COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

DEPARTMENT OF MANUFACTURING ENGINEERING AND INDUSTRIAL MANAGEMENT

NEP CURRICULUM STRUCTURE

M.Tech. Production (Manufacturing Engineering and Automation)

(Effective From AY 2023-2024)

COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

NEP 2020 Compliant

Proposed Curriculum Structure

M. Tech. (Production Engineering)
Specialization: Manufacturing Engineering & Automation)

(Effective from: A.Y. 2023-24)

Department of Manufacturing Engineering and Industrial Management

VISION

To be recognized as an innovative and distinguished center, a preferred provider of Production Engineering students with interdisciplinary education, nurturing research & development and entrepreneur skills among students.

MISSION

- ✓ To create, develop and foster capacity amongst students to become future leaders in academia, government, industries and entrepreneurial pursuit through a rigorous curriculum of theory and application that advances their ability to solve problems individually and in teams.
- ✓ To keep abreast with latest developments in academics/industry and continuously upgrade the skill sets of all involved while creating deep awareness of ethical responsibilities and human values.
- ✓ To create knowledge of fundamental principles and innovative technologies through learning, teaching and research in multi-disciplinary domains, focusing on project management, manufacturing, automation and mechatronics.
- ✓ To provide career guidance for higher education and to facilitate academics - industry interaction.
- ✓ To strengthen global collaborations and inculcate research aptitude amongst students and faculty.

GOALS

- ✓ Development of state of art laboratories and introduction of more elective(s)/courses to cater the need of industrial interdisciplinary research.
- ✓ To have 100% faculty with PhD degree and research potential.
- ✓ To increase number of publications with an average of 1.5 SCI journals per faculty per year.
- ✓ To increase research funding and number of projects by 25%.
- ✓ To encourage the students for research, higher studies and start-ups by 10%.
- ✓ To have international collaboration with reputed foreign universities and to encourage faculty exchange between them.
- ✓ To increase the number of workshops and conferences organized by department by 50%.
- ✓ To increase number of patents filed by faculty and students to the extent of 2 patent per year in the department.
- ✓ To have atleast 90% placements for UG and PG students.
- ✓ To establish a center of excellence in the domain of Design and Innovation.

Program Education Objectives (PEOs):

PEO1 *Core Competence*: Advance professionally as a result of his/her ability to solve complex technical problems and to work in multidisciplinary teams on problems whose solutions lead to significant societal benefits.
PEO2 Depth *(Research culture)*: Demonstrate professional engineering competence and able to apply principles of manufacturing and time and quality management in the design and manufacture of products and services.
PEO3 Professionalism*:* Make scholarly contributions to knowledge as demonstrated by publishing papers and/or technical reports, applying for patents, delivering effective conference presentations, and/or contributing to innovative leadership articles, advance professionally and/or pursue higher education and /or turn entrepreneur.
PEO4 *Learning Environment:* Demonstrate a commitment to the community and the profession through involvement with community and/or professional organizations and/or make contributions towards society's greater good and prosperity by exhibiting ethical attitude, life skill, team work in their profession and adapt to current trends by engaging in lifelong learning.

Program Outcomes (POs):

On successful completion Graduates will demonstrate:
PO1: An ability to apply knowledge of mathematics, manufacturing Engineering, material science, to solve the real life problems.

PO2: An ability to design and analyze the experiments and interpret the data and optimize the process in order to improve the productivity subject to technical, economical and environmental constraints.

PO3: An ability to function on multi-disciplinary teams and be familiar with organizational behavior and management.

PO4: Ability to identify, formulate, and solve industrial/practical problems with advance manufacturing and automation tools and techniques leading to sustainable development of industry and society.

PO5: Ability to understand the impact of engineering solutions and industrial automation in a global and societal context and demonstrate it through research or entrepreneurship.

PO6: Ability to communicate effectively with all levels of management and have the good professional ethics and knowledge of contemporary issues.

Correlation between the PEOs and the POs

PO1 / PEO	PO1	PO2	PO3	PO4	PO5	PO6
PEO1	✓	✓	✓	✓	✓	
PEO2	✓	✓		✓	✓	✓
PEO3		✓	✓	✓	✓	
PEO4		✓	✓	✓		✓

List of Abbreviations

Abbreviation	Title	No of courses	Credits	% of Credits
PSMC	Program Specific Mathematics Course	1	4	5.88 %
PSBC	Program Specific Bridge Course	1	3	4.41 %
PCC	Program Core Course	5	17	25 %
PEC	Program Specific Elective Course	3	9	13.24 %
LC	Laboratory Course	2	4	5.88 %
VSEC	Vocational and Skill Enhancement Course	2	18	26.47 %
OE	Open Elective	1	3	4.41 %
SLC	Self-Learning Course	2	6	8.82 %
AEC	Ability Enhancement Course	1	3	4.41 %
MLC	Mandatory Learning Course	2	--	--
CCA	Co-curricular & Extracurricular Activities	1	1	1.47 %
Total		21	68	100.0%

PG Program [M.Tech (Production Engg. - Manufacturing Engg. & Automation)]
Proposed Curriculum Structure

Semester - I

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme				Credits
				L	T	P	S	
1	PSMC	PSMC-01	Applied Statistics	3	--	--	2	3
2	PSBC	PSBC-01	Sensors and Actuators for Intelligent Manufacturing	3	--	--	1	3
3	PCC	PCC-01	Robot Integrated Manufacturing Automation	2	1	--	1	3
4	PCC	PCC-02	Advanced Materials and Processing	3	--	--	1	3
5	PCC	PCC-03	Artificial Intelligence and Machine Learning	--	1	2	--	2
6	PEC	PEC-01	Tribology	3	--	--	1	3
			Advanced Material Forming					
			Precision Engineering					
			Ergonomics in Design and Manufacturing					
			Advances in Casting and Welding					
7	AEC	AEC-01	Additive Manufacturing Technologies and Applications	3	--	--	1	3
8	LC	LC-01	Advanced Manufacturing Practices Laboratory	--	--	2	1	2
9	LC	LC-02	CAD / CAM Laboratory	--	--	2	1	2
Total Credits				**17**	**2**	**6**	**9**	**22**

PG Program [M.Tech (Production Engg. - Manufacturing Engg. & Automation)]
Proposed Curriculum Structure

Semester - II

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme				Credit
				L	T	P	S	
1	OE	OE-01	Open elective	3	--	--	2	3
2	PCC	PCC-03	Modeling and Design of Manufacturing System	3	--	--	2	3
	PCC	PCC-04	Advanced Manufacturing Technology	3	1	--	2	4
	PCC	PCC-05	Metrology and Computer Aided Inspection	3	--	--	2	3
3	MLC	ML-01	Research Methodology and Intellectual Property Rights	2	--	--	--	--
4	MLC	ML-02	Effective Technical Communication	1	--	--	--	--
5	PEC	PEC-02	Image Processing in Manufacturing	3	--	--	2	3
			Dynamics of Machining Process					
			MEMS and Nanotechnology					
			Reliability Engineering and Maintenance Analysis					
			Fluid Power Automation					
6	PEC	PEC-03	Product Design and Development	3	--	--	2	3
			Mechatronics System Design					
			Machine Tool System and Manufacturing Optimization					
			Entrepreneurship Essentials(MOOC)					
			High Pressure Die Casting					
7	CCA	CCA-01	Liberal Learning Course	--	--	--	--	1
8	LC	LC-02	Embedded Platforms, Microcontrollers and Applications Laboratory	--	--	2	--	1
9	LC	LC-02	System Modeling and Simulation Laboratory	--	--	2	--	1
Total Credits				**21**	**1**	**4**	**12**	**22**

*The department offers 'Open elective' course to students of other programmes.

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme				Credit
				L	T	P	S	
1	OE	OE-01	Reliability Engineering	3	--	--	2	3

- Exit option to qualify for **PG Diploma in Advanced Manufacturing Engineering**:
  - Eight weeks domain specific industrial internship in the month of June-July after successfully completing first year of the program.

PG Program [M.Tech (Production Engg. - Manufacturing Engg. & Automation)]
Proposed Curriculum Structure

Semester - III

Sr. No.	Course Code	Course Code	Course Name	Teaching Scheme				Credits
				L	T	P	S	
1	VSEC	VSEC-01	Dissertation Phase – I	--	--	18	12	9
2	SLC	SLC-01	Massive Open Online Course -I	3	--	--	3	3
			Total Credits					**Max 12**

Semester - IV

Sr. No.	Course Code	Course Code	Course Name	Teaching Scheme				Credits
				L	T	P	S	
1	VSEC	VSEC-02	Dissertation Phase – II	--	--	18	12	9
2	SLC	SLC-02	Massive Open Online Course -II	3	--	--	3	3
			Total Credits					**Max 12**

- **MOOC Courses:**
  - ✓ The MOOC Course must be from NPTEL of minimum 12 weeks duration.
  - ✓ Generally the selected course should be in line with specializations or project needs.

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SEMESTER - I

(MA-19001) Applied Statistics

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of course students will be able to

1. Understand basic concepts of probability & statistics and apply as per the characteristics in data analysis.
2. Apply the concept of Hypothesis testing to carry out Regression analysis & ANOVA and planning Design of Experiments.
3. Apply statistical quality control tools for various applications.

