Dr Babasaheb Ambedkar Marathwada University, Aurangabad

Proposed Syllabus Structure of M.E. (Manufacturing Engineering) w.e.f. Academic Year 2013-14

Semester-I

Course code	Name of the Subject	Teaching Scheme Contact hours per week				Examination scheme Marks					Duration of Theory Exam	Credit
		L	T	P	Total hrs	Theory	Class Test	Term Work	Viva voce	Total		
MME 601	Advanced Machining Science	3	1		4	80	20			100	3 Hrs	4
MME 602	Advance Joining Processes	3	1		4	80	20			100	3 Hrs	4
MME 603	Computer Integrated Manufacturing	3	1		4	80	20			100	3 Hrs	4
MME 604	Processing of Advanced Materials	3	1		4	80	20			100	3 Hrs	4
MME 641	Elective- I	3	1		4	80	20			100	3 Hrs	4
MME 621	Manufacturing Lab - I			4	4			50		50		2
MME 622	Measurements and Instrumentation Laboratory			2	2				50	50		1
MME 623	Seminar - I			2	2				50	50		1
	Total	**15**	**5**	**8**	**28**	**400**	**100**	**50**	**100**	**650**		**24**

Semester-II

Course code	Name of the Subject	Teaching Scheme Contact hours per week				Examination scheme Marks					Duration of Theory Exam	Credit
		L	T	P	Total hrs	Theory	Class Test	Term Work	Viva voce	Total		
MME 651	Metal Forming Processes	3	1		4	80	20			100	3 Hrs	4
MME 652	Manufacturing Process Modelling	3	1		4	80	20			100	3 Hrs	4
MME 653	Robotics and Manufacturing Automation	3	1		4	80	20			100	3 Hrs	4
MME 654	Manufacturing Metrology and Quality Engineering	3	1		4	80	20			100	3 Hrs	4
MME 691	Elective- II	3	1		4	80	20			100	3 Hrs	4
MME 671	Manufacturing Lab - II			4	4			50		50		2
MME 672	Automation and Simulation Laboratory			2	2				50	50		1
MME 673	Seminar - II			2	2				50	50		1
	Total	**15**	**5**	**8**	**28**	**400**	**100**	**50**	**100**	**650**		**24**

Semester III

Course code	Name of the Subject	Teaching Scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MME 731	Dissertation Phase I	--	12	12	--	50	50	100	12
	Total	--	**12**	**12**	**--**	**50**	**50**	**100**	**12**

Semester IV

Course code	Name of the Subject	Teaching scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MME 781	Dissertation Phase II	--	20	20	--	100	200	300	20
	Total	--	**20**	**20**	**--**	**100**	**200**	**300**	**20**
	Grand Total							**1700**	**80**

Elective – I (MME 641A-D)
Advanced Optimization Techniques
Product Design for Manufacturing
Technology and Knowledge Management
Reverse Engineering and Additive manufacturing

Elective - II (MME 691A-D)
Reliability and Maintenance Engineering
Tribology
NANO and Micro Fabrication Techniques
Manufacturing Management

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per week CH: Contact hours

Total Credits = SEM I + SEM II + SEM III + SEM IV
= 24 + 24 + 12 + 20
= 80

(MME 601) ADVANCED MACHINING SCIENCE

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	Mechanics of metal cutting; tool geometry-effect of rake, lead and clearance angles; shear angle and its relevance, strain and strain rate in orthogonal cutting, stress distribution along rake face, theories of Merchant's, Lee and Shaffer's, Oxley's, etc.	10
2	Cutting tool materials, Carbide grade design, carbide coatings, ceramic, super hard grade design, effect of cutting variables on forces, tool failure analysis, theories of tool wear, measurement of tool wear, tool life and economics of machining, CNC machining.	10
3	Thermal aspects in machining; heat and temperature distribution, modeling of chip formation in metal cutting, modeling of machining characteristics in turning, milling, drilling, grinding, etc., measurement of cutting forces and cutting temperatures.	06
4	Advanced machining processes such as EDM, ECM and Laser beam machining, Micro machining; micro-turning, micro-milling, micro-drilling, micro EDM, micro- WEDM, micro ECM, etc., ultra-precision machining, electrolytic in-process dressing and grinding, high speed machining, nano surface generation, ductile cutting of silicon wafers, mechanism of ductile cutting, nano-metric cutting, chip formation, recent developments.	12

Reference Books:

1. E. J. A. Armarego, R. H. Brown, "The Machining of Metals", Prentice Hall Inc.
2. Kronenberg, "Machining Science and Applications", Pergamon Press.
3. Geoffrey Boothroyd and W. A. Knight, "Fundamentals of Machining and Machine Tools",Marcel Dekkel Inc.
4. J. A. McGeough, "Advanced Methods of Machining", Chapman and Hall.
5. P. L. B. Oxley, "The Mechanics of Machining", Ellis Horwood Ltd.
6. Gary F. Benedict, "Nontraditional Manufacturing Processes", Marcel Dekker Inc.
7. Amitabha Battacharyya, "Metal Cutting, Theory and Practice", New Central Book Agency
8. Amitabh Ghosh and Asok Kumar Mallik, "Manufacturing Science", Affiliated East West Press Pvt. Ltd.
9. B. L. Juneja and G.S. Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age International (P) Ltd.
10. V. C. Vekatesh and H. Chandrasekharan, "Experimental Techniques in Metal cutting", Practice Hall of India Pvt. Ltd.
11. M. C. Shaw, "Metal Cutting Principles", CBs Publishers.

