GOVT. COLLEGE OF ENGINEERING AURANGABAD

CURRICULUM

Master of Technology M. Tech. (Production Engineering) (Full-Time) 2018-2019

Department of Mechanical Engineering

GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

Teaching and Evaluation Scheme

Master of Technology M. Tech. (Production Engineering) (Full-Time)Programme (2018-19)

SEMESTER-I

Sr. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/Viva-voce	Total
							Test	TA	ESE			
1	ME51001	Advanced Manufacturing Techniques	3	-	-	3	20	20	60	-	-	100
2	ME51002	Advanced Mathematical Methods	3	-	-	3	20	20	60	-	-	100
3	ME51003 To ME51005	Program Elective I	3	-	-	3	20	20	60	-	-	100
4	ME51006 To ME51008	Program Elective II	3	-	-	3	20	20	60	-	-	100
5	GE 51001	Research Methodology & IPR	2	-	-	2	20	20	60	-	-	100
6		Audit Course I	2	-	-	--						
7	ME 51009	Lab 1: AMT I	-	-	4	2				25	25	50
8	ME 51010	Lab 2: AMM	-	-	4	2				25	25	50
		Total Semester I	**16**		**08**	**18**	**100**	**100**	**300**	**50**	**50**	**600**

SEMESTER-II

Sr. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/Viva-voce	Total
							Test	TA	ESE			
1	ME 51011	Robotics and Automation	3	-	-	3	20	20	60	-	-	100
2	ME 51012	Collaborative Engineering	3	-	-	3	20	20	60	-	-	100
3	ME 51013 To ME 51015	Program Elective III	3	-	-	3	20	20	60	-	-	100
4	ME 51016 To ME 51018	Program Elective IV	3	-	-	3	20	20	60	-	-	100
5	ME 51019 To ME 51021	Program Elective V	3	-	-	3	20	20	60	-	-	100
6	ME 51022	Lab 3: Robotics and Automation	-	-	4	2				25	25	50
7	ME 51023	Lab 4:: AMT II	-	-	4	2				25	25	50
8	ME 51024	Mini Project**	--	-	4	2				50	50	100
		Total Semester II	**15**		**12**	**21**	**100**	**100**	**300**	**100**	**100**	**700**

**It is mandatory to student shall undergo an industrial training for 3 to 4 weeks and submit a detailed report to guide.

SEMESTER III

Sr. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/Viva-voce	Total
							Test	TA	ESE			
1		Open Elective*	3	-	-	3	20	20	60	-	-	100
2	ME 61001	Dissertation I	-	-	20	10				50	50	100
		Total Semester III	**3**		**20**	**13**	**20**	**20**	**60**	**50**	**50**	**200**

*Students going for Industrial Project/Thesis will complete these courses through MOOCs.

SEMESTER IV

Sr. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/Viva-voce	Total
							Test	TA	ESE			
1	ME 61002	Dissertation II	-	-	32	16				100	150	250
		Total Semester IV	**-**	**-**	**32**	**16**				**100**	**150**	**250**
		TOTAL OF ALL SEMESTERS	**34**	**--**	**72**	**68**	**220**	**220**	**660**	**300**	**350**	**1750**

Program Elective – I

ME 51003 Flexible Manufacturing System
ME 51004 Advance Operations Research
ME 51005 Modern Management System

Program Elective – II

ME 51006 Modern Engineering Materials
ME 51007 Engineering Experimental Techniques
ME 51008 Management Information System and Enterprise Resource Planning

Program Elective – III

ME 51013 Machine Tool Design
ME 51014 Computer Aided Optimization
ME 51015 Engineering Economics

Program Elective – IV

ME 51016 Materials and Logistics Management
ME 51017 Computer Integrated Manufacturing
ME 51018 Facilities Planning and Material Handling System

Program Elective – V

ME 51019 Production Management
ME 51020 Reliability Engineering
ME 51021 Sustainability in Materials and Design

Audit Courses

SW 51001 English for Research Paper Writing
SW 51002 Disaster Management
SW 51003 Sanskrit for Technical Knowledge
SW 51004 Value Education
SW 51005 Constitution of India
SW 51006 Pedagogy Study
SW 51007 Stress Management by Yoga
SW 51008 Personality Development through Life Enlightenment Skills

Open Elective* (NPTEL/ SWAYAM/ MOOCS etc.)

1. Principals of Casting Technology
2. Design for Quality, Manufacturing and Assembly
3. Mechanics of Machining
4. Robotics
5. Manufacturing of Composites

Rules for Open Elective*:*

1. The students shall appear to above open elective or available at NPTEL/ SWAYAM/ MOOCS etc. course and has to successfully complete in duration of semester.

2. After submission of authentic course certificate the credits of open elective (3 credits) will be transferred.
3. Those students who are interested to appear Swayam/ MOOCS/ NPTEL etc courses as open elective not mention in Mechanical Engineering Department syllabus has to seek sanction syllabus and credit from department in advance.
4. It is compulsory to appear online exam of Swayam/ MOOCS/ NPTEL under supervision of department otherwise performance of student will not be considered.
5. Students performance of this online examination will be considered for TA, ESE, CT.

