SYLLABUS

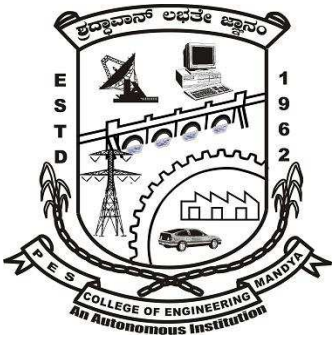
(With effect from 2017-2018)
Out Come Based Education

I & II Semester

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2017–18)
ಫಲಿತಾಂಶ ಆಧಾರಿತ ಶಿಕ್ಷಣ

Master of Technology
In
Computer Integrated Manufacturing
(Mechanical Engineering)



P.E.S. College of Engineering, Mandya - 571 401, Karnataka

(An Autonomous Institution Affiliated to VTU, Belagavi)
Grant -in- Aid Institution
(Government of Karnataka)
Accredited by NBA, New Delhi
Approved by AICTE, New Delhi.

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ

(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

Ph : 08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running Eight undergraduate and Eight Postgraduate programs. It consists of Six M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has recently become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13th June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan. Among other signatories to the international agreement are the US and the UK. Implementation of Outcome Based Education (OBE) has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

Our Higher Educational Institution has adopted the CBCS based semester structure with OBE scheme and grading system.

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize setting clear standards for observable, measurable outcomes of programs in stages. There lies a shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focus on mathematics, language, science, attitudes, social skills & moral values.

The key features which may be used to judge, if a system has implemented an outcome based education system is mainly Standard based assessments that determines whether students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, Foundation, Foundation Elective, elective, open elective and minor or soft skill courses). The CBCS provides a 'cafeteria' type approach in which the students can Choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach to learning which enables integration of concepts, theories, techniques, and, perspectives from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline. These greatly enhance the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of the academic year 2015-16. Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project and Industrial visit & Interaction are included in all undergraduate programs

Sri.B.Dinesh Prabhu
Deputy Dean (Academic)
Associate Professor,
Dept. of Automobile Engg

Dr. P S Puttaswamy
Dean (Academic)
Professor,
Dept. of Electrical & Electronics Engg.

PES College of Engineering

Vision

"*A* leading institution imparting quality engineering and management education developing creative and socially responsible professionals"

Mission

Mission of P E S College of Engineering is to,

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.
- Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.
- Promote research, product development and industry-institution interaction.

Department of Mechanical Engineering

ABOUT THE DEPARTMENT

The department of Mechanical Engineering was established in the year 1962 during the origination of the institute. The department was granted academic autonomy in the year 2009. The department presently offers B.E in Mechanical Engineering, M Tech in Computer Integrated Manufacturing (CIM), M Tech in Machine Design, M.Sc., (Engg.) by research and research leading to Ph.D. The present intake capacity of the department is 120 for BE, 18 for M Tech CIM and 24 for M Tech Machine Design. The department has a faculty-student ratio of 1:15 for UG courses and 1:12 for PG courses. The department has well established laboratories to meet the academic requirements of UG and PG programmes and a skilled technical faculty to train the students. The department has its own library which has a collection of about 3160 reference books.

The department regularly organizes industrial visits, technical lectures by experts from industries and institutes in contemporary areas to bridge the gap between syllabi and current developments. The students are encouraged to undergo industrial training as well as to take up industry oriented projects during their academic course. Mechanical Engineering Association, formed by the students and faculty of the department regularly organizes co-curricular and extracurricular activities for the students.

Vision

Be a department well recognized for its ability to develop competent mechanical engineers capable of working in global environment"

Mission

The Mission of the Department of Mechanical Engineering is to:

- Provide quality education by competent faculty.
- Provide adequate infrastructure and learning ambience for the development of essential technical skills.
- Inculcate a sense of higher education and research orientation.
- Foster industry interaction.

Credit pattern

Programme: M.Tech. in Computer Integrated Manufacturing

Core Courses	I Semester	16 credits
	II Semester	12 credits
Elective Course	I Semester	08 credits
	II Semester	12 credits
Lab	I Semester	02 credits
	II Semester	02 credits
Self Study course	III Semester	04 credits
Pedagogy Training	III Semester	02 credits
Seminar	III Semester	02 credits
Project work	III Semester	08 credits
Industrial Training	III Semester	06 credits
Project work	IV Semester	22 credits
Term Paper	IV Semester	04 credits
A total of 100 credits for 2 years		

Evaluation Scheme							
Scheme	**Weightage**	**Marks**	**Event Break Up**				
CIE	50%	50	**Test I**	**Test II**	**Quiz I**	**Quiz II**	**Assignment**
			35	35	5	5	10
SEE	50%	100	**Questions to Set: 10**		**Questions to Answer: 5**		
Scheme of SEE Question Paper (100 Marks)							
Duration: 3Hrs		**Marks: 100**			**Weightage: 50%**		

- Each of the two questions set shall be so comprehensive as to cover the entire contents of the unit.
- There will be direct choice between the two questions within each Unit
- Total questions to be set are 10. All carry equal marks of 20
- The number of subdivisions in each main question shall be limited to three only

No. of questions to be answered by students is 5

P.E.S. COLLEGE OF ENGINEERING, MANDYA-571401

Scheme of Teaching and Examination for M. Tech course in Mechanical Engineering

(Computer Integrated Manufacturing)

First semester

Sl. No.	Sub. code	Subject	Teaching Dept.	Hrs./Week L:T:P:H	Total Credits	Marks Allotted		Total Marks
						CIE	SEE	
1.	P17MCIM11	Computer Application in Design	Mechanical	4:0:0:4	04	50	50	100
2.	P17MCIM12	Computer Control of Manufacturing Systems	Mechanical	4:0:0:4	04	50	50	100
3.	P17MCIM13	Condition Based Maintenance	Mechanical	4:0:0:4	04	50	50	100
4.	P17MCIM14	Additive Manufacturing	Mechanical	4:0:0:4	04	50	50	100
5.	P17MCIM15X	Elective-I	Mechanical	4:0:0:4	04	50	50	100
6.	P17MCIM16X	Elective-II	Mechanical	4:0:0:4	04	50	50	100
7	P17MCIML17	Manufacturing Engineering Lab I	Mechanical	0:0:4:4	02	50	50	100
Total					**26**	**350**	**350**	**700**

Elective – I			
Sl.No.	Sub. Code	Subject Name	Hrs./Week - L:T:P:H
1	P17MCIM151	Advanced Materials Technology	4:0:0:4
2	P17MCIM152	Advanced Topics in Manufacturing Management	4:0:0:4

Elective – II			
Sl.No.	Sub. Code	Subject Name	Hrs./Week - L:T:P:H
1	P17MCIM161	Management Information Systems	4:0:0:4
2	P17MCIM162	Artificial Intelligence & Expert Systems	4:0:0:4

Second semester

Sl. No.	Sub. code	Subject	Teaching Dept.	Hrs./Week L:T:P:H	Total Credits	Marks Allotted		Total Marks
						CIE	SEE	
1.	P17MCIM21	Advanced Industrial Robotics.	Mechanical	4:0:0:4	04	50	50	100
2.	P17MCIM22	Flexible Manufacturing Systems.	Mechanical	4:0:0:4	04	50	50	100
3.	P17MCIM23	Metrology & Computer Aided Inspection.	Mechanical	4:0:0:4	04	50	50	100
4.	P17MCIM24X	Elective- III	Mechanical	4:0:0:4	04	50	50	100
5.	P17MCIM25X	Elective- IV	Mechanical	4:0:0:4	04	50	50	100
6.	P17MCIM26X	Elective- V	Mechanical	4:0:4:4	04	50	50	100
7	P17MCIML27	Manufacturing Engineering Lab II	Mechanical	0:0:4:4	02	50	50	100
Total					**26**	**350**	**350**	**700**

Elective- III			
Sl No	**Sub Code**	**Subject Name**	**Hrs/Week - L:T:P:H**
1	P17MCIM241	Statistical Modeling and Experimental Design.	
2	P17MCIM242	Lean Manufacturing Systems.	
Elective- IV			
Sl No	**Sub Code**	**Subject Name**	**Hrs/Week - L:T:P:H**
1	P17MCIM251	Newer Machining Techniques.	
2	P17MCIM252	Tooling for Manufacturing in Automation.	
Elective- V			
Sl No	**Sub Code**	**Subject Name**	**Hrs/Week - L:T:P:H**
1	P17MCIM261	Nano Technology.	
2	P17MCIM262	Reverse Engineering.	

P.E.S. COLLEGE OF ENGINEERING, MANDYA-571401

Scheme of Teaching and Examination for M. Tech course in Mechanical Engineering

(Computer Integrated Manufacturing)

Third semester

Sl. No.	Sub. code	Subject	Teaching Dept.	Hrs./Week L:T:P:H	Total Credits	Marks Allotted		Total Marks
						CIE	SEE	
1.	P17MCIM31	Self study course	Mechanical	4:0:0:4	04	50	50	100
2.	P17MHSM32	Pedagogy/ Research Methodology	HS&M	0:2:2:4	02	100	--	100
3.	P17MCIM33	Seminar	Mechanical	--	02	100	--	100
4.	P17MCIM34	Project-Phase-I	Mechanical	--	04	100	--	100
5.	P17MCIM35	Project-Phase-II	Mechanical	--	04	100	--	100
6.	P17MCIM36	Industrial Training	Mechanical	--	06	100	--	100
Total					**22**	**550**	**50**	**600**

Fourth semester

Sl. No.	Sub. code	Subject	Teaching Dept.	Hrs./Week L:T:P:H	Total Credits	Marks Allotted		Total Marks
						CIE	SEE	
1.	P17MCIM41	Project-Phase-III	Mechanical	--	04	100	--	100
2.	P17MCIM42	Project-Phase-IV (Thesis Evaluation)	Mechanical	--	10	100	--	100
3.	P17MCIM43	Project-Phase-V (Viva-Voce)	Mechanical	--	08	--	100	100
4.	P17MCIM44	Term Paper	Mechanical	--	04	--	100	100
Total					**26**	**200**	**200**	**400**

Note:

1 Eight weeks of compulsory Industrial Training to be undergone by the students during their third semester. A report on Industrial Training is to be submitted by the student. The report has to be evaluated by Industrial guide and Institute guide for CIE of 50 marks (industry and supervisor evaluation average marks for 50 each). The student must give seminar based on Industrial Training before a committee constituted by the department for remaining CIE of 50 marks.