Syllabus Contents:

- Probability Theory and Sampling Distributions. Basic probability theory along with examples.
- Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance.
- Inferences on Means and Standard Deviations , Inferences on a Population or Process Mean, Confidence Intervals, Hypothesis Tests, Choice of a Confidence Interval or a Test, Sample Size, Inferences on a Population or Process Standard Deviation Confidence Intervals, Inferences on Two Populations or Processes Using Independent Pairs of Correlated Data Values, Inferences on Two Populations or Processes Using Data from Independent Samples, Comparing Standard Deviations from Several Populations, estimating the difference between two means and ratio of two variances. Some sampling tests like $\chi 2$, t, F.
- Statistical Hypotheses: General Concepts , Testing a Statistical Hypothesis , The Use of P-Values for Decision Making in Testing Hypotheses, Single Sample: Tests Concerning a Single Mean , Two Samples: Tests on Two Means , Choice of Sample Size for Testing Means, One Sample: Test on a Single Proportion, Two Samples: Tests on Two Proportions One- and Two-Sample Tests Concerning Variances, Goodness-of-Fit Test
- ANOVA: One – way, Two – way with/without interactions, Latin Squares ANOVA technique,
- Principles of Design Of Experiments, some standard designs such as CRD, RBD, LSD.
- Statistical Quality Control, Introduction, nature of control limits, purpose of control charts, control charts for variables, control charts for attributes.
- Statistical analysis with R, Statistical models in R, Formulae, Generic functions, Packages, Linear models, Analysis of variance, Updating generalized linear models, families, Nonlinear least squares and maximum likelihood models.

References:

1. Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probability and Statistics for Engineers and Scientists (9th Edition), Pearson Prentice Hall, 2012
2. Douglas C. Montgomery, “Design and Analysis of Experiments” (7th Edition), Wiley Student Edition, 2009.
3. S. P. Gupta, “Statistical Methods”, S. Chand & Sons, 37th revised edition, 2008
4. William W. Hines, Douglas C. Montgomery, David M. Goldsman, “Probability and Statistics for Engineering”, (4th Edition), Willey Student edition, 2006.
5. Douglas C. Montgomery , George C. Runger , Applied Statistics and Probability for Engineers,3 rd Edition, John Wiley & Sons, Inc.,2003.

(PME-20005) Sensors and Actuators for Intelligent Manufacturing

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of the course, students will Students will be able to:

1. To acquire hands on experience in selection, calibration and measurement of engineering parameters using various sensor
2. Automate a manufacturing system with various sensors, actuators and controllers
3. Develop a control scheme based on sensor feedback.
4. Select a suitable sensor for a particular instrumentation task.
5. Calibrate a sensor and to integrate it with signal conditioning and data acquisition systems

Syllabus Contents:

- Introduction- Role of sensors in manufacturing automation- operation
- Principles of different sensors- electrical, optical, acoustic, pneumatic, magnetic, electro-optical and vision sensors.
- Condition monitoring of manufacturing system- principle- sensors for monitoring force, vibration and noise, selection of sensors and monitoring technique.
- Acoustic emission- principle and applications- concept of pattern recognition.
- Sensors for machine vision sensors- smart/intelligent sensors-integrated sensors, robot sensors, micro sensors, nano sensors, manufacturing of semi-conductor sensor and fiber optic sensor-principles, applications.

References:

1. J. Vetelinoanda. Reghu, Introduction to sensors, CRC Press, 2010, ISBN9781439808528.2.J. Frade n, Handbook of Modern Sensors: Physics, Designs and Applications, 4thedition, Springer, 2010
2. J. Frade n, Handbook of Modern Sensors: Physics, Designs and Applications, 4thedition, Springer, 2010.
3. T. G. Beckwith, R.D. Marangoni and J. H. Lienhard V., Mechanical Measurements, Pearson Prentice Hall, 2009.
4. Doe belin, Measurement systems: Applications and Design, 5th edition, McGraw Hill Book, 2004.
5. I. R. Sinclair, Sensors and Transducers, Elsevier, 2001, ISBN: 978-0-7506-4932-2.
6. J. S. Wilson, Sensor Technology Handbook, Newnes, 2004, ISBN: 0750677295.
7. B. K. Ghosh, T. J. Tarn and N. Xi, Control in Robotics and Automation: Sensor -Based Integration, Academic Press, 1999, ISBN: 978- 0-12-281845-5 6.C.W. deSilava, Sensors and Actuators, 2nd edition, CRC Press, 2016

(PME-20006) Robot Integrated Manufacturing Automation

Teaching Scheme:

Lectures: 2 hrs/week
Tutorials: 1 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the basics of robotics and artificial intelligence.
2. Use fundamentals of FMS, and AGV in manufacturing situations.
3. Apply concepts of hard and soft automation in industries.

Syllabus Contents:

- Fundamentals of Robotics, Robot anatomy, Robot configurations
- Drives in robotics, Robot controllers
- End Effectors: types, design considerations, gripper design
- Robot kinematics – Forward & Inverse kinematics, D-H approach
- Sensors in robotics, classification, considerations and applications
- Machine vision system in robotics, Image processing
- Robot programming methods, Robot programming languages, commands and programming using VAL , Programming for welding applications
- Trajectory planning, safety in robotics, robot economics, Robot applications Artificial Intelligence and Robotics
- Automation, Elements of automated systems, advanced automation functions, levels of automation
- Types of automation, Fixed, programmable, flexible, Hard & soft automation
- Fundamentals of automated production lines, analysis of transfer lines, material handling in automated systems, Geneva mechanisms, feeders,
- Inspection techniques in automation

References:

1. S.R. Deb, “Robotics Technology and Flexible Automation”, Tata McGraw Hill.
2. M.P.Groover, Weiss, Nagel & Odery, “Industrial Robotics Technology, Programming & Applications” , Tata McGraw Hill.
3. M.P.Groover, “Automation Production systems and Computer Integrated Manufacturing”, PHI learning Pvt. Ltd.
4. Yoram Koren, “Robotics for Engineers”, Tata McGraw Hill.
5. K. S. Fu, R. C. Gonzalez, C. S. G. Lee, “Robotics – Control, Sensing, Vision and Intelligence”, McGraw Hill Int.
6. H. J. Warneck and R.D. Sehfart “Industrial Robots” , I.F.S. Pub., U. K.
7. R. Paul, “Robots – Manipulators, Mathematics, Programming and Control”, MIT Press.
8. P.A. Janakiraman, “Robotics and Image Processing”, Tata McGraw Hill 1995.
9. J.G.Keramas “Fundamentals of Robotics”, Delmar Publishers
10. Nanua Singh, “System Approach to Computer Integrated Design and Manufacturing”, John Wiley (1996), ISBN 0-471-58517-3

(PME-20009) Advanced Materials and Processing

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Identify material demanding for extreme conditions.
2. Use of SMART, nano and bio-materials.

Syllabus Contents:

- Materials demand for Extreme conditions of operation, material property mapping, Processing, strengthening methods,
- Treatment and properties of Super alloys, creep resistance, Ultra high strength steels
- Light metal alloys and metal matrix composites (MMC), their applications in aerospace and automobiles
- Super-plastic materials, Materials in the vicinity of nuclear fissile fuels,
- Zirconium alloys, stainless steels
- Intermetallics, Metallic glasses
- Amorphous alloys, rapid solidification, synthesis by mechanical alloying,
- SMART materials, shape memory effect
- Functionally graded materials
- Damage Tolerant Material
- Bio-Materials, Nano materials
- Surface engineering for modifying abrasion, wear, corrosion and fatigue performance,
- Preparation of the substrate, Physical Vapour Deposition, Chemical Vapour Deposition, Ion Implantation,
- Coatings for high temperature performance, Electrochemical and spark discharge and Plasma coating methods,
- Electron beam and laser surface processing, Organic and Powder coatings, Thermal barrier coating.

References:

1. P. Ramarao, “Advances in materials and their applications”, Wiley Eastern Ltd.
2. Smallman and Bishop, “Metals and Material Science, process, applications”
3. Polmear I.J., “Light Alloys & Metallurgy of light metals”, Arnold Press,1995.
4. Westbrook J.H & Fleischer R.L., “Intermetallic compounds VOL I & II”, John Wiley, Chichester ,1995
5. Kelly A. & Nicholson R.B. (Eds), “Strengthening methods in crystals”
6. Clyne T.W. & Withers P.J., “An introduction to metal matrix composite”, Cambridge University Press, 1993.
7. Artz & L.Schulte (Ed), “New Materials by mechanical alloying techniques”, DGM, Germany, 1989.

(PME-20007) Artificial Intelligence And Machine Learning

Teaching Scheme:

Tutorials: 1 hrs/week
Practical: 2 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques.
2. Apply these techniques in applications which involve perception, reasoning and learning.
3. Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.
4. Acquire the knowledge of real world Knowledge representation.
5. Analyze and design a real world problem for implementation and understand the dynamic behaviour of a system.