(MME 602) ADVANCE JOINING PROCESSES

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Review of conventional welding processes:** Importance, Selection of process, selection of parameters and applications of Gas Welding-Oxy Acetylene, Arc Welding- TIG, MIG, MMAW, Submerged arc welding, Electroslag welding, Resistance Welding-Spot, Seam Welding. **Advanced/Unique Welding Processes:** Laser Beam Welding, Electron Beam Welding, Friction Welding Cold Pressure Welding, Ultrasonic Welding, Diffusion Welding.	10
2	**Weld design:** Weld design, weld defects, distortion and remedies, welding stresses: cause and development of residual stresses, method of controlling and relieving residual stresses in weldments. Testing of welds: tensile, impact, hardness, and corrosion. **Thermal and metallurgical consideration:** Thermal consideration of welding temperature distribution, heating and cooling curves. Solidification of weld, weld zones, heat affected zone and parent metal, macro & micro structure, Hydrogen embrittlement and cracking, weld cracking, hot and cold cracking.	10
3	**Non-destructive testing:**Introduction, in-situ metallography, dye penetrant flaw detection, application & limitation. Ultrasonic testing; advantages, disadvantages, applications, generation and characteristic of ultrasonic waves, methods and instruments for testing. **Radiographic methods:** Principal, sources of radiation: X-rays, gamma rays recording of radiations, limitation and radiation safety.	10
4	**Magnetic and electrical methods:** advantages, limitations, method of generating magnetic fields, magnetic particle testing; method and limitation. Eddy current testing method, potential drop methods, application and limitations. **Other methods:** Acoustic emission methods, leak detection, thermal inspection. Nondestructive inspection of welds: porosity, blowholes, inclusions, cracks. Modern Welding techniques: Welding of plastics, welding of ceramics, dissimilar material joining. Design requirements, allowable stress values, workmanship and inspection, introduction to welding codes and standards. Process and product standards for manufacturing of pipe - welding procedure and welder qualification, field welding and inspection.	10

Recommended Books:

1. Parmar R.S.*, Welding Engineering and Technology, Khanna Publishers, 1997*
2. O.P. Khanna, Welding Technology.
3. Md. Ibrahim Khan, Welding Science & Technology.

4. P.Halmshaw, Non-Destructive Testing.
5. Baldev Raj, T. Jayakumd, M.Thavasamutha, Practical Non-destructive Testing.
6. Baldev Raj, C.V. Subrananuum, and T.Jayakumar, Non-destructive Testing of welds.

Reference Books:

1. Lancster ,George Allen,The metallurgy of welding.
2. Metal handbook, Vol 6 ,73,ASME.
3. Richard L. Little, Welding and welding technology.
4. Welding Handbook-AWS-Welding, Cutting and Related Processes.
5. Metal Handbook- ASM-Welding

(MME603) COMPUTER INTEGRATED MANUFACTURING

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction:** Evolution of CIM, CIM hardware and software, nature and role of the elements of CIM system, development of CIM, phases and steps in CIM implementation, benefits of CIM.	06
2	**CIM and Communication:** Local Area Network, analysis of Hierarchical architecture-strategic planning, managerial planning, operator's level. Integration of total activities, such MRP I and MRP II, ERP and control through microprocessor bus bar using PLC etc., Distributed Numerical control Machines, equipment and accessories for loading, unloading, assembly, Automated Guided Vehicles etc.	08
3	**Cellular manufacturing system:** Introduction to GT, benefits, part families, part Classification and coding, product flow analysis, cellular manufacturing systems, virtual cell system, quantitative analysis in cellular manufacturing.	06
4	**Flexible manufacturing system:** Building blocks of FMS, applications, benefits, FMS layout, FMS planning and implementation issues, quantitative analysis of FMS. Computer aided material handling system, computer control system.	08
5	**DBMS in CIM:** Data base management system in CIM, data acquisition, factory data collection system, data processing, data distribution, database file structure, organization and control, data structure models (hierarchical, network, relational and three schemes). Use of internet in manufacturing and business functions, E-commerce and future trends.	06
6	**Economics of CIM:** Strategic benefits of CIM and accounting measures, evaluation of CIM systems, breakeven analysis, return on investment in the context of CIM, CIM feasibility analysis. socio-techno economic aspects of CIM.	04

Reference Books:

1. Teicholz Eric, Norr Joel, "CIM Handbook", McGraw Hill International.
2. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi
3. Krieger, Harrington J., "Computer Integrated Manufacturing"
4. Mikell P. Grover, "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi.
5. P. Radhakrishnan & S. Subramanyan "CAD/CAM/CIM", Willey Eastern Limited New Delhi.
6. F. H. Mitchell, Jr., "CIM Systems: An Introduction to Computer Integrated Manufacturing", Prentice Hall International.
7. William. W. Luggen, "Flexible Manufacturing Cells and System", Prentice Hall, England Cliffs, New Jersy
8. S. Kant Vajpayee, "Computer integrated manufacturing", Prentice Hall of India

(MME 604) PROCESSING OF ADVANCED MATERIALS

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Classification and types of conventional manufacturing processes** - Forging, rolling, extrusion, wire drawing, sheet metal processes. Manufacturing automation, Nontraditional manufacturing processes. Economics of nontraditional and automated manufacturing. Introduction to micromachining and MEMS. Introduction to coatings and tribology.	08
2	**Rapid prototyping:** Product development cycle & importance of prototyping. Types of prototypes, principles and advantages and different types of generative manufacturing processes, viz. stereolithography, FDM, SLS etc. Factors concerning to RP: consideration for adaptations, advantages, accuracy, economic considerations.	08
3	**Non conventional machining processes:** Introduction and need for non-conventional machining processes, Principle and theory of material removal. Process parameters, advantages, limitations and applications of Ultrasonic Machining USM, Abrasive Jet Machining AJM, Water Jet Machining WJM, Abrasive Water Jet Machining AWJM, Electro- chemical Machining ECM, Electro Discharge Machining EDM, Electron Beam Machining EBM, Laser Beam Machining LBM.	08
4	**Special processes and electronic fabrication:** Principles, salient features, advantages & applications of abrasive floor machining, magnetic abrasive finishing, wire EDM, electrochemical grinding, honing, lapping & super finishing. Principles, elements, process, advantages, applications & surface preparation etc. of physical vapor deposition, chemical vapor deposition, electro less coating & thermal metal spraying.	08
5	**Plastic Manufacturing Processes**: Compression molding, Transfer molding , Injection molding, Extrusion molding ,Thermoforming, Blow molding, roto molding , Structured form molding.	08

