearing.	7	15
FIRST INTERNAL TEST		
MODULE: 3 Basic concepts of corrosion, Forms of corrosion, Corrosion testing, Corrosion monitoring techniques, Corrosion prevention. Industrial lubrication, Selection of lubricant, Lubrication systems.	7	15
MODULE: 4 Reliability, Availability, Maintainability. Failure data analysis. MTTF, MTTR, Fault tree analysis, FMEA, FMECA, Reliability estimation.	8	15
SECOND INTERNAL TEST		
MODULE: 5 Introduction to the concept of safety – Need – Safety provisions in the factory act – Laws related to the industrial safety – Measurement of safety performance, Safety audit, Work permit system, Injury and accidents	6	20
MODULE: 6 Hazards, types of industrial hazards – Nature, Causes and control measures, Threshold limit values, Logics of consequence analysis – Estimation – Toxic release and fire hazard, Emergency planning and preparedness.	7	20
END SEMESTER EXAM		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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

07ME 7261 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 Outcomes:

- Get 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, 1988

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., 1992.

07ME 7261 MACHINE VISION (L-T-P : 3-0-0) CREDITS: 3		
MODULES	**Contact hours**	**End 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		
Internal Continuous Assessment *(Maximum Marks: 40)*		
Assessment procedure:		**Marks**
Two internal tests		15x2=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