Syllabus Contents:

- Introduction: What is AI, History, AI problems, Production Systems, Problem characteristics, Intelligent Agents, Agent Architecture, AI Application (E-Commerce, & Medicine), AI Representation, Properties of internal representation, Future scope of AI , Issues in design of search algorithms.
- Heuristic search techniques: Heuristic search, Hill Climbing, Best first search, mean and
- end analysis, Constraint Satisfaction, A* and AO* Algorithm, Knowledge Representation: Basic concepts, Knowledge representation Paradigms, Propositional Logic, Inference Rules in Propositional Logic, Knowledge representation using Predicate logic, Predicate Calculus, Predicate and arguments, ISA hierarchy, Frame notation, Resolution, Natural Deduction
- Logic Programming: Introduction, Logic, Logic Programming, Forward and Backward
- Reasoning, forward and Backward chaining rules. Knowledge representation using non monotonic logic: TMS (Truth maintenance system), statistical and probabilistic reasoning, fuzzy logic, structure knowledge representation, semantic net, Frames, Script, Conceptual dependency.
- Learning: What is Learning, Types of Learning (Rote, Direct instruction Analogy,
- Induction, Deduction) Planning: Block world, strips, Implementation using goal stack, Non linear planning with goal stacks, Hierarchical planning, Least commitment strategy.
- Introduction: Basic definitions, types of learning, hypothesis space and inductive bias,
- Evaluation, cross-validation, Linear regression, Decision trees, averting.
- Probability and Bayes learning, Logistic Regression, Support Vector Machine, Kernel
- function and Kernel SVM flexible Manufacturing System (FMS), and Cellular Manufacturing system (CMS)
- Ball screw design- load, rigidity and pre-load calculation Drive system with Stepper motor and DC and AC Servo Motors Design and load estimation of servo motors, Control and feedback using positional, velocity & PID system.
- Static and dynamic rigidity, Lumped parametric method and stability and instability

based on vibration analysis of machine tools-stability envelopes, Vibration study of machine tool structures – micro-displacement and error analysis of machine tools with reference to transmission system and positional displacement (stick-slip)

- Elimination of stick slip, Non-uniform micro-displacement Reliability analysis of machine tools.
- Electrical control system – relays, electromagnetic brakes, safety devices and reversible systems

References:

1. Nils J. Nilsson, “Artificial Intelligence: A new Synthesis”, Harcourt Asia Pvt. Ltd.
2. George F. Luger, “Artificial Intelligence-Structures and Strategies for Complex Problem Solving”, Pearson Education/ PHI.
3. C. M. Bishop: Pattern Recognition and Machine Learning, Springer 1st Edition-2013.
4. Ian H Witten, Eibe Frank, Mark A Hall: Data Mining, Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition.
5. Parag Kulkarni: Reinforcement Learning and Systemic Machine Learning for Decision Making, IEEE Press, Reprint 2015.
6. Nikhil Buduma: Fundamentals of Deep Learning, O’Reilly Media, June 2017.
7. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition 2012.
8. Kevin P Murphy: Machine Learning – A Probabilistic Perspective, MIT Press, August

(PME-20008) Additive Manufacturing Technologies and Applications

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. To understand the importance of additive manufacturing process, various additive manufacturing technologies, selection of suitable material, pre processing and post processing of manufactured parts.
2. To explore different applications of additive manufacturing parts from various fields like Automobile, Aerospace, Bio-medical etc.
3. To understand basic construction of additive manufacturing machines, different systems like Energy delivery, Material delivery, Nozzle and Heating Systems
4. To understand the concept of rapid tooling and its requirement

Syllabus Contents:

- Introduction to Additive Manufacturing (AM), AM evolution, Distinction between AM and CNC machining, Advantages of AM
- AM process chain; Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build , removal and clean up, post processing.
- Classification of AM processes; Liquid polymer system, discrete particle system, powder qualities, molten material systems, solid sheet system.
- Design for AM; Motivation, Design for manufacturing and Assembly concepts and objectives, AM unique capabilities, Exploring design freedoms
- Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.
- Guidelines for process selection; Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control
- Post processing of AM parts; Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.
- AM Applications; Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models
- Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries.
- Construction of basic AM machines; Construction of CNC Machine - Axes, Linear motion

References:

1. Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles and Applications”, World scientific, 2003.

2. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010
3. Ali K. Kamrani, Emand Abouel Nasr, “Rapid Prototyping: Theory and Practice”, Springer, 2006.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.

(PME- 20010) Advanced Manufacturing Practices Laboratory

Teaching Scheme:
Practical : 2 hrs/week

Examination Scheme: Term Work: 100 Marks

Course Outcomes:

1. Able to understand part modeling and part data exchange standard.
2. Able to of fabricate 3D part using an additive manufacturing machine and carry out preprocessing, and post processing of rapid prototype part.
3. Realize the application of RP and RT technologies for product development
4. Apply the reverse engineering process for product development.
5. To learn the fundamentals of nanotechnology and fabrication of nanofibers.
6. Able to apply the working principles and processing characteristics of nontraditional machining like EDM, ECDM to the production of precision components.
7. Able to determine the quality and surface integrity of products manufactured by advance manufacturing process.
8. Able to apply advance manufacturing process with socio-economic considerations.
9. Able to use different laser technologies in manufacturing and measurement.
10. Able to build, validate and verify simulation model for forming process simulation.
11. Able to evaluate the part and estimate machine tool accuracies.

Syllabus Contents: (Any Eight)

1. Development of any solid model assembly and detail using CAD modeling packages and Prototyping using 3D Printing Machine.
2. Generation of point cloud data of rapid prototype model using rotary scanner.
3. Manufacturing of nano fibers using electro-spun machine.
4. Measurement of cutting forces using tool force dynamometer.
5. To investigate the effect of material removal rate (MRR), Tool Wear and Surface roughness on workpiece and tool Electrical Discharge Machining (EDM) and rapid EDM drilling machine.
6. Micro-drilling Using Electrochemical Discharge Machining (ECDM).
7. Measurements of circularity and cylindricity of parts using Coordinate Measuring Machine (CMM).
8. Inspection process using Vision Measuring System.
9. Use of Laser Interferometer and to find error in linear positioning for NC, CNC machines.
10. Friction and wear behavior of material using different Tribometers.
11. Analysis of wear particles using Direct Reading Ferropgraph and Dual Slide Ferrogram Maker.
12. Use of Dynamic Mechanical Analyser (DMA) to find mechanical properties of Polymeric material.
13. Metal forming process simulation using software.
14. Study of Fractography by using Field Emission Scanning Electron Microscope.

(PME-20011) CAD/ CAM Laboratory

Teaching Scheme:
Practical : 2 hrs/week

Examination Scheme: Term Work: 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Use and assess commercial CAD/CAM tools efficiently, effectively and intelligently in advanced engineering applications
2. Able to generate tool paths designs in a CAD/CAM package and to send part programmes to CNC machine and being able to machine parts Apply computer software and hardware to mechanical design and manufacturing fields.
3. Formulate relevant research problems; conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.

Syllabus Contents:

- 3D solid modelling and assembly using a CAD/CAM system for a plastic injection moulding die
- Generation of CNC program by optimising tool path movement using CAM software for lathe and mill.
- Features and selection of CNC turning and milling centres.
- Practice in part programming and operation of CNC turning machines, subroutine techniques and use of cycles.
- Practice in part programming and operating a machining centre, tool panning and selection of sequences of operations, tool setting on machine, practice in APT based NC programming.
- Write a program to scale a geometric model.
- Write a program to rotate a geometric model
- To draw a 3D model of mechanical components
- Virtual Prototype modelling of assemblies by geometric modelling and rendering using commercial
- Surface modelling and sheet metal features design for industrial components
- CAD data preparation for Rapid prototyping, Virtual reality and Finite element Solvers
- Surface reconstruction from point cloud data for reverse engineering and inspection

SEMESTER - II

(IOC) Embedded Systems and Micro Controller Application

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:
At the end of course students will be able to:

1. Understand the concept of Embedded System
2. Understanding the basic principles of Microcontroller based design and development.
3. Ability to understand and design real world applications.
4. To have a better understanding on state-of-the-art interfacing technologies, their applications.
5. Identify problem and strategy for designing the solution using appropriate Microcontrollers.

Syllabus Contents:

- Function of Project Planning –Inter dependency relationship, Generation and screening of project ideas, project rating index
- Fundamentals of Assembly language Programming; Instruction format, Assembler, Linker
- Memories: Classification, Organization, Addressing methods.
- Introduction to Embedded Systems: 8051 family 8051 Assembly Language Programming, Instruction set- Addressing Modes-Programming Techniques; Arithmetic, Timer/Counter, I/O Port, Interrupts, Serial Communication, External memory interfacing;
- A/D Converter Interface (ADC08xx series)-D/A Converter Interface (DAC08xx) series; interfacing of display and keyboard
- Introduction to operating systems, Types of OS, basic functions of OS, multi- tasking, scheduling, compiler, linker, loader

References:

1. Prasanna Chandra, “Project Planning: Analysis, Selection, Implementation and Review”, Tata McGraw Hill.
2. Mohammad Ali Mazidi, “The 8051 Microcontroller and Embedded System: Using Assembly and C”, Pearson education, Second ed., 2006.
3. Kenneth J. Ayala, “The 8051 Microcontroller Architecture, Programming & Applications”, Penram International.
4. David E. Simon, “An Embedded Software Primer”, Pearson Education, 2005.
5. Raj Kamal, “Embedded Systems: Architecture , Programming and Design”, Tata McGraw-Hill Education, 2008.

(PME-20012) Modeling and Design of Manufacturing System

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme:

T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Student will be able to understand various manufacturing system existing in Industries.
2. The course will enable the student to apply latest techniques in manufacturing systems.
3. Students will be able to understand inventory management systems currently used in industries
4. The concepts of systems and inventory will be useful in perusing Industrial projects in the second year.

Syllabus Contents:

- Essentials of Manufacturing Systems
- Process for Manufacturing; material and Technological Information Flows in manufacturing systems including manufacturing cost and product cost structure
- Product planning and design, Process planning and design, Logistic planning and Design
- Management Systems for Manufacturing: managerial information flow in manufacturing systems
- Aggregate Production planning
- JIT and Kanban Production Control
- Stochastic Processes in manufacturing; Discrete time Markov Chain models, DTMC with and without repair facilities for two machines systems
- Continuous time Markov chain with resume and discard policies
- Manufacturing system Analysis through TRIZ, PETRI Nets, ETPN and GSPN, Reach-ability graphs etc.