ME 51001: ADVANCED MANUFACTURING TECHNIQUES	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

1. Understand fundamental concepts rapid casting development.
2. Identify the use of Rapid prototype in various casting operations.
3. Work out force Analysis professionally at tool chip interface in super finishing operations.
4. Understand and analyze the advance chip less manufacturing process and its machine tools.
5. Acquire knowledge of advance plastic product manufacturing process and metal coating process in view of their manufacturability, constraints and practical analysis.

Course Outcome

After completing the course, students will able to:

CO1	Recognize and apply the fundamental concepts of rapid casting development in practice, Apply the knowledge in critical patterns developments.
CO2	Improve analytical ability in various super finishing operations by problem solving and professional practice.
C03	Apply knowledge of advance chip less manufacturing process to design and develop new product.
C04	Enhance and develop professional skill of metal coating to improve life of product.
C05	Design and develop various new products by using advance plastic product manufacturing techniques

Detailed Syllabus:

Unit 1	**Advances in Casting Process:** Rapid Casting Development, Design for Casting: Manufacturability 'health-checks'; guidelines for improving the casting design; web-based collaboration, Rapid Tooling Development: Rapid prototype patterns; rapid tooling methods; benchmarking of RP&T routes for casting application, Casting Process Planning: Process selection; selection of steps and process parameters; casting cost estimation.
Unit 2	**Manufacturing by Machining:** Analysis of tool-chip interface - Geometry and models of tool wear, tool-life and tool-temperature, tool-chip interface friction, tool condition monitoring, importance.
Unit 3	**Chip less Metal Removal Processes:** Non-traditional manufacturing processes, Abrasive jet machining, Water jet machining, Magneto abrasive finishing, wire EDM, Micro drilling by different processes like laser beam, ion beam, electro jet, electro stream drilling, nontraditional deburring processes.

Unit 4	**Plastic Manufacturing Processes:** Compression molding, Transfer molding, Injection molding, Extrusion cold molding, Thermo forming, Blow molding, Roto molding, Structured form molding.
Unit 5	**Metallic Coating:** Importance, Principle application of - Chemical vapor deposition, Physical vapor deposition, Thermal spray coating, Electroplating, Electroless Coating.

Reference Books

1. Benjamin W., Niebel A., "Modern Manufacturing Process Engineering", Tata McGraw Hill publications.
2. Bendict G. F., Dekker, "Nontraditional Manufacturing Processes", Marcel Inc. NewYork.
3. HMT, "Production Technology Hand Book", Tata-McGraw Hillpublications.
4. Ravi B., "Metal Casting: Computer-Aided Design and Analysis", Prentice-Hall of India,2005.
5. Weller E. J., "Non-Traditional Machining Process", Society of Manufacturing Engineers, DearbanMichigan.
6. Amsteal, Philip, Begman, "Manufacturing Processes", John Willey and Sons, 8th edition.
7. Mishra P. K., "Non-traditional Machining Processes", Narosapublications.
8. Heine R.W., Loper C.R., Rosenthal P.C., " Principles of Metal Casting", and Tata McGrawHill, New Delhi,1991
9. Mukherjee P.C., "Metal Casting Technology", Oxford and IBH,1979.
10. Ghosh A., Mallik A. K., "Manufacturing Science", East-West Press,1985.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	1	2		3				
CO2	1	1	2	3		3				
CO3	3	1	1	3		2				
CO4	2	2	1		3	1	1			
CO5	2	1	1	2	3					

1 – High 2 – Medium 3 – Low

ME 51002 : ADVANCED MATHEMATICAL METHODS	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

We help the students to master their skills and improve their mathematical ability and maturity. The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of engineering. In addition, this course is intended to prepare the student with mathematical tools and techniques that are required in advanced courses offered in the engineeringprograms.

Course Outcome

After completing the course, students will able to:

CO1	Application of the basic science systematization thought excavation, evaluation, diagnosis project question, and plans and carries out ability of the special study and the solution.
CO2	Have independent research, collection of the data, standard problem development, acquire conclusion from data, and have development innovation and compose the ability of professional thesis.
CO3	Use mathematics in engineering realm to do design and analysis, explanation of data obtained from experiments with independently ability to solve the problem.

Detailed Syllabus:

Unit 1	**Numerical Methods to Solve Partial Differential Equations**, Hyperbolic equations, parabolic equations, Elliptic equations, solution of laplace equations, solution of poission's equations, solution of elliptic equations by relaxation method, solution of one dimensional heat flow equation, solution of two dimensional heat flow equation, solution of wave equation.
Unit 2	**Matrices:** Matrix inversion, Gauss elimination method, Gauss Jordan method, Crout'striangularisation method, Partition method, Iterative method, Homogeneous systems the eigen- value problem, the power method, Jacobi's method, eigen-values of symmetric matrices, transformation method, transformation of generalized eigen-value problem to standard.
Unit 3	**Solution of Algebraic and Transcendental Equations:** Basic properties of equations, Bisection method, False Position method, Secant method, Iteration method, Aitken's $\square^2$ method, Newton Raphson method, Horner's method, Muller's method, Root squaring method and Comparison of iterative method.
Unit 4	**Curve Fitting:** Least square curve fitting procedures for straight line, Nonlinear curve fitting, weighted least square approximation, Method of least square for continuous function.