2 The Laboratories are CIE with report submission and seminar presentation /Viva Voce of 50 marks each.

3 Pedagogy/Research methodology is CIE with objective type of question for evaluation

4 The seminar (III Semester) shall be of 100 marks CIE. It is based on the current topics presentation along with a report submission for evaluation each of 50 marks.

5 Project work Phase-1, 2 & 3 to be awarded by the Department committee constituted for the purpose

a) The Project Phase-I evaluation shall be of 100 marks CIE. It is based on Report Submission consisting of Title, Introduction, Literature Survey, Summary of Literature Survey, Objectives and Methodology (50 Marks) and Presentation (50 marks) each.

b) The Project Phase-II evaluation shall be of 100 marks CIE. It is based on Report Submission consisting of Experimentation, Theoretical analysis approach and results (if completed as a stage work) and Presentation for 50 marks each.

c) The Project Phase-III evaluation shall be of 100 marks CIE. It is based on Thesis manuscript and presentation for 50 marks each (work completion report).

6 The Project Phase-IV evaluation shall be of 100 marks CIE. It is based on the evaluation done separately by internal and external examiners and average marks of the two examiner shall be consider as final marks

7 The Project Phase-V evaluation shall be of 100 marks SEE. It is based on Thesis presentation and project viva voce has to be conducted jointly by internal and external examiner for a total of 100 marks SEE.

8 The term paper is purely based on the project work he/she chooses.

9 The Term paper shall be for 100 marks SEE. It has to be evaluated by the committee formed by HOD consisting of PG coordinator, guide and subject expert internal/ external for each candidate.

10 The term paper evaluation is based on the publication of an article in peer reviewed conference/ journal (national/ international) and quality of the journal. If the term paper is not published by the candidate or the same is communicated for publication at the end of his/ her tenure, then the committee formed by HOD consisting of PG coordinator, guide and subject expert internal/ external for each candidate will asses.

11 The self study course shall consist of five units with lab component and he/ she must be able to demonstrate the knowledge gained by the candidates. The course content must be tailer made by the department to suit their requirements.

12 The self study course shall be of 100 marks. The course evaluation is based on the lab report submission/ assignment/ viva -voce as CIE 50 marks and SEE for 50 marks.

Course Title: Computer Application in Design			
Course Code: P17MCIM11	**Sem: I**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: The course aims at producing designers and manufacturing professionals with expertise in application of state of the art knowledge in modeling for computer assisted design.

Course Content

UNIT -1

Introduction: Definitions, Design Process, Product Cycle, Computer Aided Design (CAD)-, Hardware Integration and Networking. **Cad Software**- Data Structure, Database, Database Management System (DBMS) Database Coordinate System, Working Coordinate System, Screen Coordinate System, Modes of Graphics Operations, User Interface, Software Modules-Operating System(OS) Module, Graphics Module, Applications Module, Programming Module, Communications Module, Modeling and Viewing, Software Documentation and Development. **10hrs**

UNIT – 2

Computer Graphics: Rasterscan Graphics, DDA Algorithm, Bresenham Algorithm, Anti-Aliasing Lines. Database Structures-Data Structure- Organisation, Data Models; Geometric Model Data, Engineering Data Management (EDM) System. **Transformations:** Translation, Scaling, Reflection or Mirror, Rotation, Concatenations, Homogeneous Transformation, 2D/3D Transformations-Translation, Scaling, Rotation about, X, Y and Z axes. Numericals. Mathematics of Projections- Orthographic and Isometric Projections. Clipping, Hidden Line or Surface removal, Color and Shading. **10hrs**

UNIT- 3

Geometric Modeling: Requirements of Geometric Modeling, Geometric Models, Geometric Construction Methods, Constraint- Based Modeling, Other Modeling Methods- Cell Decomposition, Variant Method, Symbolic Programming, form Features; Wireframe Modeling- Definitions of Point lines, Circles, Arcs, etc. Modeling Facilities-Geometric Modeling Features, Editing or Manipulating, Display Control, Drafting, Programming, Analytical and Connecting Features. **Graphic Standards** -Standardization in Graphics, Graphical Kernel System (GKS), Other Graphic Standards-GKS 3D, PHIGS, Exchange of Modeling Data-IGES,STEP, Drawing Exchange Format (DXF), Dimension Measurement Interface Specification(DMIS). **11hrs**

UNIT – 4

Modeling Curves & Surfaces: Curve Representation-Line, Circle, Parabola, Hyperbola, Curve Fitting- Interpolation Techniques- Legrangian Polynomial, B-Splines, Approximate Methods-Method of Least Squares, Polynomial Curve Fitting, Synthetic Curves-Hermite Cubic Spline, Bermestine Polynomials, Bezier Curve, rational Curves, and NURBS.**Surface Representation** -Analytic Surfaces, Surfaces of Revolution, Ruled Surfaces, Synthetic Surfaces- Hermite Cubic Surface, Bezier Surface, B-Spline Surface, Coons Surface Patch, Tabulated Cylinder, Sculptured Surfaces, Surfaces of Manipulation-Surface Display, Segmentation. **10hrs**

UNIT -5

Modeling Of Solids: Solid Representation-Concepts, Boundary Representations (B-Rep), Constructive Solid Geometry (CSG), Half Space Method, sweep representation. Organization of solid modelers. **Mechanical Assembly:** Introduction, Assembly Modeling, Parts Modeling and Representation, Hierarchical Relationships, Mating Conditions, Inference of Position from Mating Conditions, Representation Schemes, Graph Structure, Location Graph, Virtual Link, Generation of Assembling Sequences, Precedence Diagram, Liaison-Sequence Analysis, Precedence Graph, Assembly Analysis. **11hrs**

Text books

1. P.N. Rao, **"CAD/CAM Principles and Applications,"** 3rd Edition, McGraw Hill, Education Pvt. Ltd., New Delhi, 26 May 2010, ISBN: 978-0070681934.
2. Ibrahim Zeid and R. Shivasubramanian, **"CAD/CAM Theory &Practice,"** 2nd Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 25 June 2009, ISBN: 978-0070151345.
3. Ibrahim Zeid, **"Mastering CAD/CAM,"** McGraw Hill, 2nd Edition, 7 August 2006, ISBN: 978-0070634343.

References

1. M.P. Groover and E.W.Zimmers, **"CAD/CAM Computer aided Design and Manufacture,"** Prentice Hall, US Edition, 1984, ISBN: 978-0131101302.
2. C.B. Besant and E.W.K. Lui, **"Computer Aided Design and Manufacture,"** Affiliated East West Press India, 3rd Edition, 1988, ISBN: 8185095787.
3. Kunwoo Lee, **"Principles of CAD/CAM/CAE Systems,"** Pearson, 1st Edition, 30th January 1999, ISBN: 978-0201380361.

Course Outcomes

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

1. **Explain** the Design Process, Product Cycle, CAD, CAD Hardware and Networks.
2. **Discuss** Data Structure, Database Management System (DBMS), Coordinate Systems and Software Modules.
3. **Explain** Rasterscan Graphics, Algorithm's, Database Structures and organization. **Describe** 2D/3D Transformations and **Apply** the transformations to various situations.
4. **Discuss** the Requirements of Geometric Modeling, Modeling Facilities, 2D Modeling. **Describe** the Graphic Standards.
5. **Identify** the different types of Curves & Surfaces. **Explain** the various Representation and manipulation Techniques
6. **Explain** techniques of Solid Modeling. **Represent and Analyze** Mechanical Assemblies

Course Title: Computer Control of Manufacturing Systems			
Course Code: P17MCIM12	**Sem: I**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: To provide knowledge on principle, constructional features, programming, tooling and work holding devices in CNC machine tools.

Course Content

UNIT -1

Automation and Control technologies: Levels Of Automation, Continuous Versus Discrete Control - Continuous Control Systems -Discrete Control Systems Computer Process Control - Control Requirements - Capabilities of Computer Control. **Computer Process Control**: Forms of Computer Process Control - Computer Process Monitoring - Direct Digital Control - Numerical Control and Robotics - Programmable Logic Controllers - Supervisory Control - Distributed Control Systems and Personal Computers in process control, Enterprise - Wide Integration of Factory Data. **10hrs**

UNIT - 2

Features of NC Machine tools: Fundamentals of numerical control, advantages and limitations of N.C systems-classification of N.C systems, Design consideration of N.C machine tools, Methods of improving machine accuracy, increasing productivity with N.C machines, Machining centers, MCU Functions. **Control loops of N C Systems and CNC hardware basics**: Introduction, control of point-to point systems, Control Loops in Contouring systems. CNC Hard ware Basics: Structure of CNC machine tools, Drives, Actuation systems, Feedback devices, Axes-standards. **11hrs**

UNIT- 3

CNC Machine tools and control systems: CNC Machining centres, CNC Turning centres, High-speed machine tools, Machine control unit, Support systems, Touch trigger probes. **Tool Changing Systems:** Turning-tool geometry, Milling Tooling Systems, Tool Presetting, Methods of optimizing output from NC machine tools, Automatic Tool Changers, Work holding. **10hrs**

UNIT - 4

CNC programming: Part Programming Fundamentals – Manual Part Programming methods using ISO codes, Preparatory functions, Miscellaneous functions, Tool length compensation, canned cycles, Cutter radius compensation, canned cycles, Part Programs on milling, Drilling and Tapping operations. **Turning centre Programming**: Comparisons between machining centre and turning centres, Tape format, Axes system, General programming functions, motion commands, cut planning, Thread cutting, canned cycles, Part programs on turning**.** **11hrs**

UNIT -5

Computerized Numerical Control: CNC concepts, advantages of CNC, Digital computer, Reference-pulse Technique, sampled-Data technique, Microcomputers in CNC. **Adaptive Control Systems**: Introduction, Adaptive control with optimization, Adaptive control with constraints, variable- gains AC systems, Adaptive control of Grinding. **10hrs**

Text books

1. Y. Koren, **"Computer Controls of Manufacturing Systems,"** McGraw Hill, 1983.
2. P.N. Rao, **"CAD/CAM Principles and Applications,"** 3rd Edition, McGraw Hill, Education Pvt. Ltd., New Delhi,26 May 2010, ISBN: 978-0070681934.
3. M.P. Groover, **"Automation, Production Systems and Computer Integrated Manufacturing,"** Prentice Hall India Pvt. Ltd.,3rd Edition, 24 July 2007, ISBN: 978- 0132393218.