References:

1. Katsundo Hitomi, “Manufacturing Systems Engineering”, Viva Low-Priced Student Edition
2. Y. Narahari and N. Vishwanadhan, “Performance Modeling and Automated Manufacturing Systems” Prentice Hall India, 1994.
3. Stanley B. Gershwin, “Manufacturing Systems Engineering”, PHI latest Editon.
4. Joseph Martinich, “Production and Operations Management: An Applied Approach”, 1997, Wiley.
5. Eliyahu Goldratt, “The Goal: A Process of Ongoing Improvement”, 2nd Revised Edition, Jeff Cox, 1992.

(PME-20013) Advanced Manufacturing Technology

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Apply the concept of surface integrity effectively for a given engineering application
2. Explain micro electro-mechanical systems and their applications in advancement.
3. Understand the applications of nano-technology in manufacturing
4. Identify correct advanced manufacturing process (AMP) for a given machining application.

Syllabus Contents:

- The concept of Surface Integrity in machining and its evolution, assessment of surface integrity, enhancement of surface integrity through processes such as low stress grinding, burnishing, low plasticity burnishing, shot peening, ballizing; Engineered Surfaces, Process Signatures
- MEMs and its applications
- Overview of micro-manufacturing
- Overview of nano-technology
- Laser induced plasma processing (LIP) and Molecular Dynamics
- Advanced manufacturing processes (AMPs): Hybrid processes such as Electric discharge grinding (EDG), Electrochemical grinding (ECG), Electrochemical discharge machining (ECDM), Ultrasonic assisted EDM, etc. Recent developments and analytical aspects of AMPs such as AJM, USM, AFM, MAF, WJM, AWJM, EDM, WEDM, etc.

References:

1. Tai ran Hsu, “MEMS & Micro system: Design & Manufacture” , Tata McGraw Hill Publisher, 2002.
2. “The MEMS handbook”, CRC Press, 2001
3. Julian W. Gardner & Vijay K. Varadan, “Micro-sensors, MEMS and smart Devices”, John Wiley & Sons, 2001.
4. Nario Taniguchi, “Nanotechnology”, Oxford University Press, 1996.
5. V.K. Jain, Advanced Machining Processes, Allied Publishers Pvt. Ltd, New Delhi, 2002
6. G. Boothroyd and W.A. Knight, Fundamentals of Machining and Machine Tools, 3rd Edition, CRC Press, Taylor and Francis Group, 2006.

(PME-20014) Metrology & Computer Aided Inspection

Teaching Scheme:

Lectures: 2 hrs/week
Tutorial : 1 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Students will be able to handle high precision measurement requirements of industry.
2. Knowledge of different instruments used for high precision will be applied by the student in the industry and research work.

Syllabus Contents:

- Metrological concepts - Abbe's principle - need for high precision measurements - problems associated with high precision measurements.
- Standards for length measurement - Shop floor standards and their calibration
- Light interference - Method of coincidence - Slip gauge calibration - Measurement errors.
- Various tolerances and their specifications, gauging principles, selective assembly, comparators.
- Angular measurements - principles and instruments.
- Gear and Thread measurements.
- Surface and form metrology - flatness, roughness, waviness, roundness, cylindricity, etc.
- Computer Aided Metrology - Principles and interfacing, software metrology.
- Laser metrology - Applications of Lasers in precision measurements.
- Laser interferometer, speckle measurements, laser scanners.
- Coordinate Measuring Machine - Types of CMM - Probes used - Applications - Non contact CMM using Electro optical sensors for dimensional metrology - Non contact sensors for surface finish measurements.
- Image processing and its application in Metrology.
- Large scale Metrology, Laser Trackers, Stereo vision, Micro and Nano Metrology.
- Metrology for additive manufacturing parts, CT Scan technologies in inspection

References:

1. K.J.Hume, “Engineering Metrology”, Kalyani Publisher Latest Editon, New Delhi.
2. R. K. Jain, “Engineering Metrology”, Khanna Publishers, New Delhi
3. I.C. Gupta, “Engineering Metrology”, Dhanapat Rai New Delhi
4. Robert G. Seippel , “Opto Electronics for Technology and Engineering”, Prentice Hall New Jersey, 1989.
5. Thomas G.G, “Engineering Metrology”, Butter worth publications-1974
6. Anil K. Jain, “Fundamentals of Digital image processing”, Prentice hall of India Pvt. Ltd. 2004
7. Dale H. Besterfield, “Total Quality Management”, Pearson Education Asia, 2002.
8. Manuals of Co-ordinate measuring machines and systems

(PME-20015) Embedded platforms , Micro Controller Application Laboratory

Teaching Scheme:
Practical : 2 hrs/week

Examination Scheme: Term Work: 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the concept of Embedded System
2. Understanding the basic principles of Microcontroller based design and development.
3. Ability to understand and design real world applications.
4. To have a better understanding on state-of-the-art interfacing technologies, their applications.
5. Identify problem and strategy for designing the solution using appropriate Microcontrollers.

Syllabus Contents:

Part1: Assembly Language Programming

- Arithmetic Instruction Programming (add, subtract, multiply, divide)
- Logical instruction programming
- Input and output
- Timer and counter
- Serial communication with PC

Part2: 8051 Interfacing Programs

- Interfacing of ADC
- Interfacing of DAC to generate square, triangular, saw-tooth and sine waveform
- Interfacing 7 seg display
- Interfacing of LCD display
- Interfacing of keyboard
- Measurement of physical parameter like temperature or pressure
- DC motor interfacing and speed control
- Stepper motor interfacing

Part3: Operating System

- Introduction to multitasking on PC

(LLC) Liberal Learning Course

Teaching Scheme:

Lectures:1 hrs/week

Examination Scheme:T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Learn new topics from various disciplines without any structured teaching or tutoring
2. Understand qualitative attributes of a good learner
3. Understand quantitative measurements of learning approaches and learning styles
4. Understand various sources and avenues to harvest/gather information
5. Assess yourself at various stages of learning

Course Features:

- 10 Areas, Sub areas in each
- Voluntary selection
- Areas (Sub areas):

1. Agriculture (Landscaping, Farming, etc.)
2. Business (Management, Entrepreneurship, etc.)
3. Defense (Study about functioning of Armed Forces)
4. Education (Education system, Policies, Importance, etc.)
5. Fine Arts (Painting, Sculpting, Sketching, etc.)
6. Linguistics
7. Medicine and Health (Diseases, Remedies, Nutrition, Dietetics, etc.)
8. Performing Arts (Music, Dance, Instruments, Drama, etc.)
9. Philosophy
10. Social Sciences (History, Political Sc., Archeology, Geography, Civics, Economics, etc.)

Evaluation:

- T1: A brief format about your reason for selecting the area, sub area, topic and a list of 5 questions (20 marks)
- T2: Identify and meet an expert (in or outside college) in your choice of topic and give a write up about their ideas regarding your topic (video /audio recording of your conversation permitted (20 marks)
- ESE: Presentation in the form of PPT, demonstration, performance, charts, etc. in front of everyone involved in your sub area and one external expert (60 marks)

(ML-19011) Research Methodology and Intellectual Property Rights

Teaching Scheme:
Practical : 2 hrs/week

Examination Scheme: Term Work: 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand research problem formulation and approaches of investigation of solutions for research problems
2. Learn ethical practices to be followed in research
3. Apply research methodology in case studies
4. Acquire skills required for presentation of research outcomes (report and technical paper writing, presentation etc.)
5. Infer that tomorrow's world will be ruled by ideas, concept, and creativity
6. Gather knowledge about Intellectual Property Rights which is important for students of engineering in particular as they are tomorrow's technocrats and creator of new technology
7. Discover how IPR is regarded as a source of national wealth and mark of an economic leadership in context of global market scenario
8. Study the national & International IP system
9. Summarize that it is an incentive for further research work and investment in R & D, leading to creation of new and better products and generation of economic and social benefits.

Syllabus Contents:

- Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
- Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.
- Effective literature studies approaches, analysis
- Use Design of Experiments /Taguchi Method to plan a set of experiments or simulations
  or build prototype
- Analyze your results and draw conclusions or Build Prototype, Test and Redesign
- Plagiarism , Research ethics
- Effective technical writing, how to write report, Paper
- Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.
- Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights, Objectives and Importance of understanding Intellectual Property Rights
- Understanding the types of Intellectual Property Rights: -Patents-Indian Patent Office and its Administration, Administration of Patent System – Patenting under Indian Patent Act , Patent Rights and its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non Provisional Patent Application and Specification, Plant Patenting, Idea Patenting,

- Integrated Circuits, Industrial Designs, Trademarks (Registered and unregistered trademarks), Copyrights, Traditional Knowledge, Geographical Indications, Trade Secrets, and Case Studies.
- New Developments in IPR, Process of Patenting and Development: technological research, innovation, patenting, development,
- International Scenario: WIPO, TRIPs, Patenting under PCT.
- Process of patenting and development: technological research, innovation, patenting, development.
- International Scenario: International cooperation on intellectual property. Procedure for grants of patents, patenting under PCT.
- Patent Rights: Scope of patent rights. Licensing and transfer of technology.
- Patent information and databases. Geographical Indications.
- New Developments in IPR: Administration of patent system.
- IPR of biological systems, computer software etc.
- Traditional knowledge, case studies, IPR and IITs.
- Registered and unregistered trademarks, design, concept, idea patenting.