Reference Books:

1. "HMT Handbook" – Production Technology (TMH)
2. "Non- traditional machining processes", Willer, SME publications.
3. "Advanced Manufacturing Processes", G.F.Benidict, Marcel Dekker Publisher
4. "Materials & Processes in Manufacturing", E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, (PHI)
5. "Design & Manufacturing of Composite Structures", Geoff Eckold (Jaico Publishing House)
6. "Manufacturing Processe for Engineering Materials", S. Kalpaljian & Steven R. Schmidt, (Pearson Education)
7. Krishnan K.Chawla, "Composite Material Science and Engineering", Springer-Verlog,1987
8. Agarwal D & Brontman L.J., "Analysis & Performance of fibre composites", John Willey Publications, 1990

9. Mallik P.K. & Newman S.,"Composite Materials Technology", Henser Publications, 1990
10. Charles J A, Crane F.A.A. & Furness J A G ,"Selection and use of Engineering Materials", (3 rd Edition), Butterworth – Heiremann – 1977
11. "Materials and their applications", (4 th edition)- Jaico- 1999
12. "Non Conventional Machining", – P.K.Mishra (IIT, Kharagpur), Narosa Publishing House

ELECTIVE-I

(MME 641-A) ADVANCED OPTIMIZATION TECHNIQUES

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction** Engineering application of Optimization, Terminology, Design Variables, Constraints, Objective Function, Variable Bounds, Problem Formulation, Engineering Optimization Problems, Calculus method, Linear Programming-Simplex method, Concept of Duality.	06
2	**Single Variable Optimization Problems** Optimality Criterion; **Bracketing Methods:** Exhaustive search method, Bounding phase method; **Region Elimination Methods**: Interval Halving Method, Fibonacci Search Method, Golden Section Method**; Point estimation methods:** Successive Quadratic Estimation Method; Gradient Based Methods; Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method, Application to Root finding	08
3	**Multivariable Optimization Algorithms** Optimality Criteria, Unidirectional Search, Direct Search Methods: Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method, Gradient Based Methods: Cauchy's Steepest Descent Method, Newton's method, Marquardt's Method.	08
4	**Constrained Optimization Algorithms** Kuhn Tucker conditions, Transformation Methods: Penalty Function Method, Method of Multipliers (MOM), Sensitivity analysis, **Direct search for constrained minimization:**Variable elimination method, Complex search method.	09
5	Genetic algorithms for optimization and search Chromosomes, Selection, Recombination, Conventional (Scattered), Crossover, Blending (Intermediate), crossover, Mutation, Single-objective optimization, Multi-objective optimization, , Simulated annealing.	09

Reference Books:

1. Deb Kalyanmoy, “Optimization in Engineering Design”, PHI, New Delhi.
2. Rao S S, “ Engineering Optimization”, John Wiley, New Delhi.
3. Deb Kalyanmoy, “ Multi-Objective Algorithms using evolutionary algorithms”, John Wiley, New Delhi.
4. Devid E Goldberg, “ Genetic Algorithms in Search & Optimization and Machine Learning”, PEARSON Education.
5. H.A. Taha, “. “Operations Research: An Introduction”, PHI Pvt. Ltd.

ELECTIVE-I

(MME 641-B) PRODUCT DESIGN FOR MANUFACTURING

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction:** Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design. Major phases in design & Manufacture, Effect of material properties on design, Effect of manufacturing process on design.	06
2	**Selection of Materials and Shapes:** Properties of Engineering Materials, Selection of Materials, Selection of Shapes, Co-selection of Materials and Shapes.	04
3	**Selection of Manufacturing Processes:** Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Co-selection of Materials and Processes.	06
4	**Design for Assembly:** Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment.	04
5	**Design for Reliability and Quality:** Failure Mode and Effect Analysis, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization.	06
6	**Approaches To New Product Design:** Concurrent Design, Value Analysis, QFD, Taguchi's concept of Quality Loss function parameter design, Tolerance design, System optimization, Robust design.	06
7	**Evaluation for Manufacturability:** Evaluation of the manufacturability of a part design, methods for defining manufacturability index, Interpretation of the MI value, Manufacturability evaluation, a multi criteria approach. **Case studies on product design for manufacturing.**	08

Reference Books:

1. G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.
2. J G Bralla, Handbook for Product Design for Manufacture: A Practical Guide to Low Cost Production, McGraw Hill, NY, 1998.
3. G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY, 2000.
4. Engineering Design Products, Process and Systems Kusiak Academic Press
5. Design for Manufacture, Harry Peck, Pitman Publications
6. Design for X, G.D. Huang, Chapman & Hall

References:

1. M F Ashby and K Johnson, Materials and Design - the art and science of material selection in product design, Butterworth-Heinemann, 2003.