Unit 5	**Finite Difference Methods:** Formation of difference equation, linear difference equation, rules for finding out complementary function, rules for finding out particular integral, difference equations reducible to linear form, simultaneous difference equation with constant coefficients, application to deflection of a loaded string, loaded simply supported beams or cantilevers.

Reference Books

1. Kreyszig Erwin, "Advanced EngineeringMathematics",
2. Mathews John. H., "Numerical Methods", PHI, NewDelhi.
3. Rajasekaran S., " Numerical Methods in Science and Engineering", WheelerPublications
4. Grewal B. S., " Numerical Methods", Khanna Publication, NewDelhi
5. Shastry S. S., "Introductory Methods of Numerical Analysis", PHI, NewDelhi.
6. Chapra, Canal, "Numerical Methods forEngineers",

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		1		2		2				
CO2		2	2	1		1				
CO3			2				1			

1 – High 2 – Medium 3 – Low

ME 51003 : FLEXIBLE MANUFACTURING SYSTEMS	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Course Objectives:-

1. To introduce and discuss flexible manufacturing concepts.
2. To expose the student to the different types of manufacturing available today such as the Special Manufacturing System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS), the automated flow lines, the common CAD/CAM data base organized to serve both design and manufacturing.
3. To study about group technology, Computer aided quality control and Flexible manufacturing systems.
4. To study automated inspection techniques.

Course Outcomes:-

After completing the course, students will be able to:

CO1	Identify how automation can be used in production systems
CO2	Recall basic elements of automation, and automation strategies.
CO3	Apply group technology, cellular manufacturing knowledge
CO4	Design and analyze flexible manufacturing systems.
CO5	Apply automated inspection techniques.

Detailed Syllabus:

Unit1	**FMS concept**:- CAD-CAE-CAM, components of FMS, flexibility in manufacturing, volumevariety relationship, FMS workstation, machining centers, application and benefits, building blocks of FMS, FMS control.
Unit2	**FMS layout**:- planning for the FMS, analysis and optimization of FMS, organization andinformation processing in manufacturing, production concepts and mathematical models (numerical), automation strategies.
Unit3	**Automated flow lines**:- Methods of work-part transport, transfer mechanisms, bufferstorage, control functions, automation for machining operations, analysis of transfer lines without storage, concept of partial automation, automated flow lines with storage buffers (numerical).
Unit4	**Automated assembly systems**:- Types, design for automated assembly system, partfeeding devices, Analysis of multi station and single station assembly machines (numerical), Group Technology(GT), Optiz coding Technology, Coordinate Measuring machine(CMM)
Unit5	**Automatic Inspection Technology:** Automated inspection and testing, principles and methods, sensor technologies, machine vision, contact and non-contact inspection methods, optical inspection methods, quantitative analysis of inspection(numerical), effect of defect rate, compounding effect of defect rate, final inspection Vs Distributed inspection, partial distributed inspection, inspection or no inspection.

Text and Reference Books

1. Kundra, Tiwari, "Computer Aided Manufacturing", Tata McGraw Hill Publications
2. Groover M. P., "Automation, Production Systems and CIM", PHI Pvt. Ltd. Publications
3. Kusiak A., "Modeling and Design of FMS", Elsevier Science Publishers
4. Raouf A., Ahmed S.I., "Flexible Manufacturing", Elsevier Science Publishers
5. Ranky P.G., "Flexible Manufacturing Cells & Systems in Cim", Guildford Survey, UK
6. Ranky Paul G., "Design and operation of FMS", Guildford Survey, UK
7. Vishwanathan N., Narhari Y., "Performance Modelling of Automated Manufacturing System" PHI Publications

Mapping of Course outcome with Program Outcomes

1 – High 2 – Medium 3 - Low

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	2	3	2			2		3	
CO2	1	3	3	3			3		3	
CO3	1	1	1	2	2	3	3		3	2
CO4	1	1	1	2	2	1	3		2	2
CO5	1	2	2			2			3	2

Special Instructions if any: Nil

ME 51004 : ADVANCED OPERATIONS RESEARCH	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Course Objectives:

1. To make the use of various operation research techniques like advanced linear programming, investment decisions
2. Dynamic programming in solving, Analyzing theoretical, industrial, research and real life problems
3. Modeling and solving LPP using spreadsheet
4. Formulation of CPM and PERT problems using spreadsheet

Course Outcomes:

After completing the course, students will be able to:

CO1	Will be able to optimize solutions and its implementation by using advanced operation research techniques
CO2	Will be able to solve the problems using spreadsheet
CO3	Will be able to formulate the real life problems
CO4	Will be able to solve CPM and PERT problems using spreadsheet

Detailed Syllabus:

Unit1	**Introduction:** History, What is Operations Research, Where can OR be applied, whatare OR techniques, Important steps in tackling OR problems effectively, general methods of deriving solution, limitations of OR, **Advanced Linear Programming:** The techniques and its applications, definitions andmathematical formulation, problems formulations, graphical solution, simplex method, duality in LP, dual simplex method, sensitivity analysis in LP, degeneracy in LP, no feasible solution, unbounded solution.Modeling and solving LP problems using spreadsheet
Unit2	**Goal programming**, revised simplex method, parametric programming, integer linear programming, Branch & bound algorithm, Gomory's cutting plane algorithm.
Unit3	**Investment Decision:** Rationale and criteria, the concept of chain of equipments, costvolume profit analysis under uncertainty, risk adjusted discounted rate, risk analysis. Replacement Analysis**:** Why to replace, replacement of items, which gradually deteriorate, sudden failure preventive replacement.
Unit4	**Project Management**:-, CPM, PERT, forward pass, backward pass, critical path, Project Management using spreadsheet, Gantt Chart, project crashing using spreadsheet
Unit5	**Dynamic Programming:** Introduction, concept of dynamic programming, principle ofoptimality, stage coach problem, optimum route problem, allocation of salesman to territories, planning production of seasonal items, Markovian decision process, Toy makers problem, Taxi cab problem.

Text and Reference Books

8. Ragsdale Cliff T., "Spreadsheet modeling and Decision analysis" 5th Ed, Thomson Higher Education Natorp Boulevard Mason, USA
9. Sharma S. D., "Operation Research", 12th Ed, KedarNath Ram Nath co. publication
10. Sharma J. K., " Operation Research: theory and application",5th Ed 2012, MACIN publication.
11. Gupta P. K., Hira D. S., "Operations Research", S. Chand Publications, New Delhi.
12. Taha H. A., "Operations Research an Introduction", Prentice Hall Inc. 2003.
13. Banerjee B., "Operations Research Techniques for Management", Business Book Publishing House.
14. SwarupKanti, Gupta P. K., Man Mohan, " Operations Research", Sultan Chand and Sons Publishers.
15. Natarajan, Balasubramani, Tamilarasi, "Operations Research", Pearson Education, NewDelhi, 1st Ed., 2005

Mapping of Course outcome with Program Outcomes

1 – High 2 – Medium 3 - Low

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	1	3	2	3			3	
CO2	1	1	3	3	3				3	3
CO3	1	3	3			3		2	3	3
CO4	1	1	2			2	3		3	3

Special Instructions if any: Nil

ME 51005: MODERN MANAGEMENT SYSTEMS	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Course description: In this course we are going to learn about quality management, Quality Management Tools, Element of JIT manufacturing, Concurrent Engineering and various Approaches to Computer assisted production management.

Objectives:

1 Analysis of quality manufacturing techniques for improving productivity andprofitability.
2 Analyze maintenance problems and its effectiveimplementation.
3 Use of concurrent engineering in processimprovement.
4 Use of computational techniques for quantifying productionmanagement.

Course Outcome

After completing the course, students will able to:

CO1	Ensuring organizational goals and targets are met with least cost and minimumwaste.
CO2	Looking after health and welfare and safety of staff andworkforce.
CO3	Protecting the machinery and resources and organization including the humanresources

Detailed Syllabus:

Unit 1	**Quality Management:** Introduction to Quality management, principal of Quality management, Philosophies of various Quality Gurus, Quality planning, Quality circle, Human dimension in TQM, Quality Management Tools like Brainstorming, Histogram, check sheet, pareto diagram, Ishiwaka Diagram, control chart, scatter diagram, Affinity diagram, Tree diagram, Five S theory. Quality certification, Iso 9000,
Unit 2	**Just In Time:** Element of JIT manufacturing, Advantages, limitations, plant arrangement for flexible plan, planning, control, kanban, just in time logistics, Implementation issues in JIT manufacturing, Inventory management for JIT
Unit 3	**Concurrent Engineering:** Concurrent Engineering-Principle, traditional verses concurrent approach, scheme and tools of concurrent engineering, application, of computers in practice of concurrent Engineering, Decision making, Leadership, Process Model type, Importance, relation between models, specification automation and process improvement, application of CE in design Engg, manufacturing Engg.

Unit 4	**Computer assisted production management:** Approaches to Computer assisted production management, Motivation,Basic part representation method, shape, process economics, computer assisted QC, Co-ordinate measuring machine, construction, types, automated dimension gauging, and process gauging. Capacity planning, roll of capacity planning in manufacturing, planning and control system hierarchy of capacity planning decision links to other system modules Controls techniques.