References:

1. Aswani Kumar Bansal : Law of Trademarks in India
2. B L Wadehra : Law Relating to Patents, Trademarks, Copyright,
    a. Designs and Geographical Indications.
3. G.V.G Krishnamurthy : The Law of Trademarks, Copyright, Patents and
    a. Design.
4. Satyawrat Ponkse: The Management of Intellectual Property.
5. S K Roy Chaudhary & H K Saharay : The Law of Trademarks, Copyright, Patents
6. Intellectual Property Rights under WTO by T. Ramappa, S. Chand.
7. Manual of Patent Office Practice and Procedure
8. WIPO : WIPO Guide To Using Patent Information
9. Resisting Intellectual Property by Halbert ,Taylor & Francis
10. Industrial Design by Mayall, McGraw Hill
11. Product Design by Niebel, McGraw Hill
12. Introduction to Design by Asimov, Prentice Hall
13. Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley

(ML-19012) Effective Technical Communication

Teaching Scheme:

Lecture : 2 hrs/week

Examination Scheme: Term Work: 100 Marks 4 Assignments (25M each)

Course Outcomes:

Student will be able to

1. Produce effective dialogue for business related situations
2. Use listening, speaking, reading and writing skills for communication purposes and attempt tasks by using functional grammar and vocabulary effectively
3. Analyze critically different concepts / principles of communication skills
4. Demonstrate productive skills and have a knack for structured conversations
5. Appreciate, analyze, evaluate business reports and research papers

Syllabus Contents:

- Fundamentals of Communication 7 Cs of communication, common errors in English, enriching vocabulary, styles and registers
- Aural-Oral Communication The art of listening, stress and intonation, group discussion, oral presentation skills
- Reading and Writing Types of reading, effective writing, business correspondence, interpretation of technical reports and research papers

References:

1. Raymond Murphy “Essential English Grammar” (Elementary & Intermediate) Cambridge University Press.
2. Mark Hancock “English Pronunciation in Use” Cambridge University Press.
3. Shirley Taylor, “Model Business Letters, Emails and Other Business Documents” (seventh edition), Prentise Hall
4. Thomas Huckin, Leslie Olsen “Technical writing and Professional Communications for Non-native speakers of English”, McGraw Hill.
5. Raman Sharma, “Technical Communication”, Oxford University Press.

(PME(DE)-20002) Tribology

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Students will be able to demonstrate the behavior and characteristics of various lubricants in static and dynamic conditions.
2. Students will be able to select a lubricant for a particular process depending on the type of material and working conditions.

Syllabus Contents:

- System analysis and its application in tribo-environments
- Contract theory of surface, ergodicity and stationary of a surface, aborts bearing area curve and distribution of asperities heights.
- Apparent evaluation of contact stiffness of a joint.
- Adhesive and abrasive theories of friction with modification, method of measuring static and dynamic coefficient of friction
- Definition of wear and its various forms. Parameters affecting friction and wear, adhesive, abrasive, erosive wear etc. and analytical as well as experimental methods of determination
- Typical characteristics of the lubricant to reduce friction as well as vibration. Lubrication test kits.
- Dry friction, boundary friction, semi-liquid and liquid and liquid friction under lubrications.
- Case studies: showing monitoring of wear in reciprocating compressor using Ferrography and Quantitative Debris Monitoring (QDM), such As particle analyzer etc. Vibration signature analysis. Noise to detect failures.
- Tribological failure analysis SOAP: Spectroscopic oil analysis program. Uses of lubricant in radial journal bearing thrust bearing. Hydrostatic, Hydrodynamic and Ealsto hydrodynamic etc.
- Characteristics of lubricant for different type of uses and their properties under different environmental condition.
- Use of solid lubricant in specific cases of extrusion and metal cutting. Method of testing and characterization.

References:

1. S.K.Basu, B.B. Ahuja and S.N. Sengupta, “Fundamentals of Tribology”,6th Edition PHI, New Delhi.
2. Kragelsky, “Friction, lubrication, wear- Vol I,II and III”
3. B.C. Mujumdar, “Introduction to Tribology of bearings”, S Chand Publications, Delhi.
4. H.Czichos and Elsevies, “Tribology – A System Approach”, Latest Edition.
5. E. Rabinowics, Friction and Wear of Materials, Wiley N.Y.
6. Hailing J., "Principles of Tribology", McMillan Press Ltd.
7. Fuller D.' D. "Theory and Practice of Lubrication for Engineers". John Wiley and Sons.
8. Neale M. J. "Tribology hand Book", Butterworth's.

(PME(DE)-20003) Advanced Material Forming

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. After completing the course the students will be able to understand different bulk forming processes, applications and limitations.
2. Student will be able to use different sheet metal forming process in industry based upon the conceptual learning of formability.

Syllabus Contents:

- Theory of plasticity – yield criteria-work of plastic deformation-Equilibrium in Cartesian, cylindrical and spherical coordinates, different method of analysis, Energy-slab method of analysis, upper bound energy method, lower bound solution, Overview of FEM applications in Metal forming analysis-specifically in drawing & extrusion of metals.
- Effect of friction in forming operation, Experimental techniques of evaluation of friction in metal forming, deep drawing.
- Theory and Practice of Bulk Forming Processes: Analysis of plastic deformation in Forging, Rolling, Extrusion and drawing processes flow stress and effect of temperature.
- Selection-Die materials-Forming process equipment design.
- Sheet Metal Forming-Formability studies-conventional processes, HVF, HERF techniques-super plastic forming techniques-Hydro forming-Stretch forming-
- Laser beam forming-principles and process parameters-Advantages, limitations and applications of different forming processes.
- Special Forming Processes: Orbital forging-Isothermal-Hot and cold isostatic pressing-High speed extrusion, Water hammer forming
- Overview of P/M technique, Advantages, applications-powder performs forging-powder rolling-Tooling, process parameters and applications.

References:

1. Altan T., “Metal Forming-Fundamentals and applications”, American Society of Metals, Metals park 1983.
2. Hosford WF and Caddell R.M, “Metals Forming : Mechanics and Metallurgy”, Prentice hall, Englewood Cliffs, 1993
3. ASM handbook, “Forming and Forging”, 9th Edition, vol-14, 1998.

(PME(DE)-20004) Precision Engineering

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Identify errors due to various measurements.
2. Chose the appropriate machining process for precision components.
3. Study the appropriate geometrical features and tolerances for precision components
4. Justify the use of modern equipments tools and techniques in precision machining

Syllabus Contents:

- Geometrical Dimensioning and Tolerancing: Geometrical tolerances, tolerance zones – form, location and orientation of tolerance zones, Datum and precedence – primary, secondary and tertiary, Positional tolerances – zones, form; Combination of dimensional coordinate tolerancing and positional tolerancing, Defining substitute elements (best fit elements) from measured coordinates; Maximum Material Requirements and Minimum (Least) Material Requirements, their applications; Accumulation of tolerances (tolerance stacking)
- Machine Tools and Accuracy: General concept of accuracy of machine tool, spindle rotation accuracy, displacement accuracy, the philosophy of precision machine design, sources of error on a machine tool, factors affecting work piece accuracy from the point of view of machine design, accuracy of CNC machines – errors due to input interpolation and servo system; Thermal errors- Sources and transmission of thermal errors in precision machining, error avoidance and compensation, environment control of precision machinery- machine enclosures, room and factory enclosures.
- Tool Materials for Precision Machining: Classes of tool materials and their properties, coated carbides- laminated, CVD and PVD coated carbides, Cermets, Ceramics - hot pressed, Silicon Nitride and whisker reinforced ceramics, Diamonds – crystallographic planes, natural and synthetic diamonds, polycrystalline diamonds, diamond coated tools, Cubic boron nitrides (CBN), coated CBNs, Tool and work material compatibility
- Processing and Accuracy: Dimensional wear of cutting tools and its influence on accuracy, clamping and setting errors, errors due to location; Static Stiffness and Its Influence on Machining Accuracy, Classification of Errors; Errors
- Errors due to variation of total compliance of the process , Types of Errors caused by cutting force deformation in turning, boring and milling, case studies and calculation for overall errors by simulation.
- Errors Due to Numerical Interpolation, Errors Due to Displacement Measurement System, Definition of Accuracy of a Numerical Control System, Periodic Errors, Errors Due to velocity lag, Transient Response. Error Analysis in Dimensional Chain for single as well as multiple variables.
- Surface roughness and microfininshing processes – Terminology, influence of machining parameters on surface roughness, Honing, lapping and super finishing, Process capability – mean, variance, skewness, process capability metrics, Cp, Cpk, Methods for improving accuracy and Surface finish.

- Precision Machining Processes: Classification of material removal processes in terms of the energy source used and the tool-work piece reaction, influence of machining parameters, work material and tool geometry, Diamond turning and milling – machines, tool design and alignment, Fixed abrasive processes - Basic mechanics of grinding, finish grinding, precision cylindrical, internal and surface grinding bondless diamond grinding wheels, jig grinding, electrolytic in-process dressing, Ultra-precision grinding, nano-grinding; Loose abrasive processes – polishing, modes of material removal.
- Error Analysis in Dimensional Chain for single as well as multiple variables.
- Static Stiffness and Its Influence on Machining Accuracy, Classification of Errors; Errors
- Errors due to variation of total compliance of the process , Types of Errors caused by cutting force deformation in turning, boring and milling, case studies and calculation for overall errors by simulation.
- Condition monitoring in machining processes using acoustic emission.

References:

1. R.L. Murthy, Precision Engineering in Manufacturing, New Age International Pvt Ltd, New Delhi, Reprint 2005.
2. Venkatesh, V.C. and Izman, S. (2007), - Precision Engineering, (TMH), ISBN: 0-07-062090

(PME(DE)-20005) Ergonomics in Design and Manufacturing

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Students will understand the importance of ergonomics in day to day life.
2. The knowledge of human factors will lead to different applications in Industry as well as dissertation.
3. Student will be able to assess the human efforts to perform a particular task. The assessment and analysis of the task will help in reducing human efforts.