2. M F Ashby, Material Selection in Mechanical Design, Butterworth-Heinemann, 1999
3. T H Courtney, Mechanical Behavior of Materials, McGraw Hill, NY, 2000.
4. K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.
5. S S Rao, Engineering Optimization: theory and practice, John Wiley, NY, 1996.
6. ASTM Design Handbook.
7. B.H. Amstead, P.F. Oswald and M. Begeman, Manufacturing Processes; John Wiley 1987
8. Competitive Product design for Manufacturability Barkan and Ishvi McMillan

ELECTIVE-I
(MME 641-C) TECHNOLOGY AND KNOWLEDGE MANAGEMENT

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	External influences on organization- Workforce composition- Evolving work roles and Responsibilities- Teamwork- Relationship building-Communication- Leadership- Decision making Change management-Worker motivation- Types of organization- Creating strategic focus-Strategic values and corporate culture- Systems and policies- Employee capabilities-Knowledge as asset –organizational knowledge-Leadership and knowledge management.	08
2	Learning organization-Knowledge systems- Knowledge workers- Phases of knowledge Development- Knowledge management infrastructure-Harassing organizational knowledge –Five P's of knowledge management-Knowledge sharing as a core competency-Developing strategic knowledge community.	06
3	Contribution of disciplines to knowledge Leadership –Librarianship-HRM-Strategic visionary – Motivator-Communicator-Change agent- Learning facilitator-Strategic knowledge leader- Self managed team- Virtual knowledge team- Leading a knowledge network Recruiting and selecting Knowledge leaders.	06
4	Organization culture- Knowledge culture principles-Knowledge culture enablers-Knowledge culture during change- Existing knowledge culture – Enhancement planning-Implementing enhancement programs-Pilot testing Planned culture interventions- Maintaining the knowledge culture.	06
5	Structured support for knowledge management –Organizational structure and staffing- Performance management- Rewards- Learning and development – Knowledge management systems- Subsystems- Phases of managing core knowledge- Developing core knowledge structure- Content authorship.	06
6	Effective knowledge repositions-Mapping content structure- Repository quality control –Knowledge services-Models of service provision-Learning in a knowledge environment –Working with technology-Knowledge strategy evaluation – Successful knowledge management-Mergers, acquisition and downsizing integrated knowledge development.	08

Reference Books:

1. Shelda Debowsks ,"Knowledge Management," Wiley 2007

ELECTIVE-I
(MME 641-D) REVERSE ENGINEERING AND ADDITIVE MANUFACTURING

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction** Scope and tasks of reverse engineering (RE) - Domain analysis- process of duplicating, introduction to rapid product development and Additive Manufacturing (AM), Market requirements for rapid product development, concept of Rapid Prototyping & Rapid Manufacturing, Generic characteristics and limitations of AM technology.	06
2	**Reverse Engineering** Definition of reverse engineering, History of Reverse Engineering, Preserving and preparation for the four stage process, Evaluation and Verification, Technical Data Generation, Data Verification, Project Implementation, Functionality- dimensional- developing technical data - digitizing techniques, construction of surface model solid-part material, characteristics evaluation, software and application, prototyping, verification.	08
3	**Reverse Engineering Equipments** Contact and non-contact methods of RE; Touch probe: operating principles, error analysis; Laser scanning: triangulation principles, system performance, case study; X-ray scanner: principles, applications and limitations	06
4	**Additive Manufacturing Technology** Fundamental physical/chemical mechanisms of model building; System operation principles; Properties of media, influence of process parameters, technical features; Process limitation - dimensional and geometric accuracy, surface textures and post-processing treatments; Economics and applications for the four main RP technology such as stereo lithography, fused deposition modeling, selective laser sintering/sintering, 3D printing.	08
5	**Recent Developments of AM** Emerging AM processes; Developments in associated rapid manufacturing; Overall evaluation and comparison of AM technology; Selection of AM systems; Applications of AM in various industrial, health care and other sectors; Design for AM.	06
6	**Rapid Tooling and data management** Direct and indirect tooling, AM-based rapid tooling, recent developments in rapid manufacturing; Design for additive manufacturing. Data management in reverse engineering, Software application, recycling real-time embedded software, design experiments to evaluate a Reverse Engineering tool	06

Reference Books:

1. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994.
2. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996.
3. Reversing: Secrets of Reverse Engineering, Eldad Eilam, Wiley publishers, 2005.

4. Additive manufacturing technologies, Ian Gibson, D W Rosen, B Struker, Springr, 2010.
5. Understanding Additive Manufacturing, Andreas Gebhardt, Hanser Gardner Publications, 2012
6. Rapid Manufacturing, An industrial Revolution for the digital age, Neil Hopkinson, Richard Hague, Philip Dickens, John Wiley & sons Ltd. 2006

MME 621 MANUFACTURING LAB-I

Teaching Scheme **Examination Scheme**
Practical: 4 Hrs/week **Term Work:** 50 Marks
Credit: 02

Course Objective

To expose the student to the Computer Aided Manufacturing practices followed in the industry.

The Lab work shall consist of following exercises.

1. Generating and simulating CNC part programs (at least two exercises each).

Note: A different exercise shall be given to each student in the batch.

1.1) Preparing a suitable CAD model for a part to be turned and generating the CNC part program to machine the same on a CNC lathe from the given form of raw material using a suitable CAM software and a post processor.

1.2) Preparing a suitable CAD model for a part to be machined and generating the CNC part program to machine the same on a CNC machining center (vertical/horizontal) from the given form of raw material using a suitable CAM software and a post processor. (2 dimensional machining like drilling , surface or slot milling etc.)

2. Generating a simple part program using CAM software and executing it on a CNC machine on CNC lathe or CNC machining center.

Note: A different exercise shall be given to each group of six students in the batch.

The evaluation of the work done by the student will be based on a file documenting the practical work and assignment carried out during the course followed by a viva-voce examination. The journal shall consist of the printouts and report of following experiments.

MME 622 MEASUREMENTS AND INSTRUMENTATION LAB

Teaching Scheme **Examination Scheme**
Practical: 2 Hrs/week **Viva -voce:** 50 Marks
Credit: 01

The laboratory work shall consist of exercises as given below.