References

1. Martin J, **"Numerical Control of Machine Tools,"** Butterworth-Heinemann, 20th May 1991, ISBN: 9780750601191.
2. Y. Koren& J. Ben-Uri, **"Numerical Control of Machine Tools,"** Khanna Publishers, Delhi, 1978.
3. Wilson, **"Numerical Control in Manufacturing,"** McGraw Hill New York, 1963.
4. Sherawat & Narang, **"CNC Machines,"** Dhanpat Rai and Co (P) Ltd., ISBN: 1234567144616.

Course Outcomes

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

1. **Discuss** the Levels Of Automation. & **Explain** the Computer Process Control
2. **Describe** the features of NC Machine tools & **Apply** the knowledge in selection of control l
   loops, drives, feedback devices and actuation systems.
3. **Discuss** CNC Machining centres, CNC Turning centres and Tool Changing Systems
4. **Develop** part programs for given component on turning and milling machine
5. **Explain** CNC concept, Reference-pulse Technique, sampled-Data technique, Microcomputers in CNC & Adaptive Control Systems

---

Course Title: Condition Based Maintenance			
Course Code: P17MCIM13	**Sem: I**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: The course aim is to provide extensive knowledge of Condition Based Maintenance (CBM); the techniques & tools used, the diagnostics and advanced methods of CBM

Course Content

UNIT -1

Condition Based Maintenance: Introduction, Principles, Economics and Application; Condition Monitoring Methods. Economics of Condition Monitoring, Setting up a CM Activity, Implementation of Condition Based Maintenance, Consequences of implementation of CBM. Information System, Selection of Monitoring Methods, Assessment of monitoring techniques. **Performance Trend Monitoring:** Introduction, Thermodynamic and Fluid dynamic analysis, Primary and Secondary, performance parameter, Steam turbine performance parameters. **10hrs**

UNIT - 2

Vibration Monitoring And Analysis: Introduction, Machinery signatures, Selection of Transducers. Analysis Techniques, Machine failure modes, Measurement location, Vibration severity criteria, Vibration frequency analysis, Permanent Monitoring. **Vibration Monitoring Of Ball And Roller Bearings:** Introduction, Shock pulse method, SPM for testing Antifriction bearings, Manual Monitoring Continuous monitoring, The Kurtosis method, Fiber optics system, Vibration signature analysis, Contact resistance method. SPM & its Applications. **11hrs**

UNIT- 3

Non-Destructive Testing: Introduction, Visual testing, Liquid Penetrant inspection and other methods, Radiographic examination, Electrostatic or Ven De Graff generators, Linear accelerators. Gamma-ray Radiography- Sources-Radium, Thallium 170, Iridium 192, Cobalt 62. Isotope Projectors-Geometric factors, Radiographic film, Radiograph. Safety Hazards and Government control; Cost. Sonics, Ultra Sonics, Ultra Sonic inspection and other techniques. **Sound Monitoring:** Introduction, sound frequencies, sound loudness measurement, acoustic power, sound measurement, sound level meters, sound analyzers, sound signal data processing, sound monitoring. **9hrs**

UNIT - 4

Specialized Techniques: Acoustic imaging, Ultra sonic triangulation fault location, Acoustic Emission Technique (AET) - Instrumentation, Transducers, Pre-amplifier and filter, Main amplifier and Signal processing/ Display unit, Signals and processing, Magnetic testing Methods, Current flow Magnetisation, Induction Magnetic Flow Method, Induction Threading bar method, Induction Magnetising Coil method, Induced Current flow method, Magnetic particle Inspection Inks, Strippable Magnetic film, Eddy Current apparatus. Thermography-Thermographic Equipment, Application of Thermography, Corrosion monitoring, Need for corrosion monitoring, Fields of application, Monitoring Techniques, Resistance techniques. Analytical technique and others. **10hrs**

UNIT -5

Mechanical Fault Diagnosis By Wears Monitoring & Lubricant Analysis: Introduction, Source of Contamination, Significant oil contaminants, Used oil Contamination-time trends, Changes in the carrier fluid, Ferratic wear debris. Wear process monitoring techniques-Direct debris detection methods, Debris collection methods. Lubricant sampling & analysis-Sampling, Lubricant sampling methods, Lubricant analysis methods, Interpretation of results, Indications from the amount of debris present, Indication from the size distribution of debris, Application of chemical analysis of debris, Wear detection using proximity monitors. **Condition Monitoring Case Studies & Applications:** Failure of fan bearings- History of failures, Analysis of the failures, Solution. High frequency vibration of gas compressor-History of trouble, Analysis of trouble, Solution. **12hrs**

Text books

1. R. Collacatt, **"Mechanical Fault Diagnosis and Condition Monitoring,"** Springer Netherlands, 1st Edition 1977, ISBN: 978-94-009-5725-1.

References

1. L. F. Pau, **"Failure Diagnosis and Performance Monitoring,"** Marcel Deker Inc., 1st May 1981, ISBN: 978-0824710187.
2. Mohammed Ben-Daya, Uday Kumar and D.N. Prabhakar Murthy, **"Condition Monitoring and Condition Based Maintenance,"** John Wiley & Sons, 19 FEB 2016, ISBN: 9781118926581.

Course Outcomes

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

1. **Discuss** Condition Based Maintenance &Performance Trend Monitoring
2. **Explain** the relationship between vibrations and machine status also vibration measurements and analysis.
3. **Discuss** Non-Destructive Testing, Safety Hazards and Government control.
4. **Describe** Specialized Techniques of condition monitoring.
5. **Analyze** Professional and practical skills of fault diagnosis, machinery monitoring, and maintenance scheduling.

Course Title: Additive Manufacturing			
Course Code: P17MCIM14	**Sem: I**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: The course enables the students to understand different additive manufacturing techniques also to identify different rapid tools development techniques.

Course Content

UNIT -1

Introduction: Definition of Prototype, Types of prototype, roles of prototype, Need for the compression in product development, History of RP systems, classification of RP systems, STL file, and basic steps in RP, advantages and disadvantages of RP system, Survey of applications. **Stereo lithography Systems:** Principle, Process parameter, process details, Data preparation, data files and machine details, merits and demerits, materials, Applications. Case study. **10hrs**

UNIT - 2

Fusion Deposition Modeling: Principle, Process parameter, merits and demerits, machine details materials, Applications, Case study. **Selective Laser Sintering:** Type of machine, Principle of operation, process parameters, Data preparation for SLS, merits and demerits, machine details materials, Applications, Case study. **Laminated Object Manufacturing:** Principle of operation, LOM materials, process parameters, process details, merits and demerits, materials, application. **Solid Ground Curing:** Principle of operation, process parameters, Machine details, merits and demerits, materials, Applications, Case study.

11hrs

UNIT- 3

Laser Engineering Net Shaping (Lens): Principle of operation, process details, merits and demerits, materials, applications, Case study. **Medical modeling:** method of modeling, MAGICS, MIMICS, MAGIC communicator, etc. Internet based software**,** Applications, Case study. **Concepts Modelers:** Concept modelers and its uses, difference between concept modelers and RP machine. Principle of operation, merits and demerits, Applications of Thermal jet printer, Sander's model market, 3-D printer, GenisysXs printer, JP system 5, object Quadra systems. **10hrs**

UNIT - 4

Indirect Rapid Tooling: Types of rapid tooling, Indirect Rapid Tooling -Silicon rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, Cast Kirksite, 3D Keltool**. Direct Rapid Tooling** — Soft Tooling v/s. Hard tooling. Direct AIM, Quick cast process, Rapid steel 1.0, Rapid steel 2.0,Copper polyamide, and Sand Form. Rapid Tool, DMLS, ProMetal, Sand casting tooling, Laminate tooling. **11hrs**

UNIT -5

Rapid Manufacturing Process Optimization: factors influencing accuracy, data preparation errors, Part building errors, Error in finishing, influence of build orientation**. Allied Processes:** vacuum casting, surface digitizing, surface generation from point cloud data, surface modification — data transfer to solid models. **10hrs**

Text books

1. Paul F. Jacobs, **"Stereo lithography and other RP & M Technologies,"** American Society Mechanical Engineers, 1st January 1996, ISBN: 978-0872634671.
2. Pham D.T & Dimov S.S, **"Rapid Manufacturing,"** Springer-Verlag London Ltd., 1st Edition 2001, ISBN: 978-1-4471-1182-5.