Syllabus Contents:

- Introduction: Human Factors and Systems, Information Input and Processing, Visual Displays of Dynamic Information
- Human Output and Control: Physical Work and Manual Materials Handling, Motor Skills, Human Control of Systems
- Controls and Data Entry Devices, Hand Tools and Devices Work Place Design.
- Applied Anthropometry, Work-Space Design, and Seating, Arrangement of Components within a Physical Space
- Interpersonal Aspects of Workplace Design Environmental Conditions: Illumination, Climate, Noise, and Motion human Factors Applications.
- Human Factors in Design and Manufacturing, Dynamic consideration in design of product using vibration stability in bio mechanisms.
- Safety in manufacturing. Considerations of human stress, Allowable limit of stress, stress adjustment.
- Evaluation human learning phenomenon, Progress Elasticity and the factors influencing the same.
- Determination of Training period for discrete and repetitive tasks. Machine Learning index.
- Estimation of human error and human reliability, combining various forms of human error by random number simulation
- Human Error, Accidents and safety, Human Factors and the Automobile, Human Factors in Systems Design, Manpower planning, job allocation.

References:

1. Mark S. Sanders, Ernest. J. Mcormick, “Human Factors in Engineering and Design”, 7th Edition, McGrath Hill, NY
2. C.T. Morgan, J.S. Cook, A. Chapnis and M.W. Land, “Human Engineering- Guide to Equipment design”, McGraw Hill, N.Y, 1963.

(PME(DE)-20001) Advances In Casting And Welding

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Students will be able to demonstrate the behavior and characteristics of various lubricants in static and dynamic conditions.
2. Students will be able to select a lubricant for a particular process depending on the type of material and working conditions.

Syllabus Contents:

- Casting design **:** Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering
- Casting metallurgy: Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys, Babbit alloy and Cu alloy.
- Recent trends in casting and foundry layout **:** Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.
- Welding metallurgy and design: Heat affected Zone and its characteristics Weldability of steels, cast iron, stainless steel, aluminium, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.
- Recent trends in welding: Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electro slag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

References:

1. ASM Handbook vol.6, welding Brazing & Soldering, 2003
2. ASM Handbook, Vol 15, Casting, 2004
3. Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
4. CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
5. Heineloper & Rosenthal, Principles of Metal Casting, Tata McGraw Hill, 2000.
6. Iotrowski – Robotic welding – A guide to selection and application – Society of mechanical Engineers, 1987.
7. Jain P.L., Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003
8. Lancaster.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980
9. Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002
10. Schwariz, M.M. – Source book on innovative welding processes – American Society for Metals (OHIO), 1981
11. Srinivasan N.K., Welding Technology, Khanna Tech Publishers.

(PME(DE)-20006) Image Processing in Manufacturing

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Students will be able to use image processing for manufacturing applications, online inspection and quality control.

Syllabus Contents:

- Image representation and nomenclature, Relationship of image processing and computer vision, Digital image fundamentals, Geometric model for imaging and applications- Imaging requirements.
- Image transformers-Sampling, Enhancement, Restoration and conversions, Segmentation, thresholding representation and description.
- Processing binary images- Image measurements, Multilevel image analysis, Higher dimensional modelling, Image based knowledge manipulation.
- 2D/3D Image acquisition, 3D image Visualisation, Imaging surfaces, Image processing system components. Study of surface finish - Sorting and counting of objects, Tool Wear measurement, measurement technique, Robot application.

References:

1. The Image Processing Hand Book- J.C. Russ, CRC Press/IEEE Press.
2. Digital Image Processing and Computer Vision- R. J. Schalkoff, John Wiley & Sons.
3. Digital Image Processing- R. C. Gonzalez & R. E. Woods, Addison Wesley.
4. Introduction to machine vision- R. C. John, Tata McGraw Hill.

(PME(DE)-20007) Dynamics of Machining Process

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Students will be able to visualize the effect of dynamic forces.
2. Student will be able to understand the concept of dynamic forces during machining process.
3. Student will be able to know to reduce the effect of dynamic forces.

Syllabus Contents:

- Static and dynamic forces generated by machining process during turning, milling , grinding and all machining operations.
- Response of elastic system supporting machining process. Interaction with vibratory cutting forces. Transfer function of vibratory system.
- Coupling of cutting forces and vibratory system. Coupled coordinate system dynamics characteristics of elements equivalent elastic system and cutting process.
- Model of dynamic cutting force stability analysis, regenerative chatter mode of coupling effect, limiting width of cut as measure of instability chatter. Stable and unstable regions. Measurement of chatter threshold. Remedial methods to avoid chatter and effect of vibrations.
- Self excited vibrations and stick-slip vibrations. Methods to minimize these effects.
- Effect of dynamic forces on spindles slides and sideways and dimensional accuracy.

References:

1. S. A. Tobias, “Machine Tool Vibration,” Blackie, London, 1965.
2. S. K. Basu and D. K. Pal, “Design of Machine Tools” , Oxford – IBH, 6th Edition, 2015.
3. F. Koenigsberger J. Tlusty, "Machine Tool Structures", Volume 1
4. Yusuf Altintas, "Manufacturing Automation", Cambridge University Press 2000

(PME(DE)-20008) MEMS and Nanotechnology

Teaching Scheme:
Lectures: 2 hrs/week
Tutorials: 1 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Expose the evolution of micro electromechanical systems,
2. Use the various fabrication techniques and to make students to be aware of micro actuators.
3. Impart knowledge to nano materials and various nano measurements techniques

Syllabus Contents:

- Over view of mems and Microsystems : Definition – historical development – properties, design and fabrication micro-system, microelectronics, working principle ,applications and advantages of micro system. Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds - silicon piezo resistors, Galium arsenide, quartz, polymers for MEMS, conductive polymers.
- Fabrication processes and micro system packaging: Photolithography, photo resist applications, light sources, ion implantation, diffusion–Oxidation - thermal oxidation, silicon dioxide, chemical vapour deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process – LASER, Electron beam ,Ion beam processes– Mask less lithography. Micro system packaging –packaging design– levels of micro system packaging -die level, device level and system level – interfaces in packaging – packaging technologies- Assembly of Microsystems
- Micro devices : Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands - displacement sensors, pressure sensor, flow sensors, Accelerometer , chemical and bio sensor - sensitivity, reliability and response of micro-sensor - micro actuators – applications.
- Science and synthesis of nano materials: Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture
- Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nano tubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes.
- Characterization of nano materials: Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

References:

1. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
2. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.
3. Mark Madou , Fundamentals of Microfabrication, CRC Press, New York, 1997.
4. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN : 8493-9138-5
5. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
6. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN:470-85106-6
7. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.

(PME(DE)-20009) Reliability Engineering and Maintenance Analysis

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Student will be able to demonstrate the skills related to life cycle costing and condition based monitoring.
2. Student will understand various aspects of maintenance in practical situations.
3. Student will be able to handle various software's and equipments related to Terotechnology.

Syllabus Contents:

- Basic Probability, concept and various distributions. Concept of Reliability and analysis of various configurations of assemblies and sub-assemblies. Series, Parallel and other grouping.
- System reliability. Set theory, optimal Cut Set and Tie Set, 'star-delta' method, matrix method etc.
- System reliability determination through 'Event Tree' analysis and Fault tree analysis.
- Reliability, Availability and Maintainability of equipment. A number of case studies done in Indian perspectives using Short Sample, nonparametric reliability.
- Monte-Carlo simulation and Techno economic life. Optimal allocation of component reliability to achieve maximum system reliability- various techniques and methods such as Minimum Effort method, Proportional, Conditional, AGREE, ARINC, Fair & Kim's Algorithm,
- Failure Modes and Effects Analysis (FMEA), Failure Modes, Effects and Criticality Analysis (FMECA). R.P.N., Graph theory etc.
- Maintenance Management Practice –Various types of maintenance, breakdown, preventive, periodic or predictive, condition based maintenance as predictive preventive maintenance.
- Periodic Preventive Management – Scheduled maintenance and period for P.M.
- Life cycle cost taking into consideration maintenance, reliability, hazard function etc. Life cycle costing: Rigorous models, mathematical formulation etc.
- Condition based maintenance, using Vibration Signature, SOAP, ferrography, hot ferrography, Infra Red Camera, fluorescent dye, Quantum Debris Analysis using Particle Analysers and other diagnostic techniques.
- Reliability Centered Maintenance. Total Productive Maintenance: Organisation, merits and demerits. Types of maintenance and their comparison, computerized maintenance, maintenance management auditing and evaluation. Analytical methods in maintenance

References:

1. Bhadury and S.K. Basu, "Terotechnology: Reliability Engineering and Maintenance Management", Asian Books, New Delhi 2002.

2. A. K. Gupta, “Terotechnology & Reliability Engineering”, McMillan Co.
3. A. K. S. Jardine, “Maintenance, Replacement & Reliability”, HMSO, London.
4. C.Singh and C.S. Dhillon, “Engineering Relaibility-New Techniques and Applications”, John Wiley and Sons, Tata McGraw Hill Publishing Company Limited, New Delhi.
5. L.S.Srinath, “Concepts in Reliability Engineering” Affiliated East West Press.
6. K.C. Kapoor and L.R. Lubersome, “Reliability in Engineering Design” ,Willey
7. C. Singh and C.S. Dhillon, “Engineering Reliability New Techniques and Applications” John Wiley and Sons.

(PME(DE)-20010) Fluid Power Automation

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. To have an overview of manufacturing, manufacturing operations and automation technologies
2. To study the definition and elements of mechatronics and automation system
3. To learn how to apply the principles of mechatronics and automation for the development of productive and efficient manufacturing systems.
4. To study the hydraulic and pneumatic systems employed in manufacturing industry.