1. Measurement of forces using strain gauges and study of static characteristics.
2. Measurement of temperature using minimum two types of temperature sensors and study of static characteristics
3. Pressure measurement using manometer, dead weight tester and Bourdon tube; Static calibration.
4. Flow measurement using rotameter/turbine flow meter,
5. Displacement, rotational speed and velocity measurement
6. Measurement of vibrations of machine tool members / structures
7. Static performance characteristics of operational amplifiers
8. Analog to Digital and Digital to Analog conversion of electrical signals
9. Use of Proportional/Integral/Derivative mode for measurement and control of speed/pressure/temperature

The Practical Examination will consist of viva voce based on the syllabus and term work. The practical examination will be assessed by two examiners, one will be the subject teacher and other examiner appointed by Dr. B.A.M.U. Aurangabad.

MME 623 SEMINAR – I

Teaching Scheme	Examination Scheme
Practical: 2 Hrs/week	**Viva -voce:** 50 Marks
Credit: 01	

Seminar – I shall be based on the literature survey on any topic, which will lead to dissertation in that area. It will be submitted as a report of about 30 pages.
The candidate will have to deliver a seminar presentation before the examiners, one of them will be guide and the other will be examiner appointed by the university.

(MME 651) METAL FORMING PROCESSES

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Theory of plasticity** : Theory of plastic deformation – Yield criteria – Tresca and Von-mises – Distortion energy – Stress-strain relation, Strain hardening, Material incompressibility, Work of plastic deformation, Work hardening,– Mohr's circle representation of a state of stress (numerical)– cylindrical and spherical co-ordinate system – upper and lower bound solution methods – Overview of FEM applications in Metal Forming analysis. Initiation and extent of plastic flow (microstructural point of view). Analysis of forming processes, Slab method, other methods of analysis like FEM, upper & lower bound, slip line field.	10
2	**Theory and practice of bulk forming processes:** Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming.	10
3	**Sheet metal forming:** Sheet forming; blanking, piercing, press bending, deep drawing, stretch forming, spinning, hydro forming, rubber-pad forming, explosive forming, Formability of sheet, Formability tests, Forming limit diagrams, Process simulation for deep drawing and numerical approaches.	10
4	**Surface treatment and metal forming applications:** Influence of temperature and gliding velocity – Friction heat generation – Friction between metallic layers – Lubrication carrier layer – Surface treatment for drawing, sheet metal forming, Extrusion and hot and cold forging. Processing of thin Al tapes – Cladding of Al alloys – Duplex and triplex steel rolling Thermo mechanical regimes of Ti and Al alloys during deformation Formability welded blank sheet – Laser structured steel sheet - Formability of laminated sheet.	10

Reference Books:

1. Dieter G.E., Mechanical Metallurgy (Revised Edition II) McGraw Hill Co., 2004
2. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003.
3. ASM Hand book, Forming and Forging, Ninth edition, Vol – 14, 2003
4. Shiro Kobayashi, Soo-Ik-oh-Altan, T, Metal forming and Finite Element Method, Oxford University Press, 2001.
5. Altan.T, Soo-Ik-oh, Gegel, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio, 1983.
6. Marciniak,Z., Duncan J.L., Hu S.J., 'Mechanics of Sheet Metal Forming', Butterworth-Heinemann An Imprint of Elsevier, 2006
7. Narayanasamy, R., "Metal forming technology"2nd Edition, Ahuja Pub,2000.

(MME 652) MANUFACTURING PROCESS MODELING

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction to Manufacturing Process Modeling:-** Types of Models, Principles of modeling. Automated Manufacturing System.	02
2	**Simulation**:- Introduction to simulation, need, models, application areas of simulation, discrete-event distributed , continuous, combined discrete-continuous and monte carlo simulation, modeling of queuing & inventory problems for simulation.	08
3	**Graph theory: -** Introduction, Paths & circuit. Trees & fundamental Circuits, representation of graphs, graph theoretic algorithms, applications of graphs in mfg.	08
4	**Regression methods:-** Introduction, models coefficient of co relation, least square methods, multiple regression, fuzzy variables, fuzzification & defuzzification & fuzzy regression, applications to mfg.	08
5	**Neural network: -** Introduction, supervised & unsupervised learning, layered modeling of networks, application of neural network to classification & recognition problems.	08
6	**Search techniques:** - Introduction to one dimensional & multidimensional search, genetic algorithm and simulated annealing.	06

Reference Books:

1. “Graph Theory" By Narsing Deo, PHI.
2. “Simulation" By J. Banks. PHI.
3. " Performance modeling of automated, mfg. System" By Vishwanathan & Narhari, PHI
4. "Simulation modeling and Analysis" A.M. Laws and W.D. Keltron

(MME 653) ROBOTICS AND MANUFACTURING AUTOMATION

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction**: Robot classification, applications in manufacturing, kinematics of robot, programming and robot languages, performance characteristics of robot, end effectors, Robot kinematics: Forward and Inverse kinematics.	04
2	**Developments in Grippers and Sensors**: End effectors and Different types of grippers, vacuum and other methods of gripping. Tactile array sensors, close circuit control for tactile grippers and sensors, variable pressure and light converting sensors, viscoelastic membrane type sensors, piezoelectric sensors, high resolution pneumatic tactile sensors, roller type slip sensors, special gripper design analysis force through FEM for viscoelastic analysis.	08
3	**Development in drives:** Stepper motor drive : construction, working, step angle, stepping rate, torque dynamic, detent torque, switching scheme, wave and phase techniques and transient reaponse.	04
4	**D.C. Servo system motor :** PID control and position feedback, Hydraulic and pneumatic actuation – Rotary hydraulic drive, microprocessor based pneumatic control.	04
5	**Robot applications in Manufacturing process :** Robotized welding, MIG, Spot welding, working principle, applications of robots in material transfer, machine loading, assembly and inspection, continuous arc welding, spray coating machining, die casting, drilling, routing, grinding, wire brushing, water jet cutting, laser cutting, riveting and similar operations interfacing with controller or PC, Use of simulation packages, Robotized inspection, Vision system with preprocessing segmentation, pattern recognition, interpretation, image sensing, digitizing, image processing, smoothing of image, vision equipments, CCD, raster scan, line scan, area sensing, automatic visual inspection, distance controlled robot, medical, bioengineering and genetic applications.	14
6	**Robot Path Control:** Contour path and blending techniques, obstacle avoidance, LEE's algorithm, cubic polynomial with via points.	06