References

1. Terry Wohlers, **"Wohlers Report 2000,"** Wohler's Association, 1st Edition 2000.

Course Outcomes

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

1. **Describe** Rapid prototyping techniques.
2. **Explain** concept modelers
3. **Discuss** different types rapid tools production
4. **Explain** rapid prototyping process optimization.
5. **Discuss** surface digitization from other types of data.

Course Title: Advanced Materials Technology			
Course Code: P17MCIM151	**Sem: I**	**L:T:P:H: 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Objective: The aim of the course is to enable the students to understand principles and working of various processing techniques for identifying material and recommend appropriate methods to improve process performance.

Course Content

UNIT -1

Structure-Property Relations & Newer Materials: Introduction, Atomic structure, atomic bonds, secondary bonds, crystal structure, **C**rystal structure, crystal defects, grain structure, elastic and plastic deformation in single crystals, strain /work hardening, plastic deformation in polycrystalline metals, fracture of metals. **Newer Materials**: Plastics, polymerization, thermosetting and thermoplastic materials and properties. Ceramic materials and their properties. Composite materials – classification, matrix and reinforcement materials,

properties, rule of mixtures, longitudinal strength and modulus (isostrain model), transverse strength and modulus (isostress model), applications of composites. **11hrs**

UNIT - 2

Processing of Composites: Processing of MMCs: Matrix and reinforcement materials, diffusion bonding, squeeze casting, reocasting, arc spray forming, superplastic forming, in situ process. **Processing of CMCs**: matrix and reinforcement materials, fabrication of glass fibers, boron fibers, carbon fibers, alumina fibers, silicon carbide fibers. Processing- slurry infiltration process, melt infiltration process, direct oxidation or Lanxide process. **Processing of PMCs**: matrix and reinforcement materials, processing of polyethylene fibers, aramid fibers. Processing of PMCs – hand lay-up process, spray-up technique, filament winding process, pultrusion process, autoclave moulding. **11hrs**

UNIT- 3

Powder Metallurgy: Introduction, Production of Powder, Characterization & Testing of Powders, Powder Conditioning, Powder Compaction, Sintering, Finishing operations, Applications of PM components. **10hrs**

UNIT - 4

Surface Treatment: Introduction, Surface Engineering, Surface quality & integrity concepts, Mechanical treatment, Thermal spraying processes and applications, Vapour depositions processes and applications, Ion-implantation. **10hrs**

UNIT -5

Nano Technology: Concept of Nanotechnology, Nanomaterials, preparation of Nanomaterials- plasma arcing, CVD, sol-gel method, electrode deposition, ball milling, New forms of carbon, types of nano-tubes, properties of nano-tubes, Nano material characterization –TEM, scanning probe microscopy, atomic force microscopy, scanning tunneling microscopy, applications of nanotechnology. **10hrs**

Text books

1. E. Paul Degarmo, J.T. Black, Ronald A Kohser, **"Materials and Processing in Manufacturing,"** John Wiley and Sons,11th Edition, 19th September 2011, ISBN: 978-0470924679.
2. K.K.Chawla, **"Composite Materials–Science & Engineering,"** Springer (sie), 2006, ISBN: 978-8181284907.
3. A.K. Sinha, **"Powder Metallurgy,"** DhanpatRai Publications,2nd Edition, ISBN: 978-9383182145
4. Dr. H. K. Shivanand and B.V. BabuKiran, **"Composite Materials,"** Asian Publication, ISBN: 9788184121452.
5. Mick Wilson and Kamali Kannangara, **"Nanotechnology-Basic science and Emerging Technology,"** Chapman and Hall/CRC, 1st Edition, 27th June 2002, ISBN: 978-1584883395.

References

1. V.S.R Murthy, A.K.Jena, K.P.Gupta, G.S.Murthy, **"Structure and Properties of Engineering Materials,"** Tata McGraw Hill, 2003, ISBN: 9780070482876.
2. M.M. Schwartz, **"Composite Materials Hand Book,"** McGraw Hill, 1983, ISBN: 978-0070557437.
3. RakeshRathi, **"Nanotechnology,"** S.Chand and Company, 1st December 2010, ISBN: 978-8121930826.

Course Outcomes

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

1. **Explain** the concepts and principles of advanced materials and manufacturing processes
2. **Select** materials and processes for particular application
3. **Explain** the concept of powder metallurgy technique
4. **Explain** the principles and application of surface treatment methods
5. **Define** Nanotechnology, **Describe** Nano material characterization.

Course Title: Advanced Topics in Manufacturing Management			
Course Code: P17MCIM152	**Sem: I**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: This course is designed to address the key operations and logistical issues in service and manufacturing organizations that have strategic as well as tactical implications. The specific objective includes; To understand the application of operations management policies and techniques to the service sector as well as manufacturing firms.

Course Content

UNIT -1

System theory concepts and system simulation as applied to manufacturing.Flexible production system and continuous flow production. Line Balancing. **10hrs**

Unit - 2

Management by objectives, quality circles, PQ team approach, Flex time, Job Analysis, Job rotation. **11hrs**

UNIT- 3

Group Technology, Single Minute Exchange of Dies (SMED) techniques.MRP I, MRP II, J I T, Kanban& Kaizen System. **10hrs**

UNIT - 4

Total Quality Control, zero defect theory, Quality assurance, SPC Tools. **11hrs**

Unit -5

Concepts of Value Engg., Value analysis, zero base budgeting. Introduction to Logistics, Management, Terotechnology and Life Cycle Costing. **10hrs**

Text books

1. Richard T Schonberger, **"Japanese Manufacturing Techniques,"** Macmillan USA, 1st November 1982, ISBN: 978-0029291009.
2. Dr. Shigeo Shingo and Andrew P. Dillon, **"Single Minute Exchange of Dies,"** Productivity Press, 1st Edition, 1st April 1985, ISBN: 978-0915299034.
3. Elwood S Buffa, **"Models for Production and Operations Management"** John Wiley & Sons, New York, 8th Edition, 2nd September 1987, ISBN: 978-0471857822.

References

1. Yashro Mondreu, **"Totyoba Productions Systems,"** Inst. Of Indl. Engrs., 1983.
2. David J Sumanth, **"Productivity Engg. & Management,"** McGraw Hill Higher Education, 1st March 1984, ISBN: 978-0070624269.
3. Benjamin S. Blanchard, **"Logistics Engineering Management,"** Prentice Hall, 4th Edition, 1992, ISBN: 9780135288290.
4. M.P. Groover, **"Automation, Production systems and Computer Integrated Manufacturing,"** PHI, 3rd Edition, 24th July 2007, ISBN: 978-0132393218.

Course Outcomes

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

1. **Discuss** System theory concepts and system simulation as applied to manufacturing. **Explain** Flexible production system and continuous flow production. Line Balancing.
2. **Describe** Management quality circles, PQ team approach, Flex time, Job Analysis, Job rotation.
3. **Explain** Group Technology, Single Minute Exchange of Dies (SMED) techniques. MRP I, MRP II, J I T, Kanban& Kaizen System,
4. **Discuss** Total Quality Control, zero defect theory, Quality assurance, SPC Tools
5. **Explain** Concepts of Value Engg., Value analysis, zero base budgeting. **Discuss** Logistic,. Management, Terotechnology and Life Cycle Costing.

Course Title: Management Information Systems			
Course Code: P17MCIM161	**Sem: I**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: To provide students with basic concepts in information system and the benefits with these systems in modern society. Differentiate between data, information, and knowledge. To understand systems definition, systems requirements, and information needed for decision maker. To identify several methods to enhance and develop information systems and to manage the information system recourses

Course Content

UNIT -1

Introduction and Organizational Systems: Definition, importance, evolution, computers and MIS organizational structures, Logical foundation, future of MIS. Nature and Characteristics of organizations. **12hrs**

UNIT - 2

Information Systems and Communication Technology: Organizational and information system structures, information, data information, management and information systems. Information support for functional areas, impact of business and information systems, organizing information systems, absorption of MIS in organizations. **10hrs**

UNIT- 3

Database Technology: Data base and enterprise management, File processing systems and data base systems, Database Approach and its architecture, DBMS, Models, RDBMS, SQL, 4GL, Data Administration, Current development in databases. **10hrs**

UNIT - 4

Decision Support Systems: Definition, Evolution of DSS, DSS issues, Structure Constructions-approaches, Generators, Tools, Software and Cost benefits. **10hrs**

UNIT -5

Expert Systems and Artificial Intelligence: Basic Concepts, Structure development, Benefits and Limitations. **10hrs**

Text books

1. L .S. Sadagopan,**"Management Information Systems,"** Prentice Hall of India New Delhi, 1997, ISBN: 9788120311800.

References

1. Davis G.B and M.Olson, **" Management Information Systems,"** McGraw Hill New York, 2nd Edition, 1985, ISBN: 9780070158283.
2. O'brienJ .A Jr., **"Management Information Systems"** McMillan, New York, 1995.
3. Date C.J, **"An Introduction to Database Systems,"** Pearson, 8th Edition, 22nd July 2003, ISBN: 978-0321197849.
4. Turban E and Meredith J.R, **"Fundamental of Management Science,"** Burr Ridge, 6th Edition, IRWINinc1994, ISBN: 9780256117240.
5. Murdick R.G and Ross J.E, **"Information Systems for Modern Management,"** Prentice Hall of India, 2nd Edition, 1977, ISBN: 9780134646022.

Course Outcomes

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

1. **Define** the concepts and definition of the Information and Organization systems
2. **Explain** different types of Information systems and communication Technologies
3. **Explain** DBMS, Models, RDBMS, SQL, 4GL, Data Administration, Current development in databases
4. **Define and Explain** Evolution of DSS, DSS issues
5. **Explain** Development of Artificial Intelligence

Course Title: Artificial Intelligence & Expert Systems			
Course Code: P17MCIM162	**Sem: I**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: The objective of this course is to provide the student with an overview of topics in the field of artificial intelligence (AI). The course also provides the student with a working knowledge of designing an expert system and applying expert system technology in designing and analyzing engineering systems.