Syllabus Contents:

- Hydraulic Power Generators, Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators: selection, specification and characteristics.
- Pressure, Direction and Flow control valves, Relief valves, Non return and Safety valves, Actuation systems.
- Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits – press circuits - hydraulic milling machine - grinding, planning, copying, forklift, earth mover circuits - design and selection of components - safety and emergency mandrels.
- Pneumatic fundamentals - control elements, position and pressure sensing
- Pneumatic logic circuits - switching circuits -fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipment's - selection of components - design calculations - application - fault finding – hydro pneumatic circuits
- Use of microprocessors/microcontrollers for sequencing - PLC, Low cost automation - Robotic circuits.

References:

1. Antony Espossito, "Fluid power with Applications", 7th Edition, Prentice Hall Higher Education, 2008.
2. Andrew Parr, "Hydraulic and Pneumatic", (HB), Jaico Publishing House, 1999.
3. Bolton. W. "Pneumatic and Hydraulic Systems", Butterworth - Heinemann, 1997

PME(DE)-20011) Product Design and Development

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. At the end of the course, students will demonstrate the ability to:1.Learn basics of product design process and morphology of design.
2. Students are exposed to Concept design, detail design, manufacturing, marketing, Introduction strategy of new product. Students learn about process of design for production of metal components.
3. Understand producibility requirements in the Design of Machine Components.
4. To understand optimization tools and ergonomic principles applied on typical product design as well as concept of value engineering in new product design.
5. To prepare a brief presentation on design morphology of at least one product as well as assignments is given to students to evaluate manufacturability and design for production.
6. At the end of course students should aware of different stages of product design.

Syllabus Contents:

- Introduction To Product Design: Asimov's Model Definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-consumption Cycle, The Morphology of Design (The sever phases), Primary Design Phases and flowcharting, Role of Allowance Process Capability, and. Tolerance in Detailed Design and Assembly.
- Product Design Practice and Industry: Introduction, Product Strategies Time to Market, Analysis of the Product, The Three S's, Standardization Renard Series (Preferred Numbers), Simplification, The Designer and it's Role, The Designer: Myth and Reality, The Industrial Design Organization Basic Design Considerations, Problems faced by Industrial Designer. Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers, What the Designer contributes, Role of Aesthetics in Product Design, Functional Design Practice. Review of Strength, Stiffness and Rigidity Considerations in Product Design Principal Stress Trajectories (Force -Flow Lines), Balanced Design, Criteria and Objectives of Design, Material Toughness: Resilience, Designing for Uniform Strength, Tension vis-à-vis Compression.
- Design for Production -Metal Parts: Producibility Requirements in the Design of Machine Components, Forging Design, Pressed Components Design, Casting Design, Design for Machining Ease, The Role of Process Engineer, Ease of Location and Clamping, Some Additional Aspects of Production Design, Die Casting and Special Castings, Design for Powder Metallurgical Parts, Expanded Metals and Wire Forms.
- Esigning with Plastics, Rubber, Ceramics and Wood: Approach to Design with Plastics, Plastic Bush Bearings, Gears in Plastic, Fasteners in Plastic, Rubber Parts,

Design Recommendations for Rubber Parts, Distortion in Rubber, Dimensional Effects, Tolerances, Ceramics and Glass Parts, Production Design Factors for Ceramic Parts, Special Considerations for Design of Glass Parts, Dimensional Factors and Tolerances, Wood. Design for assembly and disassembly.

- Optimization in Design: Introduction, Siddal's Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multipliers, Simplex search Method, Geometric Programming, Johnson's Method of Optimum Design.
- Economic Factors Influencing Design: Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Break-even Analysis, Economics of a New Product Design (Samuel Eilon Model).Human Engineering Considerations in Product Design Introduction, Human being as Applicator of Forces, Anthropometry: Man as Occupant of Space, The Design of Controls, The Design of Displays, Man/Machine Information Exchange.
- Value Engineering and Product Design: Introduction, Historical& Perspective, What is Value? Nature and Measurement of Value, Maximum Value, Normal Degree of Value, Importance of Value, The Value Analysis, Job Plan, Creativity, Steps to Problem-solving and Value Analysis, Value Analysis Tests, Value Engineering Idea Generation Cheek-list, Cost Reduction through Value Engineering Case Study on Tap Switch Control Assembly, Material and Process Selection in Value Engineering.
- Modern Approaches to Product Design Concurrent Design, Quality Function Deployment (QFD) for design.

References:

1. A.C. Chitale and R.C. Gupta, Product Design and Manufacturing by PHI.
2. Karl T. Ulrich & Steven D., Product Design & Development Eppinger Tata McGraw Hill, 3rdEdition, 2003
3. Tim Jones, Butterworth Heinmann, New Product Development by Oxford, TAC-1997.
4. Roland Engene Y. Inetoviez, New Product Development: Design & Analysis, John Wiley and Sons Inc., N.Y. 1990.
5. Geofferry Boothroyd, Peter Dewhurst and Winston Knight. Product Design for
6. 19Manufacture and Assembly, Amherst, 1983.
7. Bill Hollins, Stwout Pugh, Butterworth, Successful Product Design by London 1990.
8. Boothroyod & DewburstP.,Design for Assembly, a Designer's Hand book, University of Massachusets, Amherst, 1983.
9. Keyinotto & Kristini Wood, Product Design Pearson Education 2004

(PME(DE)-20012) Mechatronics System Design

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Demonstrate how mechatronics integrates knowledge from different disciplines in order to realize engineering and consumer products that are useful in everyday life.
2. Application of theoretical knowledge: understanding selection of suitable sensors and actuators; designing electro-mechanical systems.
3. Technical work: working with mechanical systems that include digital and analogue electronics as a data acquisition model.

Syllabus Contents:

- Rotational drives - Pneumatic Motors: continuous and limited rotation - Hydraulic Motors: continuous and limited rotation - Brushless DC Motors - Motion convertors, Fixed ratio, invariant motion profile, variators, remotely controlled couplings Hydraulic Circuits and Pneumatic Circuits.
- Mechanical Systems and Design - Mechatronics approach - Control program control, adaptive control and distributed systems - Design process - Types of Design - Integrated product design - Mechanisms, load conditions, design and flexibility Structures, load conditions, flexibility and environmental isolation – Man machine interface, industrial design and ergonomics, information transfer from machine from machine to man and man to machine, safety.
- Real time interfacing - Introduction Elements of data acquisition and control Overview of I/O process-Installation of I/O card and software - Installation of application software- Over framing.
- Microcontrollers: Introduction to use of open source hardware (Arduino & Raspberry Pi); shields/modules for GPS, GPRS/GSM, Bluetooth, RFID, and Xbee, integration with wireless networks, databases and web pages; web and mobile phone apps.
- Case studies on Data Acquisition - Transducer calibration system for Automotive applications Strain Gauge weighing system - Solenoid force - Displacement calibration system - Rotary optical encoder - Inverted pendulum control - Controlling temperature of a hot/cold reservoir -Pick and place robot - Carpark barriers.
- Case studies on Data Acquisition and Control - Thermal cycle fatigue of a ceramic plate - pH control system - De-Icing Temperature Control System - Skip control of a CD Player - Autofocus Camera, exposure control.
- Case studies on design of Mechatronics products - Motion control using D.C. Motor, A.C. Motor & Solenoids - Car engine management - Barcode reader.

References:

1. W. Bolton, Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, 2nd Edition, Addison Wesley Longman Ltd., 1999.

2. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, PWS Publishing company, 1997
3. Bradley, D. Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products
and Processes, Chapman and Hall, London, 1991.
4. Brian Morris, Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics, Mc Graw Hill International Edition, 1995.
5. Gopal, Sensors- A comprehensive Survey Vol I & Vol VIII, BCH Publisher

(PME(DE)-20014) Machine Tool System and Manufacturing Optimization

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Knowledge gain of modern and advanced machine tools.
2. Study of analysis of machine tool configuration system.
3. Study of system parameter optimization.
4. Study on characteristics and process parametric effect of machine tool system.

Syllabus Contents:

- Recent trends in machine tool development, ultra precision machine tools, Machine tool systems and category of machine tool .
- Advance system configuration, CNC and machining center system. Multi axis machine tools and axes designation, conceptual diagram of anti crush system. System structure of vertical CNC machine, lubrication system and tilting of guides, stick slip system analysis and machine tool component vibration analysis etc.
- Machine tool system pre selective, selective and adaptive control system study.
- Reliability and availability of machine tool analysis, Principal of automation and automatic machine tools.
- Machining process optimization for maximum power and tool life condition, optimization using maximum production rate, minimum cost etc.
- Availability optimization using markov chain analysis etc, optimum allocation of parameters for desired objective.

References:

1. S. K. Basu and D. K. Pal, “Design of Machine Tools” , Oxford – IBH, 6th Edition, 2015
2. A. Bhattacharya and G.C. Sen, “Principles of Machine Tools”, New Central Book Agency, Calcutta
3. B. Leatham and Jones, “Computer Numerical Control Machines”
4. Yoram Koren, “Computer Control in Manufacturing” , Tata McGrew Hill.
5. Kundra, Rao and Tiwari, “Numerical Control and Computer Aided Manufacturing”, Tata McGraw Hill.
6. S.J. Martin, “NC Machine tools”, ELBS.
7. N. K. Mehta, “Machine Tool Design”, Tata McGraw Hill.