Reference Books:

1. Robotics Technology and Flexible Automation, S.R.Deb, Tata McGraw Hill
2. Robotics : Control, sensors, vision and intelligence,
3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, McGraw-Hill.
4. Robotics Engineering", Klafter, Chemielwski & Negin, PHI publications.
5. Applying Machine Vision, Zuech, Nello, , John Wiley and sons, 1988.
6. Yoram Koren, Robotics, McGraw Hill 1992
7. Robotics and Image Processing, Janakiraman P.A. Tata McGraw Hill.

(MME 654) MANUFACTURING METROLOGY AND QUALITY ENGINEERING

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Laser Metrology** Introduction – types of lasers – laser in engineering metrology – metrological laser methods for applications in machine systems – Interferometry applications – speckle interferometry – laser interferometers in manufacturing and machine tool alignment testing – calibration systems for industrial robots laser Doppler technique – laser Doppler anemometry.	08
2	**Precision Instruments Based on Laser** Laser telemetric systems – detection of microscopic imperfections on high quality surface Pitter NPL gauge interferometer – classification of optical scanning systems – high inertia laser scan technique – rotating mirror technique – laser gauging – bar coding – laser dimensional measurement system.	08
3	**Co-ordinate Measuring Machine** Co-ordinate metrology – CMM configurations – hardware components – software –Probe sensors – displacement devices – Performance Evaluations – Software –Hardware – Dynamic errors – Thermal effects diagram – temperature variations environment control – applications.	09
4	**Opto Electronics and Vision System** Opto electronic devices – CCD – On-line and in-process monitoring in production –applications image analysis and computer vision – Image analysis techniques – spatical feature – Image extraction – segmentation – digital image processing – Vision system for measurement – Comparison laser scanning with vision system.	09
5	**Computer Integrated Quality Assurance** Total quality control - quality assurance - Zero defects-POKA-YOKE Statistical evaluation of data using computer-data integration of CMM and data logging in computers - TQM.	06

Reference Books:

1. John A. Bosch, Giddings and Lewis Dayton, Co-ordinate Measuring Machines and Systems, Marcel Dekker, Inc, 1999.
2. Juran J.M. and Gyna F.M., Quality Planning and Analysis, Tata-McGraw Hill, New Delhi
3. Zuech, Nello, Understanding and Applying Machine Vision, Marcel Dekker, Inc, 2000
4. Elanchezhian. C, Vijaya Ramnath. B and Sunder Selwyn, T., Engineering Metrology, Eswar Press, Chennai, 2004.
5. Taguchi. G and Syed L. et al., " Quality Engineering in production systems ", McGraw Hill,1980
6. John Bank, " Essence of TQM ",Prentice Hall of India Pvt.,Ltd.,1990.

ELECTIVE-II

(MME 691-A)RELIABILITY AND MAINTENANCE ENGINEERING

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test : 20 Marks

Unit	Contents	Hrs.
1	**Introduction:** Reliability concepts and patterns of failure, reliability Management, reliability, for system effectiveness. **Reliability and hazard rates:** Failure data, reliability function, failure rate and hazard rate, common distributions in failure mechanisms – experimental, Weibull, gamma, Normal, log normal, extreme value, model selection for components failure, failure analysis.	6
2	**System Reliability:** Series, parallel and mixed configurations. k-out-of-n-structure. Economics of introducing a standby or redundancy into a production system, Logic Diagrams, Markov Model. Fault-Tree Analysis and Other Techniques: Fault-tree Construction, Calculation of Reliability, Tie- set and Minimal Tie-set.	8
3	**Reliability design:** Design for reliability, design process, assessment methodology, reliability allocation, reliability improvement, selection of components to improve system reliability **Reliability Testing:** Product Testing, Reliability Life Testing, Burn –In Testing, Accelerated Life testing.	8
4	**Maintenance Engineering**: Fundamentals of Maintenance Engineering, importance of Maintenance, types of maintenance policies: corrective maintenance, preventive maintenance, condition monitoring and its techniques. Emerging trends in maintenance-Proactive Maintenance, Total Productive Maintenance (TPM). Reliability Centered Maintenance (RCM), RCM approach, RCM methodology, Application of RCM: examples and computers implementation.	8
5	Replacement Decisions: Economic models, block replacement policy, age replacement policy, replacement policies to minimize downtime, economics of preventive maintenance. Inspection Decisions: Optimal inspection frequency to profit maximizing, minimization of downtime and availability maximization.	10

Reference Books:

1. An Introduction to Reliability and Maintainability Engineering by Charles E. Ebeling, TMH Publication, New Delhi.
2. Concepts in Reliability in Engineering by L. S. Srinath, Affiliated East West Press.
3. Terotechnology: Reliability Engineering & Maintenance Management by S. K. Basu and B. Bhadury - Asian Books Private Limited
4. Maintenance, Replacement and Reliability- Theory and Applications by A.K.S. Jardine and A.H.C. Tsang, CRC Press, Taylor and Francis, New York.