Course Content

UNIT -1

Human and Machine Intelligence: Concepts of fifth generation computing, programming AI environment, developing artificial intelligence system, definition of Expert systems, Natural Language processing, neural networks. **Tools for Machine Thinking:** Forward chaining, Backward chaining, use of probability and fuzzy logic. **10hrs**

UNIT - 2

Expert System Development: Choice of Domain, collection of knowledge base, selection of inference mechanism, case studies of expert system development in design and manufacturing. **Advanced Knowledge Representation for Smart Systems:** semantic nets-structure and objects, ruled systems for semantic nets; certainly factors, Automated learning. **11hrs**

UNIT- 3

Advanced Programming Techniques: Fundamentals of object oriented programming, creating structure and object, object operations, involving procedures, programming applications, object oriented expert system. **10hrs**

UNIT - 4

Languages in AI: Using PROLOG to design expert systems, converting Rules to PROLOG, Conceptual example, introduction to LISP, Function evaluation, Lists, Predicates, Rule creation. **11hrs**

UNIT -5

Expert System Tools: General structure of an expert system shell, examples of creation of an expert system using an expert system tool. **Industrial Application of AI and Expert Systems:** Robotic vision systems, Image p processing techniques, application to object recognition and inspection, automatic speech recognition. **10hrs**

Text books

1. Robert Levine et al, **"A Comprehensive Guide to Artificial Intelligence and Expert Systems,"** McGraw Hill Inc, 1st June 1986, ISBN: 978-0070374706.
2. Henry C Mishkoff, **"Understanding Artificial Intelligence,"** H W Sams, 2nd Edition, 1988, ISBN: 9780672272714.

References

1. S.J. Russel and Peter Norvig, **"Artificial Intelligence: A Modern Approach,"** Pearson, 3rd Edition, 1st December 2009, ISBN: 978-0136042594.
2. M. Tim Jones, **"Artificial Intelligence: A System Approach,"** Jones and Bartlett Publishers Inc., 1st Edition, 20th February 2009, ISBN: 978-0763773373.

Course Outcomes

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

1. **Explain** programming AI environment &developing artificial intelligence System **Discuss** Forward chaining, Backward chaining, use of probability and fuzzy logic.
2. **Describe** selection of inference mechanism, case studies of expert system development in design and manufacturing.
3. **Explain** semantic nets-structure and objects, ruled systems for semantic nets; certainly factors, Automated learning.
4. **Discuss** Fundamentals of object oriented programming, creating structure and object, object operations, involving procedures, programming applications, object oriented expert system.
5. **Explain** Using PROLOG to design expert systems, converting Rules to PROLOG, Conceptual example, introduction to LISP, Function evaluation, Lists, Predicates, Rule creation
6. **Discuss** General structure of an expert system shell, examples of creation of an expert system using an expert system tool.
7. **Industrial Application of AI and Expert Systems:** Robotic vision systems, Image processing techniques, application to object recognition and inspection, automatic speech recognition.

Course Title: Manufacturing Engineering Lab I			
Course Code: P17MCIML17	**Sem: I**	**L:T:P:H : 0:0:4:4**	**Credits: 02**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Contents

1. Solid Modeling of simple machine parts using CATIA software - Two models
2. Structural Analysis of 3D machine elements using ANSYS Software – Two problems
3. Design and building of Hydraulic circuits using Single acting Cylinder and Double acting Cylinder &its analysis.
4. Study of different types of chips produced in machining ductile materials and brittle materials.-Three different materials.
5. Machining of Composites materials and study of delamination-Two different composite materials.

Total 10 Experiments

Text Books

1. Anthony Esposito, **"Fluid Power with Applications**,**"** Pearson Education, 7th Edition, 2008, ISBN: 9781292023878.
2. P N Rao, **"CAD/CAM Principles and Applications**,**"** Tata McGraw Hill Education Pvt., Ltd., New Delhi, 3rd Edition, 2010, ISBN: 9780070681934.
3. K.K Chawla, **"Composite Materials: Science and Engineering**,**"** Springer-Verlag, New York, 3rd Edition, 2012, ISBN: 978-0-387-74365-3.

Course Title: Advanced Industrial Robotics.			
Course Code: P17MCIM21	**Sem: II**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: To be familiar with the automation and brief history of robot and applications. To give the student familiarities with the kinematics of robots, Knowledge about Autonomous Mobile Robots and their design. Mobile Robot Maneuverability. Knowledge about Mobile Robot Planning & Navigation.

Course Content

UNIT -1

Introduction to Robotics: Geometrical configuration of robots and its work volume, Precision of movement, Numericals, Advantages, disadvantages and industrial applications of robot. Grippers, classification, working principle. **11hrs**

UNIT - 2

Kinematic Analysis & Coordinate Transformation: Direct Kinematic Problem in Robotics, Geometry based direct Kinematic Analysis Coordinate & Vector Transformation using Matrices, The orientation Matrix & Translator Vector, Homogeneous Transformation Matrices, Three dimensional Homogeneous Transformations, Denavit-Hartenberg Convention-Implementing the DH Convention, Obtaining the DH Displacement Matrices. Applications of DH method- Three axis Robot Arms, Three Axis wrists, six axis Robot Manipulators, Assigning the Tool Coordinate System. **11hrs**

UNIT- 3

Robot Programming: Lead through programming methods- Robot program as a path in space, motion interpolation. Wait, signal & delay command, branching examples. **Robot languages**- Robot languages elements & functions, types of commands, programs control & sub routines, example programs, types of robot languages. **10hrs**

UNIT - 4

Autonomous Mobile Robots: Introduction, Locomotion - Key issues for locomotion, Legged Mobile Robots, Leg-Types and configurations & stability, Examples of legged robot locomotion, Gaits-Biped, Quadraped and Hexaped; Wheeled Mobile Robots, Wheeled locomotion-the design space, Wheeled locomotion and Case studies. **Mobile Robot Kinematics:** Introduction, Kinematics Models & Constraints, Representing robot position, Forward Kinematics models, Wheel Kinematics constraints, Robot kinematics constraints and Examples. **10hrs**

UNIT -5

Mobile Robot Maneuverability: Mobile Robot Maneuverability- Degree of mobility, Degree of steerability, Robot maneuverability. Mobile Robot Workspace-Degree of freedom, holonomic robots, path & trajectory considerations. Motion Control – Open loop control, Feedback control and Examples. **Mobile Robot Planning &Navigation:** Introduction, Competences for Navigation-Planning & Reacting, Path planning, Obstacle avoidance. Navigation Architectures-Modularity for code reuse & sharing, Control localization, Techniques for decomposition, Case studies-tiered robot architectures. **10hrs**

Text books

1. Y.Koren, **"Robotics for Engineers"**, McGraw Hill, 1st Edition, March 1987, ISBN: 978-0070353992.

2. M.P.Groover, **"Industrial Robotics"**, McGraw Hill Education, International Edition, 1st March 1986, ISBN: 978-0071004428.
3. Roland Siegwart & Illah R Nourbakhsh, **"Introduction to Autonomous Mobile Robots"**, MIT Press, 6th April 2004, ISBN: 978-0262195027.

References

4. John J Craig, **"Introduction to Robotics: Mechanics & Control"**, Pearson, 4thEdition, 5th March 2017, ISBN: 978-0133489798.
5. Joseph Duffy, **"Analysis of Mechanism and Robot Manipulators"**, John Willey & Sons, 1980, ISBN: 9780470270028.

Course Outcomes

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

1. **Define and Classify** Robots and Structures of Robotic Systems, Grippers
2. **Describe** Robot Program methods. **Write** Robot Program
3. **Define** Kinematic Analysis, Direct Kinematic Problem in Robotics. **Describe** Three dimensional Homogeneous Transformations, Denavit-Hartenberg Convention, Applications of DH method
4. **Define and Classify** Autonomous Mobile Robots**. Describe** Mobile Robot Kinematics
5. **Describe** Mobile Robot Maneuverability- Degree of mobility, Degree of steerability, Motion Control. **Explain** Mobile Robot Planning & Navigation.

Course Title: Flexible Manufacturing Systems.			
Course Code: P17MCIM22	**Sem: II**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: The course aims at imparting knowledge to students about a highly automated group technology machine cell, consisting of a group of processing workstations that are interconnected by an automated material handling and storage system, and controlled by a distributed computer system.

Course Content

UNIT -1

FMS – An Overview: Definition of an FMS – Types of flexibility and flexibility criteria in manufacturing, Types & configurations and FMS concepts –FMS applications and benefits. **Development & Implementation of an FMS:** Planning phase – Integration–System configuration – FMS layouts – FMS Project development steps. **10hrs**

UNIT - 2

Automated Material Handling & Storage: Functions, Types, Analysis of material handling equipments, Design of Conveyor & AGV systems, Problems. Storage system

performance – AS/RS – Carousel storage system – WIP storage system – interfacing handling storage with manufacturing, Problems. **10hrs**

UNIT- 3

Distributed Numerical Control: DNC system, Communication between DNC computer & machine control unit, Hierarchical processing of data in DNC system – Features of DNC systems. Tool Management of FMS: Tool strategies, tool identification, Tool monitoring and fault detection Wash stations, Inspection stations. CMM, Sequence of operations, Advantages, Types of CMM. **10hrs**

UNIT - 4

Group Technology: Part families**,** Parts classification and coding Production flow analysis, Applications of Group technology, Quantitative analysis in cellular manufacturing, Problems, comparison between cellular manufacturing. FMS Modeling and Analysis of FMS: Quantitative analysis of FMS and problems. Petri net modeling techniques. **12hrs**

UNIT -5

FMS Relational: Economic and technological justification for FMS, typical case studies – Future prospects. Flexible assembly system hardware components and features, design planning and scheduling of FAS. **10hrs**

Text books

1. Parrish D J, **"Flexible Manufacturing,"** Butter Worth – Heinemann Ltd., 1993, ISBN: 978-0750610117.
2. Groover M P, **"Automation, Production Systems and Computer Integrated Manufacturing,"** Prentice Hall India (P) Ltd, 3rd Edition, 24th July 2007, ISBN: 978-0132393218.
3. Kusiak A, **"Intelligent Manufacturing Systems,"** Prentice Hall, 1990, ISBN: 9780134683645.
4. William W. Luggen, **"Flexible Manufacturing Cells & Systems,"** Prentice Hall, 1st October 1990, ISBN: 978-0133217384.