(PME(DE)-20013) Entrepreneurship Essentials

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Identify a business opportunity
2. Evaluate an idea and assess the market
3. Explore the risks and rewards of entrepreneurship
4. Leverage experiments to validate concepts and refine your business strategy
5. Discover the key financial decisions entrepreneurs must make in the early stages of a startup
6. Understand the process of raising capital and speaking to investors

Syllabus Contents:

- Definition, Innovation and entrepreneurship, Contributions of entrepreneurs to the society, risk-opportunities perspective and mitigation of risks. Corporate entrepreneurship or entrepreneurship.
- Opportunity Identification, factors determining competitive advantage, Market segment, market structure, blue ocean strategy, Marketing research, Demand-supply analysis
- Value proposition, Business Model Canvas, Developing an Effective Business Model, Legal forms of business.
- Design Thinking, Design-Driven Innovation, TRIZ (Theory of Inventive Problem Solving), Zero-based design, Systems thinking, SPRINT Lean product development, Lean entrepreneurship, Lean manufacturing, Go-to-market strategy
- What is a balance team and why is it important, Recruiting early employees, Writing a business plan, Pitching.
- Preparing financial statements, analysis of opportunities based on -nancials, break-even & margin of safety analysis
- Government incentives for entrepreneurship, Incubation, acceleration, Funding new ventures, Legal aspects of business

References:

1. Norman M. Scarborough, Jeffrey R. Cornwell, Essentials of Entrepreneurship and Small Business Management, Pearson
2. H. Nandan, Fundamentals of Entrepreneurship 3rd Edition, PHI

(MM(DE)-19003)High Pressure Die Casting

Teaching Scheme:

Lectures: 3 hrs/week

Examination Scheme:T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Establish correlation between process parameters to resultant die casting.
2. Solve numerical problems related to die casting design.
3. Understand concepts and process capabilities of casting
4. Know pre-treatment and post heat treatments of die castings
5. Understand die casting defects and their remedial measures.

Syllabus Contents:

- Introduction. Evolution of die-casting processes. Permanent mold casting. Die-casting of low melting metals and alloys, Zinc and lead alloys. Die-casting of aluminum alloys. Hot-chamber and cold-chamber pressure die casting methods. Low pressures die casting developments. General advantages and limitations of high-pressure die-casting methods.
- High pressure die-casting machines. Plate type and toggle type machines. Range of pressures and capacities of HPDC machines. PQ2 analysis of machine capacity. Basic process and pressure-time cycles. Hydraulic systems. General control systems in HPDC machines.
- Alloys for HPDC method. Zinc alloys. Aluminum alloys. Alloys with short and long melting temperature ranges. Hot shortness and related solidification problems. Common Aluminum die-casting alloys. Magnesium and Aluminum-magnesium alloys.
- Melting methods and melt quality problems in aluminum alloys, charge calculation for alloy preparation, raw materials, quality, cost of production and energy consumption Scrap, ingots, master alloys, degassing agents and other additives. Gas content measurement. Densitometry for casting quality. Analytical methods for routine heat quality records. Basic factors in the process of solidification in metallic molds. Solidification: Controlled solidification, Microstructure Development, etc., Inspection/Quality Check: mechanical/ Micro structural/ physical/ Chemical properties, NDT, etc
- Dies for High pressure die-casting processes. Common alloys for HPDC dies and their heat-treatment. CAD systems for HPDC die design. Provision of cooling channels, inserts and supports in die-design. Die-coats and die-casting consumables.
- High Integrity Die Castings. Advanced methods for high integrity and quality aluminum pressure die-castings. Squeeze casting, Semi-solid casting methods, Rheo-casting, vacuum die casting systems.

References:

1. Degarmo, E. Paul; Black, J T.; Kohser, Ronald A. (2003), Materials and Processes in Manufacturing (9th ed.), Wiley, ISBN 0-471-65653-4.
2. Andresen, Bill (2005), Die Casting Engineering, New York: Marcel Dekker, ISBN 978-0-8247-5935-3.

3. Alan Kaye and Arthur Street , Die Casting Metallurgy, Butter worths Monographs in Materials, 1982.
4. Davis, J. (1995), Tool Materials, Materials Park: ASM International, ISBN 978-0-87170-545-7
5. ASM Metals Handbook, 9th Edition, Vol 15: Casting , 2008 , Metals Park, Ohio, U.S,A.
6. Brevick, Jerald; Mount-Campbell, Clark; Mobley, Carroll , 2004 , Energy Consumption of Die Casting Operations (PDF), Ohio State University.
7. North American Die Casting Association, Arlington Heights, Illinois IL 60004, USA.: Publications and Handbooks, 2015

SEMESTER - III

(PME-21001) Dissertation Phase – I

Teaching Scheme

Practical : 2 hrs/week

Examination Scheme

Term Work: -- 100 Marks

Course Outcomes:

1. Students will identify a practical problem from industry or research problem.
2. An extensive literature review will help them in understanding the latest happenings in the field.
3. Students will understand how to analyze the problem.

Syllabus Contents:

- Dissertation should be based on detailed study of any topic related to Manufacturing Engineering & Automation. The problem related to the field is to be identified and the data must be collected related to the problem.

(PME-20002) Introduction To Internet Of Things

Teaching Scheme

Self Learning

Examination Scheme

Term Work: -- 100 Marks

Course Outcomes:

1. Students will be able to apply IoT for the industrial application.
2. Students will be able to build application using machine to machine learning.
3. Students will be able to write Paython program for simple IoT application.

Syllabus Contents:

- Introduction to IoT, Sensing, Actuation, Basics of Networking. Basics of Networking, Communication Protocols. Communication Protocols, Sensor Networks. Sensor Networks, Machine-to-Machine Communications. Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino. Introduction to Python programming, Introduction to Raspberry. Implementation of IoT with Raspberry Pi, Introduction to SDN.SDN for IoT, Data Handling and Analytics, Cloud Computing. Cloud Computing, Sensor-Cloud. Fog Computing, Smart Cities and Smart Homes. Connected Vehicles, Smart Grid, Industrial IoT. Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring.

References

1. RFCs, Standards such as OASIS, Component Datasheets, White Papers, IEEE/ACM published recent papers/articles.
2. Internet of Things - Arshdeep Bahga, Vijay Madiseti.
3. NPTEL Link - https://nptel.ac.in/courses/106/105/106105166/

SEMESTER - IV

(PME-21003) Dissertation Phase – II

Teaching Scheme:

Practical : 2 hrs/week

Examination Scheme: Term Work: -- 100 Marks

Course Outcomes:

1. Students will be able to apply the techniques learned during the course.
2. Student will be able to provide solution to the problem.
3. Student will be in a position to publish his work in conference and Journals.

Syllabus Contents:

- Project should be research oriented experimental work, involving detail analysis or development of the industrial case studies related to Manufacturing Engineering & Automation as per the common instructions for all branches of M.Tech.

(PME-20004) Manufacturing Systems Management

Teaching Scheme:

Self Learning

Examination Scheme: ESE: -- 100 Marks

Course Outcomes:

1. Students will be able to apply Cellular Manufacturing, JIT systems, Synchronous manufacturing and Flexible manufacturing in the industrial applications.
2. Students will be able to do Loading and scheduling in Flexible manufacturing system.

Syllabus Contents:

- Introduction The challenge, Requirements of Manufacturing, Various methodologies, Cellular Manufacturing, Cell Formation - Early methods, Production Flow Analysis, Rank Order Clustering, Similarity based methods
- Cell formation algorithms, P median formulation, Assignment formulation, ZODIAC algorithm, Metaheuristics, Considering sequence, considering workload, Minimizing intercell movement, Remainder cells, Machine duplication.
- Product based cell formation, Operator Allocation, Rabbit chasing, dedicating operators. Static operator allocation problems, Network Models, Cell scheduling and sequencing, Part Family sequencing, dispatching rules.
- Cell layout, Just In Time Manufacturing, Concepts and definitions, Implementation issues, Kanban, CONWIP and Kanban, Synchronous Manufacturing, The Goal, Principles of SM, TOC and LP, Scheduling.
- Flexible Manufacturing Systems, Concepts, FMS loading problems, FMS scheduling problems

References:

1. Askin R G and Strandridge C R (1993), Modelling and Analysis of Manufacturing
2. Askin R G and Goldberg J B (2002), Design and Analysis of Lean Production Systems, John Wiley and Sons.
3. NPTEL Link - https://nptel.ac.in/courses/110106044/#

Interdisciplinary Open Course offered to other Programmes)

(IOC-20004) Reliability Engineering

Teaching Scheme:
Lectures :3 hrs/week

Examination Scheme: T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

1. Understand the importance and application of reliability.
2. Use the concepts of reliability in designing and maintenance of products.
3. Simulate techno economic life which is very important for industry application.

Syllabus Contents:

- Basic Probability, concept and various distributions. Concept of Reliability and analysis of various configurations of assemblies and sub-assemblies. Series, Parallel and other grouping. System reliability. Set theory, optimal Cut Set and Tie Set, 'star-delta' method, matrix method etc. System reliability determination through 'Event Tree' analysis and Fault tree analysis.
- Usage monitoring of plant and evaluation of reliability through failure data analysis.
- Concept of loading roughness, probability in design including evaluation of safety margin. Reliability of Engineering Design; Mean, Median & K statistics for Reliability evaluation (non parametric, Short Sample).
- Monte-Carlo simulation and Techno economic life.
- Optimal allocation of component reliability to achieve maximum system reliability – various techniques and methods such as Proportional, Conditional, AGREE, ARINC etc.
- Reliability, Availability and Maintainability of equipment.
- A number of case studies done in Indian perspectives using Short Sample, nonparametric reliability.
- Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), Failure Modes, Effects and Criticality Analysis (FMECA). R.P.N., Graph theory etc. Diagnostic maintenance through ferrography, Vibration Signature, SOAP and other programme

References:

1. C. Singh and C.S. Dhillon, Engineering Relaibility-New Techniques and Applications – John Wiley and Sons
2. K. C. Kapoor and L. R. Lubersome, Reliability in Engineering Design Willey Publication.
3. L. S. Srinath, Concepts in Reliability Engineering- Affiliated West Press.