5. Maintainability, Maintenance and Reliability for Engineers by B.S. Dhillon, CRC Press, Taylor and Francis, New York.
6. Reliability in Engineering Design by K. C. Kapur and L. R. Lumbersome, John Willey and sons.
7. Maintenance Engineering handbook by R. Keith Mobley, Lindley R. Higgins, Darrin J. Wikoff.-7th ed., McGraw-Hill.

Additional References

1. Reliability Engineering by E.A. Elsayed, John Wiley & Sons, Inc, New Jersey
2. Reliability Engineering-Specification and Performance, Springer –Verlag London Limited
3. nptel.iitm.ac.in/
4. ocw.mit.edu/
5. see.stanford.edu/
6. Reliability Engineering and System Safety (Elsevier)
7. International Journal of Reliability, Quality and Safety Engineering (World Scientific Publishing Company)
8. International Journal of Performability Engineering (RAMS Consultant)
9. Quality and Reliability Engineering International (Wiley Online Library)
10. Reliability Engineering (Elsevier)
11. Journal of Quality in Maintenance Engineering (Emerald)

ELECTIVE-II

(MME 691-B) TRIBOLOGY

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Introduction to Tribology:-** Importance of Lubrication, (Boundary Lubrication and Film Lubrication), Bearing, Friction, Wear, General Tribology considerations in the design of gears, Cams, Reciprocating components, etc. Engine Tribology basics-Tribology aspects of engine components such as bearings, piston assembly, valve train and drive train components etc.	04
2	**Surface roughness and its standardization measurement techniques**:- **Standardization**: Introduction. M and E system. **Measurement:** Measurement techniques and instruments. **Statistical analysis of surface:-** Statistical analysis of surface, contacting areas ,apparent area of contact, real area of contact, Abby's bearing area curve, load Vs contact ratio .	06
3	**Friction and wear:-** **Friction:-** Causes of Friction, Adhesion Theory, Abrasive Theory, Junction Growth Theory, Laws of Rolling Friction, Friction Instability, Friction-sliding friction-rolling friction characteristics of common metals and nonmetals friction under extreme environments, Engine friction- Losses and engine design parameters. **Wear :-** Wear Mechanisms, Adhesive Wear, Abrasive Wear, Corrosive Wear, Fretting Wear, Economic role of wear, type of wear, wear mechanism, factors affecting wear. selection of materials for different wear situations, measurement of wear, tribometers and Tribometry, Pinion- disc method of measuring friction and wear. Engine wear-mechanisms, Wear resistance material and coatings and failure mode analysis.	10
4	**Lubrication of Bearings:-** **Hydrodynamic Bearing:-**Mechanics of Fluid Flow, Reynold's Equation and its limitations, idealized bearings ,Infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution). **Finite Bearings:**-Hydrostatic, Hydrodynamic and thrust oil bearings, heat in bearings. **Hydrostatic squeeze film:-**Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings. **Elasto-hydrodynamic Lubrication:-** Pressure-viscosity term in Reynold's Equation, Hertz theory, Ertel-Grubin Equation, lubrication of spheres. **Air lubricated bearings:-** Tilting pad bearings, hydrostatic, hydrodynamic and thrust bearings with air lubrication.	12
5	**Rheodynamic (static) lubrication:** Non-Newtonian fluids, characteristics, Thixotopic, materials and Bingham	06

	solids, Grease lubrication and stability, Tribology of components in extreme environments like vacuum, pressure, temperature.	
6	**Application of Tribology:-** Introduction, Rolling Contact Bearings, Gears, Journal Bearings - Finite Bearings	02

Reference Books:

1. 'Fundamentals of Tribology', S.K. Basu, S.N. Sengupta, B.B. Ahuja
2. 'Engineering Tribology' , Prasanta Sahoo
3. Bowden F.P. & Tabor D., "Friction and Lubrication of solids", Oxford University Press., 1986.
4. Ernest Rabinoweiez: "Friction and Wear of materials" Interscience Publishers, 1995.
5. Neale M.J., Tribology-: Hand Book", Butterworth, 1995.
6. Fuller D.D.: "Theory and practice of Lubrication for engineers", John Wiley sons, 1984.
7. Gross W. A.: "Gas film lubrication", John Wiley and Sons.

ELECTIVE-II

(MME 691-C) NANO AND MICRO FABRICATION TECHNIQUES

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	OVER VIEW OF MEMS AND MICROSYSTEMS Definition – historical development – fundamentals – properties, micro fluidics, design and fabrication micro-system, microelectronics, working principle and applications of micro system.	04
2	MATERIALS, FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds silicon piezo resistors, Galium arsenide,quartz, polymers for MEMS, conductive polymers. Photolithography, photo resist applications, light sources, in implantation, diffusion process exudation – thermal oxidation, silicon diode, chemical vapour deposition, sputtering - deposition by epitoxy – etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level.	08
3	MICRO DEVICES AND MATERIALS Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands displacement sensors, pressure and flow sensors, micro actuators – smart materials – applications.	05
4	SCIENCE OF NANO MATERIALS Classification of nano structures – effect of the nanometer length scale effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process.	06
5	CHARACTERIZATION OF NANO MATERIALS Nano-processing systems – Nano measuring systems –characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron 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.	07

Reference Books:

1. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Mark Madou Fundamentals of Microfabrication, CRC Press, New York, 1997.
3. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
4. The MEMS Hand book, Mohamed Gad-el-Hak, CRC Press, New York, London.
5. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003