References

1. Considine D M and Considine G D, **"Standard Handbook of Industrial Automation,"** Chapman and Hall, London, 1st Edition, 1986, ISBN: 9781461291664.
2. Viswanatham N & Narahari Y, **"Performance Modeling of Automated Manufacturing Systems,"** Prentice Hall of India (P) Ltd, 12th March 1992, ISBN: 978-0136588245.
3. Ranky P G, **"The design and Operation of FMS,"** IFS Publications. 1988, ISBN: 9780903608442.
4. Dr.H.K.Shivanand, **"Flexible Manufacturing System,"** New Age International Pvt. Ltd., 1st Edition, 1st January 2006, ISBN: 978-8122418705.
5. Tadeusz and Sawik, **"Production Planning and Scheduling in Flexible Assembly Systems,"** Springer-Verlag Berlin Heidelberg, 1st Edition, 1999, ISBN: 978-3540649984.

Course Outcomes

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

1. **Define** FMS. **Explain** Concepts, Development & Implementation of an FMS with applications.

2. **Define** Automated Material Handling & Storage its functions and types. **Explain** AS/RS and WIP Storage. **Solve** problems
3. **Define** and **Explain** DNC system. **Explain** Features of DNC systems. **Explain** Tool strategies, Tool identification, Tool monitoring and fault detection, Types of CMM. **Solve** Problems.
4. **Define Group Technology: Explain** Part families**,** Parts classification and coding Production flow analysis, Quantitative analysis. **Solve** Problems. **Explain** Petri net modeling techniques.
5. **Explain** Economic and technological justification for FMS with typical case studies and Future prospects. **Describe** Flexible assembly system.

Course Title: Metrology and Computer Aided Inspection.			
Course Code: P17MCIM23	**Sem: II**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: This course aims at imparting the knowledge, basic concept and importance of metrology, to educate the students on different types of measurement systems. Learn about the various measuring instruments to measure the linear, angular, form and surface finish measurements. Introduce the applications of computer and laser in the field of metrology, quality control and inspection.

Course Content

UNIT -1

Limits, Fits and Gauges: Introduction, Tolerances, Interchangeability, Limits of size, Terminology, Selection of Fits, ISO System of limits and fits, Types of Gauges, Gauge Design, Problems. **Metrology of Screw Thread:** Introduction, Screw threads terminology, Effect of pitch errors, Measurement of various elements of thread, problems. **10hrs**

UNIT - 2

Measurement of Straightness, Flatness, Squareness, Parallelism, Circularity and Rotation: Straightness, Straight edge, Test for straightness by using spirit level and autocollimator, Flatness testing, Mathematical treatment of determination of straightness and flatness of surfaces, Laser equipment for alignment testing, Parallelism, Equidistance and Coincidence, Squareness, Measurement of circularity, Tests for checking rotation, Profile measurements. **Measurement of Surface Finish:** Introduction, Surface texture and definitions, Surface roughness, Terminology as per Indian Standards, Methods of measuring surface finish- Direct instrument measurement, Replica method, The sample length or Cut-off length, Analysis of surface traces, Assessment of surface roughness as per Indian Standard, Roughness comparison specimens, Mechanical roughness indicator. **10hrs**

UNIT- 3

Machine Tool Metrology: Introduction, Machine tools tests, Alignment tests on lathe, Alignment tests on milling machine, Alignment tests on pillar type drilling machine, Tool wear measurement using microscope. **Co-Ordinate 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, statistical evaluation of data using computer, Data integration of CMM and data logging in computers. **12hrs**

UNIT - 4

Machine Vision: Shape identification, Edge detection techniques, Normalization, gray scale color relation, Template Techniques, Surface roughness using vision system, Interfacing robot and image processing system. **Laser Applications in Metrology:** Laser interferometer, Laser inspection, Dimensional measurement techniques-Scanning Laser gauge, Photo diode array imaging, Diffraction pattern technique, Laser triangulation sensors, Two frequency laser interferometer, Laser scanning gauge and Gauging wide diameter from the diffraction pattern formed in a laser. **10hrs**

UNIT-5

Testing and Calibration of Gauges and Dynamic Measurement: Introduction, calibration of linear and angular measuring instruments, measurement of limit gauges, checking of slip gauges, dynamic measurement of size, form and position, automatic inspection machines, measurment during machining, electronic gauging, contactless three dimensional measurement by laser based system, multi-dimensions automatic gauging and sorting machines, electro-optical inspection, some recent developments in optical measurements. **Evaluating Uncertainty in Measurement:** Introduction, sources of uncertainty in measurements, method of evaluation of uncertainty, competence of testing and calibration laboratories, apex level calibration 2nd NPL, international traceability, mass metrology, coordinate measuring machine and uncertainty in measurements, length measurement uncertainty of CMM. **10hrs**

Text books

1. Thomas G. Beckwith, Roy D. Marangoni and John H. Lienhard V, **"Mechanical Measurements,"** Pearson, 6th Edition, 17th August 2006, ISBN: 978-0201847659.
2. Sabrie Soloman, **"Sensors and Control Systems in Manufacturing,"** McGraw Hill Education, 2nd Edition, 1st December 2009, ISBN: 978-0071605724.
3. Donald P. Eckman, **"Industrial Instrumentation,"** CBS, 1st Edition, 1st December 2004, ISBN: 978-8123908106.
4. Roger H. Harlow, Connie Dotson and Richard Thompson, **"Fundamentals of Dimensional Metrology,"** Delmar Cengage Learning, 4th Edition, 15th August 2002, ISBN: 978-0766820715.
5. G. Thomas and G. Gladstone, **"Engineering Metrology,"** Butter Worth Publications, 1974, ISBN: 9780408705103.
6. Alan S. Morris, **"The Essence of Measurement,"** Prentice Hall of India, 1997, ISBN: 978-0133716757.
7. Doebelin, **"Measurement Systems: Applications & Design,"** McGraw Hill Higher Education, 4th Revised Edition, 1st January 1990, ISBN: 978-0070173385.

References

1. R K Jain, **"Engineering Metrology,"** Khanna Publishers, 1st January 2009, ISBN: 978-8174091536
2. Ulrich Rembold, Armbruster and Ulzmann, **"Interface Technology for Computer Controlled Manufacturing Processes,"** CRC Press, 1st Edition, 25th January 1983, ISBN: 978-0824718367.
3. J. Watson, **"Optoelectronics,"** Van Nostrand Reinhold (UK), March 1988,

ISBN: 978-0278000087.

4. Jayal A.K, **"Instrumentation and Mechanical Measurements,"** Galgotia Publications 2000.
5. Robert G. Seippel, **"Optoelectronics for Technology and Engineering,"** Prentice Hall India, 1st October 1988, ISBN: 978-0136384045.
6. Gupta S.C, **"Engineering Metrology,"** Dhanpat rai Publications, 2005.

Course Outcomes

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

1. **Define** limits, fits and gauges. **Explain** tolerances, interchangeability, ISO system of limits and fits. **Solve** problems. **Define** and **Explain** metrology of screw thread. **Solve** problems.
2. **Define** surface finish. **Explain** surface texture, surface roughness and methods of measuring surface finish. **Explain** Measurement of straightness, flatness, squareness, p parallelism, circularity and rotation.
3. **Define** machine tool metrology. **Explain** machine tools tests, alignment tests and tool wear measurement using microscope. **Explain** co-ordinate measuring machine**,** data integration of CMM and data logging in computers. **List** types of CMM.
4. **Define** Machine Vision**. Explain** different types of identification and detection techniques using Machine Vision. **Define** and **Explain** Laser applications in metrology.
5. **Explain** uncertainty in measurements and method of evaluation of uncertainty. **Discuss** Testing and Calibration of gauges and dynamic measurement

Course Title: Statistical Modeling and Experimental Design.			
Course Code: P17MCIM241	**Sem: II**	**L:T:P:H: 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: The objective of this course is to frame business problems in appropriate statistical terms in order use data to make better decisions. The students will learn to make sense of data along with the basics of statistical inference and regression analysis and their hands-on implementation using software.

Course Content

UNIT -1

Statistical Modeling and Data Analysis: Introduction, Review of basic statistical concepts: Concepts of random variable, Sample and population, Measure of Central tendency; Mean, median and mode. Normal & Log- Normal distributions. Illustration through Numerical examples. **10hrs**

UNIT - 2

Introduction to Designed Experiments: Strategy of experimentation, Some typical applications of experimental design, Basic principles, Guidelines for designing experiments, A brief history of statistical design, Summary: Using statistical techniques in experimentation. **10hrs**

UNIT- 3

Factorial Experiments: Basic definitions, The advantages of factorials, The two factorial design. Introduction, Factorial Experiments Terminology: factors, levels, interactions, Two-level experimental designs for two factors and three factors. Illustration through Numerical examples. **10hrs**

UNIT - 4

Regression Analysis: linear and multiple Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples. **10hrs**

UNIT -5

Signal to Noise Ratio: Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal the-better-type, Larger-the better type. Signal to Noise for Dynamic problems. Illustration through Numerical examples. **12hrs**

Text books

1. Douglas C. Montgomery, **"Design and Analysis of Experiments,"** John Wiley & Sons, 25th May 2012, ISBN: 978-1118146927.
2. Madhav S. Phadke, **"Quality Engineering Using Robust Design,"** Prentice Hall, US Edition, 1989, ISBN: 978-0137451678.