Reference Books

(1) Juran TQM,TMHPublications.
(2) Introduction to TPM, ProductivityPress(India).
(3) Groover M.P, Automation Production System, Prentice Hall,USA.
(4) Bedwarth David, Computer Integrated Design and Manufacturing, Gray SkyBook.
(5) JuranJ.M,Quality Planning and Anaysis-McGrawHill,USA.
(6) Sud and Ingle,Quality Circle Master Guide, PHIPublications.
(7) Ross Phillip J,Taguchi Techniques for quality Engineering, McGraw HillPublications.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1							
CO2	1		2	2						
CO3	1	3	2	1						

1 – High 2 – Medium 3 – Low

ME 51006: MODERN ENGINEERING MATERIALS	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

1. Understand and analyze the structure and properties of ferrous and non-ferrous materials and their heat treatment processes.
2. Analyze the properties and applications of composite material for different applications.
3. Understand the structure and application of organic materials.

Course Outcome

After completing the course, students will able to:

CO1	Analyze and predict the heat treatment process for a particular ferrous and nonferrous material.
CO2	Prediction and analysis of composite material for different applications.
CO3	To be able to select a material for design andconstruction.
CO4	Acquire knowledge of material properties and changes with different heat process.

Detailed Syllabus:

Unit 1	**Ferrous Materials:** Mechanical properties, heat treatments and applications; stainless steel and heat resisting steels, precipitation hardened able steels, valve steels, high strength low alloy steel (HSLA), micro alloyed steels, ball bearing steel, tool steels, high nitrogen steels, alloy castiron.
Unit 2	**Nonferrous Materials:** Mechanical properties, heat treatments and applications; copper alloys (Brasses and Bronzes), Al –alloys (Al-Mg-Si, Al-Cu, Al-Si), designation system in Al – alloys.
Unit 3	**Composites:** Classifications, properties, application of composites, polymer matrix materials, metal matrix materials, ceramic matrix materials, carbon materials, glass materials, fiber reinforcements, types of fibers, whiskers, laminar composites, filled composites, particulate reinforcedcomposites
Unit 4	**Design of composites materials:** Hybrid composites, angle plied composites, mechanism of composites, calculation of properties, unidirectional fiber composites, critical volume fraction, discontinuous fiber composites, rule of mixtures equation, critical angle. Analysis of an Orthotropic Lamina, strengths of orthotropic lamina, analysis of Laminated Composites, stress strain variations inlaminates,

Unit 5	**Organic Materials:** Classification, properties, application of polymers, plastics and elastomers. Ceramics: Classification, properties, structures of refractories, abrasive materials, electronic ceramics, cement and concrete.

Reference Books

1. Jastrezebski Z.D., The nature and properties of engineering Materials, WileyNewyork.
2. Aver S.H, Introduction to Physical Metallurgy, McGrawHill,Tokyo.
3. Sharma S.C,Composite Material, Narosa Publishing House,NewDelhi.
4. DeGarmo E.P., Black J.T, Kosher R.A, Materials and processes inManufacturing,PrenticeHall.
5. Rajput R.K.,Materials Science and Engineering,Kataria andsons.
6. ChawlaK.K,CompositeMaterials,Springer.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1			3				
CO2	1	3	2		3	1				
CO3		1	3			2				
CO4	1	3	2		3	1				

1 – High 2 – Medium 3 – Low

ME 51007 : ENGINEERING EXPERIMENTAL TECHNIQUES	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Course Objectives:

1. To understand the basic concepts of generalized measurement and experimental planning
2. To analyze the experimental data using various statistical techniques
3. Measurement of parameters like force, torque, motion and vibration
4. To understand thermal and nuclear radiation measurement techniques
5. Use of data acquisition system for processing the experimental data.

Course Outcome: After completing the course, students will be able to:

CO1	Able to design, plan and execute experimental systems for particular engineering problems
CO2	Analyze and report performance of experimental systems.
CO3	Select the proper technique for measurement of force, torque, strain and radiations
CO4	Handle data acquisition system and its working

Detailed Syllabus:

Unit1	**Basic Concepts:** Definition of terms, Calibration, Standards, Dimensions and units, thegeneralized measurement system, Basic concepts in dynamic measurements, system response, distortion, impedance matching, experimental planning.
Unit2	**Analysis of Experimental Data:** Causes and types of experimental errors, uncertaintyanalysis, evaluation of uncertainties for complicated data reduction, Statistical analysis of experimental data, probability distributions, the Gaussian, normal error distribution, probability graph paper, the Chi -square test of Goodness of fit, The method of least squares, the correlation coefficient, standard deviation of the mean, *t*-distribution, Graphical analysis and curve fitting, general considerations in data analysis.
Unit3	**Data Acquisition and Processing:** The general data acquisition system, signalconditioning, data transmission, analog to digital and digital to analog conversions, data storage and display, the program as substitute for wired logic.
Unit4	**Thermal and Nuclear Radiation Measurement:**- Detection of thermal radiation, measurement of emissivity, reflectivity and trans-emissivity measurement, solar radiation measurement, nuclear radiation and its detection, GEIGER-MULLER Counter, Ionization chamber, scintillation counter, statistic of counting (numerical).
Unit5	**Force Torque and Strain Measurements:** Mass balance measurements, elasticelements of force measurements, torque measurement, stress strain measurements, various types of strain gauges.