ELECTIVE-II

(MME 691-D) MANUFACTURING MANAGEMENT

Teaching Scheme:
Lectures: 03Hrs/Week
Tutorials: 01Hrs/Week
Credit: 04

Examination Scheme:
Theory Paper: 80 Marks (3 Hrs.)
Class Test: 20 Marks

Unit	Contents	Hrs.
1	**Scope of Manufacturing Management:** History and development of Manufacturing Management - Contribution of various pioneers beginning from Division of Labor to Quality Revolution and Environmental Control. Manufacturing Management - Nature, Scope, Importance and Functions.	06
2	**World Class Manufacturing:** Concept, quality management system, manufacturing challenges of information age, lean and agile manufacturing, reconfigurable manufacturing, green production ,PLC, TRM, IG, computerized production management system, World-Class Manufacturing: The Indian Scenario, Leading India Towards World-Class Manufacturing, TQM,TPM,SIX SIGMA.	08
3	**JIT:** Just in Time Manufacturing, elimination of waste, sequencing for JIT mixed model assembly lines, supply management for JIT, Push-Pull system. KANBAN, Production smoothening, Jidoka, Andon.	06
4	**KAIZEN**- Concept, Kaizen system, Kaizen umbrella, PDCA cycle, 5S, Kaizen evaluation, GEMBA Kaizen.	06
5	**Supply Chain Management**: Introduction, SCM concepts, dynamic behavior of supply chain systems, advanced planning and scheduling (APS) and SCM management, order promise and inventory management.	08
6	**Lean Manufacturing:** Elements of lean manufacturing, implementation, transforming from traditional to lean manufacturing, lean tools and techniques for: waste reduction, SMED, one piece flow, pull system.	06

Reference Books:

1. Maynords Industrial Engineering Handbook, 5th Edition, Edited by: Kjell B. Zaindin.
2. Purchasing and Supply Chain Management: Analysis planning and practice, Second Edition by Arjan J Van Weele, Vikas Publishing house.
3. World of Kaizen, Shyam Talewadekar, Quality Management System Publication.
4. World Class Manufacturing: A Strategic Perspective, B S Sahay, K B C Saxena, Ashish Kumar.
5. Just in Time Manufacturing, M G Korgaonkar, Macmillan Publisher.

MME 671 MANUFACTURING LAB-II

Teaching Scheme
Practical: 4 Hrs/week
Credit: 02

Examination Scheme
Term Work: 50 Marks

Course Objective

The objective of this course is to prepare students with manufacturing knowledge, in an industrial environment, and inculcate the ability to solve problems.

Min two Industrial based case studies/ practices /Assignment tasks on any of the following

1. Simulation of manufacturing such as Rolling/ forging / forming process simulation using CAE/FEM.
2. Rolling / forging / forming defect analysis and prevention.
3. Study of any one RPT (additive manufacturing) process
4. Study of Non-Destructive Testing of materials for defects analysis and measurement purposes.
5. Study of metal removal rate/ tool wear in non conventional machining methods such as WEDM, EDM, AJM.
6. Case studies on special manufacturing processes.
7. Study on design and manufacturing of special purpose fixtures for industrial component.
8. Case study on application of robots in manufacturing.
9. Case study on Manufacturing cost reduction and productivity improvement.

Note: The evaluation of the work done by the student will be based on a file documenting the case studies / practices / assignments carried out during the course followed by a viva-voce examination. Internal guide may be allotted to each student.

MME 672 AUTOMATION AND SIMULATION LAB

Teaching Scheme
Practical: 2 Hrs/week
Credit: 01

Examination Scheme
Viva -voce: 50 Marks

The laboratory work shall consist of exercises as given below

1) Design of hydraulic / pneumatic circuits for different machine tools, automation projects and their performance testing
2) Study, design / simulation of automation projects in material handling/packaging
3) Exercise on flexible automation using PLC, different sensors and actuators
4) Exercise on control of electrical motors using microcontroller / microprocessor.
5) Simulation of Robotic system for automation using a suitable software
6) Simulation of Electrohydraulic / Electropneumatic circuits using a suitable software –like FESTO PneuSim & HydroSim or Automation Studio or similar simulation software

The Practical Examination will consist of viva voce based on the syllabus and term work. The practical examination will be assessed by two examiners, one will be the subject teacher and other examiner appointed by Dr. B.A.M.U. Aurangabad.

MME 673 SEMINAR – II

Teaching Scheme	**Examination Scheme**
Practical: 2 Hrs/week	**Viva -voce:** 50 Marks
Credit: 01	

Seminar – II shall be based on the literature survey on any topic, (preferably in continuation with the Seminar – I) which will lead to dissertation in that area. It will be submitted as a report of about 40 pages.

The candidate will have to deliver a seminar presentation before the examiners, one of them will be guide and the other will be examiner appointed by the university.

MME 731 DISSERTATION – I

Teaching Scheme:	**Examination Scheme**:
Contact Hours: 12 Hrs/week	**Term Work:** 50 Marks
Credit: 12	**Viva-voce:** 50 Marks

The dissertation shall consist of a report on any research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The dissertation will consist of two parts as dissertation part-I and dissertation II.

Term work:

The dissertation part I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be a senior faculty member from the department.

Viva-voce:

The dissertation part I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be an external examiner.

MME 781 DISSERTATION – II

Teaching Scheme:	**Examination Scheme**:
Contact Hours: 20 Hrs/week	**Term Work:** 100 Marks
Credit: 20	**Viva-voce:** 200 Marks

The dissertation part - II will be in continuation of dissertation part - I and shall consist of a report on the research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The examinee shall submit the dissertation in triplicate to the head of the institution duly certified by the guide and the concerned head of department and the principal that the work has been satisfactorily completed.

Term work:
The dissertation will be assessed by two internal examiners appointed by the Institute, one of whom will be the guide and other will be a senior faculty member from the department.

Viva voce:
It shall consists of a defense presented by the examinee on his work in the presence of examiners appointed by the university, one of whom will be the guide and other will be an external examiner.