References

1. Thomas B. Barker, **"Quality by Experimental Design,"** Marcel Dekker, Inc ASQC Quality Press.1985, ISBN: 9780824774516.
2. C.F. Jeff Wu and Michael Hamada, **"Experiments Planning Analysis and Parameter Design Optimization,"** Wiley Editions, July 2009, ISBN: 978-0-471-69946-0.
3. W.L. Condra, **"Reliability Improvement by Experiments," CRC Press,** 2nd Edition, 19th April 2001, ISBN: 978-0824705275.
4. Phillip J. Ross, **"Taguchi Techniques for Quality Engineering,"** McGraw Hill Publishing Co., 2nd Revised Edition, 1996, ISBN: 978-0070539587.

Course Outcomes

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

1. **Describe** basic statistical concepts. **Solve** numerical on Mean, median and mode
2. **Explain** Guidelines for designing experiments.
3. **Discuss** Factorial Experiments Terminology
4. **Explain** Regression analysis. **Solve** Mathematical models
5. **Discuss** signal to noise ratio.

Course Title: Lean Manufacturing Systems.			
Course Code: P17MCIM242	**Sem: II**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: This course introduces you to key concepts in lean manufacturing such as continuous improvement, just-in-time production, "pull" philosophy, TQM.

Course Content

Unit -1

Just in Time Production System. JIT Logic -Pull system Japanese approach to production elimination of waste - JIT implementation requirements JIT application for job shops, Case studies. **10hrs**

UNIT - 2

Kanban System:- Kanban rules supplier Kanban and sequence schedule used by supplier. Monthly information & daily information. Later replenish system by Kanban sequenced withdrawal P system by sequence schedule table -problems & counter measures in applying Kanban system to subcontractors -Supplier Kanban circulation in the paternal manufacturer - structure of supplier Kanban sorting office. The rise & fall of Mass Production Mass production, work force, organization, tools, product – logical limits of mass production, Sloan as a necessary compliment to Ford. Case study:- Rouge Production Plant. **11hrs**

UNIT- 3

The Rise of Lean Production: - Birth place, concrete example, company as community, Final assembly plant, product development and engineering. Changing customer demand, dealing with the customer, future of lean production. **Shortening of Production Lead Times** -reduction of setup times, practical procedures for reducing setup time. **10hrs**

UNIT - 4

Standardization of Operations:-Machine layout, multifunction workers and job rotation. Improvement activities to reduce work force and increase worker morale foundation for improvements. **Elements of Lean Production viz. G M Framingharn:** Toyota Takaoka Mass Production V /s lean production, diffusing lean production. **10hrs**

UNIT -5

Managing lean enterprise: Finance, Career ladders, geographic spread and advantages of global enterprise. **Prospects for catching up:** Simplicity in the natural state -institutional factors -life time employment -educational commodities -quality & productivity in full circle. **An Action Plan:** Getting started - Creating an organization to channel your streams. Install business system to encourage lean thinking. The inevitable results of 5 year commitment. **11hrs**

Text Books

1. R B Chase,N J Aquilano and F R Jacobs, **"Productions and Operations Management,"** McGraw Hill Company, 9th Edition, 2001, ISBN: 978-0075612780.
2. Yasuhiro Monden, **"Toyoto Production System: An Integrated Approach to Just in Time,"** Productivity Press, 4th Edition, 28th October 2011, ISBN: 978-1439820971.

3. James P Womack, Daniel T Jones and Daniel Roos, **"The Machine that Changed the World. The Story of Lean Production,"** Free Press, Reprint Edition, 13th March 2007, ISBN: 978-0743299794.

References

1. James P.Womack and Daniel T.Jones, **"Lean Thinking,"**Free Press, 2nd Edition, 10thJune 2003, ISBN:978-0743249270.
2. Richard Schourberger,**"Japanese Manufacturing Techniques: Nine Hidden Lessons Simplicity,"**Free Press, 1stEdition, 1st November 1982, ISBN: 978-0029291009.
3. James Bossert, **"Quality Function Development,"** CRC Press, 2000, ISBN: 978-1850758846.

Course Outcomes

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

1. **Explain** Just in Time Production System.
2. **Discuss** Kanban System.
3. **Explain** The Rise of Lean Production & Shortening of Production Lead Times.
4. **Explain** Standardization of Operations & Elements of Lean Production.
5. **Discuss** Managing lean enterprise, Prospects for catching up & An Action Plan.

Course Title: Newer Machining Techniques.			
Course Code: P17MCIM251	**Sem: II**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: The course aims at Modern Machining Processes, which presents unconventional machining methods which are gradually commercial acceptance. All aspects of mechanical, electrochemical, thermal, Nano and Micro processes are studied.

Course Content

UNIT -1

Machining of Hard Materials: Basic Features of Hard Machining, Comparison with Grinding Operations, Technological Processes Including Hard Machining, Equipment and Tooling, Machining Using Hybrid Processes, Characterization of Hard Machining Processes, Cutting Forces, Chip, Cutting Temperature, Wear of Ceramic and PCBN Tools, Applications of Hard Machining Processes. **10hrs**

UNIT - 2

Ecological Machining and Machining of Particulate Reinforced Metal Matrix Composites: Near-Dry Machining: Introduction, Amount and Cost, Health and Environmental Aspects, Principal Directions in the Reduction of MWF Economical, Ecological and Health Impacts, Nearly Dry Machining (NDM) - How NDM Operates, Classification of NDM, Why NDM Works, Consideration of the NDM System Components, Introduction to particulate-reinforced metal matrix composites, Effect of Reinforcement Particles on Surface Integrity and Chip Formation, Strength of MMC during Machining, Chip Shape, Surface Integrity, Shear and Friction Angles, Relation between Shear and Friction Angles, Forces.. **11hrs**

UNIT- 3

Sculptured Surface Machining: Introduction, The Manufacturing Process, The CAM, Centre of Complex Surfaces Production, Workpiece Precision, Workpiece Roughness, Tool Path Selection Using Cutting Force prediction, Examples – Three axis Mould, Five-axis Mould, Three-axis Deep Mould. **10hrs**

UNIT - 4

Fine Finishing Processes and Hybrid Thermal Processes: Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magnetic Float Polishing (MFP), Micromachining. Electrochemical Super finishing, Electrochemical Buffing, Hybrid Thermal Processes: Introduction, Electroerosion Dissolution Machining, Electrodischarge Grinding, Abrasive Electro discharge Machining, EDM with Ultrasonic Assistance, Electrochemical Discharge Grinding, Brush Erosion-Dissolution Mechanical Machining. **11hrs**

UNIT -5

Micro and Nano-Machining: Introduction, Machining Effects at the Microscale, Size Effects in Micromachining, Nano-machining – Nano-metric Machining, Theoretical Basis of Nano-machining, Comparison of Nano-metric Machining and Conventional Machining. **10hrs**

Text books

1. J. Paulo Davim, **"Machining: Fundamentals and Recent Advances,"** Springer Publications, 24th September 2008, ISBN: 978-1848002128.
2. V.K. Jain, **"Advanced Machining Processes,"** Allied Publisher Pvt., Ltd., 1st Edition, 2007, ISBN: 978-8177642940.

References

1. Hassan Abdel-Gawad El-Hofy, **"Advanced Machining Processes: Nontraditional and Hybrid Machining Processes,"** McGraw-Hill Education, 1st April 2005, ISBN: 978-0071453349.
2. Choi, Byoung K, Jerard, Robert B, **"Sculptured Surface Machining: Theory and Applications,"** Springer Publications, 1999, ISBN: 9780412780202.
3. Davim, J. Paulo, **"Machining of Hard Materials,"**1st Edition, 7th January 2011, ISBN: 9781849964494.

Course Outcomes

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

1. **Explain** machining of hard materials using different processes. **Explain c**haracterization of Hard Materials and **List** its Applications.
2. **Explain** ecological machining and near-dry machining of particulate reinforced metal matrix composites and its effect on Surface Integrity and Chip Formation.
3. **Explain** sculptured surface machining. **Explain** the manufacturing Process, the CAM, centre of complex surfaces production.
4. **Define** fine finishing process and **Explain** its processes. **Define** hybrid thermal process and **Explain** its processes
5. **Define** and **Explain** micro and nano-machining

Course Title: Tooling for Manufacturing in Automation.			
Course Code: P17MCIM252	**Sem: II**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: Students are introduced to metal cutting principles, cutting tool materials, types of cutting tools and its nomenclature. Students get orientation into clamping methods and jigs used in automated environment.

Course Content

UNIT -1

Metal Cutting: Theory of Metal Cutting, Orthogonal and oblique cutting, basic requirements of a cutting tool, Cutting action, Mechanism of chip formation, Types of Chips, Merchants Analysis of forces. Machining power. Numerical. **10hrs**

.