Text and Reference Books

1. Holman J. P., "Experimental Methods for Engineers", 6th Ed, McGraw Hill Publications, New York.
2. Jain R. K., "Mechanical Measurements", Khanna Publishers, New Delhi.
3. Kumar D. S., "Mechanical measurement and control", 5th Ed, Metropolitan Book co., New Delhi.
4. Doebelin E. O., "Measurement systems: application and design", 4th Ed, McGraw Hill Publications, New York.

Mapping of Course outcome with Program Outcomes

1 – High 2 – Medium 3 - Low

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	1	2	2	1	3		3	
CO2	2	2	2	2	2	1	3			
CO3	1		2			1			3	
CO4	1		2			2			3	

Special Instructions if any: Nil

ME 51008 : MANAGEMENT INFORMATION SYSTEMS & ENTERPRISE RESOURCE PLANNING	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Prerequisites: ME459: Principles of Design of optimization.

Course description: In this course we are going to learn about Computers & MIS organizational structures and Nature and characteristics of organizations. Also ERP basic features.

Objectives:

1 Understand the basic concept of Management InformationSystem.
2 Analyze the organizational framework for Management InformationSystem.
3 Analyze the Computational aspect of databasemanagement.
4 Analysis of the decision supportsystems.
5 Understanding and analysis of Recourse planning in anenterprise.

Course Outcome

After completing the course, students will able to:

CO1	Analyzing the feasibility of application of MIS toorganizations
CO2	Improvement in Organizational effectiveness withMIS
CO3	Effective utilization and analysis of organizationaldata
CO4	Improvement in cost benefit by effective decisionmaking
CO5	Effective utilization of organizationalrecourses

Detailed Syllabus:

Unit 1	**Introduction:** Definition, Importance, Evolution, Computers & MIS organizational structures, Motivation, Logical foundation, Future of MIS
Unit 2	**Information Systems & Organization:** Nature and characteristics of organizations. Leadership, Organization and Information system structure, information. Data Information, Communication, Management & Information System. Information support for functional areas, impact of business on information systems, Organizing information systems, Acceptance of MIS in organization.
Unit 3	**Computers & Database Technology:** Evolution of computer hardware & soft wares, Database and enterprise management, file processing systems and database systems. Database approach and its architecture, DBMS, Models, RDBMS, SQL, 4GL, Data administration, Current development of databases.

Unit 4	**Decision Support System:** DSS issues, Decision making, Structure, Construction-approaches. Generators, Tools, Software and cost benefits and simple examples of applications.
Unit 5	**Enterprise Resource Planning:** ERP basic features, Modules of ERP, ERP soft wares – comparative study, Implementation of ERP-preparation, Training needs.

Reference Books

1. Sadgopan S., "Management Information System", Prentice Hall of India, New Delhi1997.
2. Davis Gordon B. and Olson M., "Management Information Systems", Mc Milan, NewYork.
3. Jawadekar W.S., "Management Information Systems", Tata McGraw-Hill,2002
4. O'Brien, J. A. Jr., "Management Information Systems", Mc Milan, NewYork.
5. Date C. J., "An Introduction to Database Systems", 6th Edition, Addison Wesley,1995.
6. Turban E. and Meredith J. R., "Fundamental of Management science", IRWIN Inc.,1991.
7. Murdick R. G. and Ross J. E., "Information Systems for Modern Management",PHI.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	2						
CO2	1		2		3					
CO3	1	3	2	3	3					
CO4	2	2	1	2						
CO5										

1 – High 2 – Medium 3 – Low

GE 51001 : Research Methodology and IPR	
Teaching Scheme **Lectures: 2 Hrs/Week** **Tutorial: 0 Hr/Week** **Credits: 2**	**Examination Scheme** **Class Test I : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Objectives:

The objective of this course is to expose the post graduate students to basic methodologies and techniques of carrying out research work which will be helpful for Dissertation work.

Course Outcome:

After completing the course, students will able to:

CO1	Selection of research problem
CO2	Formulation of research problem.
CO3	Analysis of research problem.
CO4	Analysis and report writing of work undertaken.