UNIT - 2

Design of Metal Cutting Tools: Single point tool, Design consideration from strength, and Rigidity Consideration, Chip breakers types, Design of Form Tools. Numerical. **Dynamometry:** Introduction, dynamometer requirements, force measurement, electric transducers, bonded strain gages, strain gage lathe dynamometer, transducer tube lathe dynamometer, dimensional analysis, milling, drilling and surface grinding dynamometer, piezoelectric dynamometer. **11hrs**

Unit- 3

Location and Clamping Methods: Introduction, basic principles of locating, locating methods & devices, Basic principles of clamping, clamping methods. Tool holder, introduction to tool holding devices. Introduction to tool holding devices. **Jigs & Fixtures:** Introduction, Types of drill jigs, General considerations in design of drill jigs, Drill bushings. Types of fixtures, Lathe fixtures, Grinding fixtures, Boring fixtures, Broaching fixtures, Steps involved in designing a fixture. **10hrs**

UNIT - 4

Press Working – Blanking & Piercing: Introduction, Power press, Press specifications, basic cutting operations, types of dies, stripping devices, Pressure pads, pilots, shedders, Clearances, centre of pressure, Cutting forces, Press tonnage, methods of reducing cutting forces, strip lay out, tool materials, press tool design. **11hrs**

UNIT -5

Tools: Press Working–Bending: Introduction, Bending dies, bending methods, spring back, bending allowance, Bending force, problems. **Press Working – Forming & Drawing:** Introduction, types of forming, drawing operations, factors affecting drawing, determination of blank size, drawing force, Design of drawing dies. **10hrs**

Text books

1. Cyril Donaldson, et. al., **"Tool Design,"** McGraw Hill Education, 4th Edition, 20th April 2012, ISBN: 978-0070153929.

2. M.C. Shaw, **"Metal Cutting Principles,"** Oxford University Press, USA, 2nd Edition, 12th August 2004, ISBN: 978-0195142068.

References

1. Edward G Hoffman, **"Fundamentals Of Tool Design,"** SME, USA, 4th June 1998, ISBN: 978-0872634909.
2. Gr. Nagpal, **"Tool Engineering& Design,"** Khanna Publications, ISBN: 9788174092038.
3. E.PaulDegarmo, J.T.Black, Ronald A Kohser, **"Materials and Processing in Manufacturing,"** Wiley, 11th Edition, 30th August 2011, ISBN: 978-0470924679.

Course Outcomes

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

1. **Explain** basic requirements of a cutting tool. **Discuss** Mechanism of chip formation.
2. **Describe** single point tool**. Solve** numerical on design tool.
3. **Explain** basic principles of locating & clamping. **Discuss** General considerations in design of drill jigs
4. **Explain** press specifications, types of dies and press tool design.
5. **Describe** bending methods and **solve** problems on press working – bending. **Illustrate** factors affecting drawing.

Course Title: Nano Technology.			
Course Code: P17MCIM261	**Sem: II**	**L:T:P:H : 4:0:0:4**	**Credits: 04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: The course enables the students to understand different concepts of nano technology and structures.

Course Content

UNIT -1

Introduction and Electronic Properties of Atoms &Solids: Overview of Nanosience and Engineering, Classification of nanostructures, Nanoscale Architecture, Scaling and miniaturization laws. The isolated atom – Bonding between atoms –The Free electron (Particle) model and energy bands – particle in 1-D potential well of infinite height (discussion on energy values, wave functions –normalization and probability densities). Particle in 1- D potential well of finite height– Concept of tunneling. **11hrs**

UNIT - 2

Effects of Nanometer Length Scale and Concept and Materials: Changes to the system total energy. Changes to the system structure. How nanoscale dimensions affect properties – structural, thermal, chemical, mechanical, magnetic, optical and electrical. Chemistry of Carbon Fullerenes: structure and synthesis, chemical reactivity- chemistry of higher fullerenes applications. **10hrs**

UNIT- 3

Nanotubes and Self Organization: Carbon forms structured by Energetic species-amorphous nanotubes and crystalline forms. Structure and properties of carbon nanotubes. Inorganic nanotubes, structure, synthesis and properties. Phase behavior of nanoparticle suspensions, hard sphere, behavior, soft repulsions, and weakly attractive suspensions. Catalysis: Nanocrystalline Zeollites –Hydrothermal synthesis of nanocrystalline zeollites application in environmental catalysis. **11hrs**

UNIT - 4

Scattering Characterization: X - rays and their interaction with matter, Electron and their interaction with matter, Photon scattering, Plasmon scattering, Single-electron excitation, Direct radiation losses, Neutrons and their interaction with matter, Ions and their interaction with matter, Elastic scattering and diffraction, Technology of Characterization, Profilometry, Optical microscope, SEM, TEM. **10hrs**

UNIT -5

Fabrications and Characterizations of Nano Structures: Milling, Oxidation/Deposition, Etching, Lithographic, processes – Photo, c-beam, Focused ion beam, x-rays Soft lithography, Machining – Micromachining. **10hrs**

Text books

1. Ed. William A Goddard III, Donald W Brenner, Sergey Edwart Lyschevski and Gerald J. Iafrate, **"Handbook of Nano Science Engineering and Technology,"** CRC Press, New York, ISBN: 9781439860151.
2. Gentili M., Giovannella C., and Selci S, **"Nano lithography: A Borderland Between STM, EB, IB and X-Ray Lithographies,"** Springer, Netherland, 1994, ISBN: 978-94-015-8261-2.

References

1. Ueno T, Ito T and Nonogaki S, **"Microlithography Fundamentals in Semiconductor Devices and Fabrication Technology,"** CRC Press, 1st Edition, 25th June 1998, ISBN: 978-0824799519.
2. Wayne M. Moreau, **"Semiconductor Lithography Principles**, **Practices and Materials,"** Springer, 22nd February 2012, ISBN: 978-1461282280.
3. Matsui S, Ochiai Y and Suzuki K, **"Sub-Half-Micron Lithography for ULSIs,"** Cambridge University Press, June 2000, ISBN: 0521570808.
4. Charles J Poole and Frank J Owens, **"Introduction to Nanotechnology,"** Wiley-Blackwell, 24th June 2003, ISBN: 978-0471079354.
5. G Ali Mansoori, **"Principles of Nanotechnology,"** World Scientific, 2005, ISBN: 9789812561541.

Course Outcomes

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

1. **Describe** Scaling and miniaturization laws.
2. **Explain** nanoscale dimensions affect properties.
3. **Discuss** different types rapid tools production
4. **Explain** rapid prototyping process optimization.
5. **Discuss** surface digitization from other types of data.

Course Title: Reverse Engineering			
Course Code: P17MCIM262	**Sem: II**	**L:T:P:H : 4:0:0:4**	**Credits:04**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course objective: The course aim is to provide extensive knowledge of reverse and concurrent engineering, Methods of advanced measuring devices, geometric modeling with applications.

Course Content

UNIT -1

Introduction to Reverse Engineering:
Introduction of reverse and concurrent engineering, Elements of concurrent engineering, Advantage and applications. The generic processes, Phase 1–scanning, Contact Scanners, Noncontact Scanners, Phase 2–Point Processing, Phase 3–Application Geometric Model Development, Reverse Engineering–Hardware and Software. **10hrs**

UNIT - 2

Theory of Measurements and Methodologies and Techniques for Reverse Engineering: Linear, Angular, Curved surfaces, Methods of advanced measuring devices, Coordinate measuring machine (CMM), Elements of CMM, Data accumulation, Retrieval. Computer Vision and Reverse Engineering, Coordinate Measuring Machines, Active Illumination 3-D Stereo, Data Collection, Mesh Reconstruction, Surface Fitting. **11hrs**

UNIT- 3

Geometric Modelling: 2D and 3D graphics, Concepts of various transformation of geometric models, Wireframe, Surface and Solid modelling techniques, Representation of parametric and non-parametric curves and surfaces, Mathematical representation of solid and solid modeling based application. **10hrs**

UNIT - 4

Geometric Modelling with Applications: CAD/CAM data exchanges, Visual realism and Graphics tools, Applications, Auto-CAD, Auto surt, Auto Mil, and UNIGRAPHICS, CAD/CAM interfaces, Process planning, Computer aided production planning systems, Capacity planning, Part programming, APT, CAPPS programming, Geometry definition, Tool path generation. **11hrs**

UNIT - 5

Brief Study of Reverse Engineering: Applications and Examples of RP in Design, Engineering, Analysis and Planning, Manufacturing and Tooling, Aerospace Industry, Automotive Industry, Relationship Between Reverse Engineering and Rapid Prototyping, Legal Aspects of Reverse Engineering. **10hrs**

Text books

1. Vinesh, Raja, Kiran J and Fernandes, **"Reverse Engineering: An industrial Perspective,"** Springer-Verlag, London, 2008, ISBN: 978-1-84628-856-2.

References

1. Ingle Kathryn .A, **"Reverse Engineering,"** McGraw Hill Professional Publishing, 1st June 1994, ISBN: 978-0070316935.

Course Outcomes

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

1. **Discuss** generic processes.
2. **Explain** coordinate measuring machine (CMM) and elements of CMM.
3. **Discuss** Concepts of various transformations of geometric models.
4. **Describe** computer aided production planning systems.
5. **Explain** relationship between reverse engineering and rapid prototyping.

Course Title: **Manufacturing Engineering Lab II**			
Course Code: P17MCIML27	**Sem: II**	**L:T:P:H : 0:0:4:4**	**Credits:02**
Contact Period: Lecture: 52 Hr; Exam: 3 Hrs		**Weightage: CIE: 50; SEE: 50**	

Course Contents

1. Measurement of Surface roughness parameters of partsproduced by four different processes
2. Optimization of process parameters in CNC WEDM- Two different materials
3. Development of CIM Layout consisting of Machining centers, AGVs and Material handling systems, tool changing station, raw material storage and finished product storage area. (Using solid modeling package).- Two layouts
4. Casting of Metal Matrix Composites
5. Processing of Polymer composites by Hand layup method

Total 10 Experiments

Text Books

1. R.K. Jain, **"Engineering Metrology,"** Khanna Publishers, 20th Edition, 2007, ISBN: 9788174091536.
2. Madhav S. Phadke, **"Quality Engineering Using Robust Design,"** Prentice Hall, 1989, ISBN: 9780137451678.
3. K.K Chawla, **"Composite Materials: Science and Engineering,"** Springer-Verlag New York, 3rd Edition, 2012, ISBN: 978-0-387-74365-3.