Detailed Syllabus:

Unit 1	Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature review.
Unit 2	Basic Concepts of Probability, Probability Axioms, Measures of Central Tendency, Measures of Dispersions, Measures of Symmetry, Measures of Peakedness. Regression Analysis – Simple Linear Regression, Multiple linear Regression, Correlation. Tests of Hypothesis and Goodness of Fit: Definition of null and alternative hypothesis, students 't' distribution: properties, application with example. Chi-square distribution: definition, constants of Chi-square distribution. Application with example. F-test: example of application.
Unit 3	**Optimization Techniques:** Linear Programming, Simplex Method, Dual Simplex, Sensitivity Analysis. Artificial Variable Technique, Dynamic Programming, Introductory concepts of non-linear programming. **Or** **Modeling and simulation:**

	Introduction to modeling: Concept of system, continuous and discrete systems. Importance of experimental analysis, guidelines for design of experiments, uncertainty and error analysis, concept of uncertainty, propagation of uncertainty, planning experiments from uncertainty analysis.
Unit 4	Fuzzy logic**:** Introduction, Concepts, Basic Fuzzy Mathematical Operations, Fuzzy databases, Membership Functions, Fuzzy Linear Programming. Neural Networks: Artificial Neural Networks, architectures and algorithms, Basic neuron models, Neural network models, Learning algorithms. Genetic Algorithms: Introduction to genetic algorithm, Operators, Applications.
Unit 5	**Interpretation and Report Writing:** Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Writing a technical paper, plagiarism and its implications.

Reference Books

1. S.P.Gupta, " Statistical Methods", S. Chand & Sons.
2. Kothari C.R.(2011), " Research Methodology-Methods and Techniques", New Age International Publishers, New Delhi.
3. Gupta S.L. and Gupta Hitesh (2011), “Research Methodology-Text and cases with SPSS applications” International Book House Pvt. Ltd., New Delhi.
4. Rao V and H. Rao, (1996), “C++, Neural Networks and Fuzzy Logic”, BPB Publications, New Delhi.
5. Goldberg, D.E. (2000), “Genetic Algorithms in Search, Optimization & Machine Learning”, Addison Wesley Longman (Singapore) Pte. Ltd., Indian Branch, Delhi.
6. George J. Klir and Bo Yuan (2010), “Fuzzy Sets and Fuzzy Logic”, PHI Learning Pvt. Ltd, New Delhi

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1			3				
CO2	1	3	2		3	1				
CO3	1	3	2		3	1				
CO4	2	3	1			2				

1 – High 2 – Medium 3 – Low

ME 51009 : LAB– I (Advanced Manufacturing Techniques)	
Teaching Scheme **Practical: 4 Hrs/Week** **Credits: 2**	**Examination Scheme** **Term Works : 25 Marks** **Viva voce : 25 Marks** **Total : 50Marks**

Objectives:

1. Study ofEDM machining processes,
2. To Understand and study CMM, NDT techniques.
3. Study the machining processes parameter such as USM, Abrasive Machining ECM Etc.

Experiments:

1. Experiment on EDM Machine and Study of Process Parameters.
2. Experimentation on CMM
3. Experiments on different NDT techniques
4. Experimentsand study of the process parameters withUSM, Abrasive Machining etc.

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Term Work**	**Practical Examinations & Viva Voce**
S1	Implementation	04	05
S2	Manipulation	07	10
S3	Precision	14	05
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks 50		25	25

Preparation S1	04	05
Conduct of Experiment S2	04	07
Observation & analysis of Results S3	08	05
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	05
Total	**25**	**25**

ME 51010 : LAB– II (Advanced Mathematical Methods)	
Teaching Scheme **Practical: 4 Hrs/Week** **Credits: 2**	**Examination Scheme** **Term Works : 25 Marks** **Viva voce : 25 Marks** **Total : 50Marks**

Objectives:

1. Acquiring knowledge of writing codes for solving problems

Outcomes:

Enhancing knowledge about writing codes for solving problems.
The laboratory work will consist of development of codes for different numerical methods for learning purpose, chosen from those given in the contents of the Advanced Mathematical Methods syllabus.
Further, the lab hours shall be used for coding the algorithms developed for solution of any problem selected by student from the field of Production Engineering.

Assessment table

Assessment Tool	S1	S2	S3	S4	S5
	C01	C02	C03	CO4	CO5
Term work 25 Marks	10	05	02	02	01
Practical Examinations & Viva Voce	07	03	02	06	02

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Term Work**	**Practical Examinations & Viva Voce**
S1	Implementation	04	05
S2	Manipulation	07	10
S3	Precision	14	05
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks 50		25	25

Preparation S1	04	05
Conduct of Experiment S2	04	07
Observation & analysis of Results S3	08	05
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	05
Total	**25**	**25**

ME 51011 : ROBOTICS AND AUTOMATION	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

1. To understand robot anatomy and characteristic of different type, dynamic performance of robotic system and its kinematics.
2. To know the different sensors, gripers their selection and dynamic performance analysis.
3. To accustom with robot programming and its use in casting, welding, machining industry.
4. To know the CNC, PLC and DC servo systems and machine interfacing.

Course Outcome

After completing the course, students will able to:

CO1	To develop ability of analyzing robot performance
CO2	Applying knowledge for sensor and gripper selection
CO3	Preparing for programming of PLC's for various industrial systems

Detailed Syllabus:

Unit 1	**Automation and Robotics:** Definition, need of the Robotics, market and future prospects, differentiation of Robots from other automation systems, near relations to robots, robot usages and conditions for its application, Robot Anatomy and Characteristics: Classification, point to point and continuous path system, control loops of robot system, work volume, speed of movement, dynamic performance, Accuracy and repeatability, drive system, sensors used in robotics, letter symbol, coding and kinematicsarrangement
Unit 2	Transformations and Kinematics: Coordinate transformation -Vector operations – Basic transformations matrices - Properties of transformation matrices-Homogeneous transformations– Forward solution, DH algorithm - Inverse kinematic solution, Brief Robot dynamics
Unit 3	Controls and End Effectors: Control system concepts - Analysis - control of joints - Adaptive and optimal control – End effectors - classification - Mechanical - Magnetic - Vacuum - Adhesive - Drive systems and controls- Force analysis and Gripper design
Unit 4	Robot Applications: Work cell control and interlocks, Robot applications in manufacturing like material transfer and machine loading/unloading, processing operations, assembly and inspection, etc. Introduction to Robotics Technology of the future, Future applications.

Unit 5	Automation; Introduction , Types of Automation, Types of Automation Systems, Programmable Logic Controllers, Parts of a typical PLC system, Programming of PLC, Example applications of PLC in a CNC machine.

Reference Books

1. Groover M. P., Willis, "Industrial Robotics", McGrawHill.
2. Aures R. U. and Miller S. M., "Robotics applications and implications", BallingerPublishing Co.,Cambridge
3. Groover M. P. and Zimmer E. W., "Computer Aided Design and Manufacturing",Prentice Hall of India Ltd, NewDelhi
4. "Machatronics", HMT Limited, Tata McGraw Hill Publications, NewDelhi
5. David G., "Machatronics", Tata McGraw Hill Publications, NewDelhi
6. Handbook of IndustrialRobotics

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		1	2	2						
CO2	1	3	2			1				
CO3	1	1	3	2						

1 – High 2 – Medium 3 – Low

ME 51012: COLLABORATIVE ENGINEERING	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hr/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Objectives:

1. Develop concepts of cross functional team, Conceptual design, QFD for Design for Assembly
2. Identify the various key parameters in Product Design for casting, molding, welding, forging, sheet mental operations
3. Work out force Analysis Analyze professional product design on basis of Cost, reliability, Value, safety, ergonomics, environment etc.
4. Acquire knowledge of various software's of PLM, DFM, for new productdesign

Course Outcome:

After completing the course, students will able to:

CO1	Apply the fundamental concepts cross functional team, Conceptual design, QFD for Design for Assembly in practice
CO2	Apply the knowledge in critical patterns developments, Improvement analytical ability in Product Design by considering casting, molding, welding, forging, sheet mental operations in professional practices
CO3	Apply knowledge of various software's, Cost, reliability, Value to design develop new product and DFA and develop numerical ability to design new product.
CO4	Develop new product and DFA and develop numerical ability to design new product.

Detailed Syllabus:

Unit 1	Collaborative PLM: Concept – product development through cross-functional teams supported by information and communication technologies, Product innovation, Product lifecycle, Product definition using QFD, Conceptual design, Concept evaluation.
Unit 2	Design for Manufacture: Design for moulding, Design for forging and welding, Design for sheet metal forming, Design for machining.
Unit 3	Design for Assembly: Design for use (ergonomics), Design for safety and reliability, Design for service/maintenance, Design for environment.
Unit 4	Design for Quality and Cost: Design for quality, Design to cost, Product cost estimation, Product lifecycle cost, important aspects affecting market competitiveness, Value engineering (self-study).

Unit 5	Product Lifecycle Engineering: Product data management, Product structure and storage, Workflow and project management, Change management, Distributed product data management, Web-based collaboration, Knowledge management, Collaborative engineering team, PDM/PLM systems, DFM/PLM software demonstration, Intelligent CAX/PLM, Future evolution.

Reference Books

1. Bralla J. G., "Handbook of Product Design for Manufacturing", McGraw-Hill, New York, 1986.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1			3				
CO2	1	3	2		3	1				
CO3	1	3	2		3	1				
CO4	2	3	1			2				

1 – High 2 – Medium 3 – Low

ME 51013 : MACHINE TOOL DESIGN	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

Understand fundamental concepts machine tool drives, hydraulic transmission systems of machine tools, identify the forces in various machining operations, Carry out force Analysis professionally, Recognize and understand the standard speed and feed box design procedures for different machine tools. To acquire a skill to design and develop machine tool structure spindles and guide ways, CNC and DNC with practicing various analytic

Course Outcome

After completing the course, students will able to:

CO1	Recognize and apply the fundamental concepts of transmission system
CO2	Apply the knowledge of forces in machining to develop machine tool force diagrams, and improve analytical ability in professional practice in designing speed and feed boxes for various machine tools
CO3	Identify, Formulate Engineering problems in Machine tool Design
CO4	Enhance and develop professional skill of designing machine tool structures, spindles, guide ways of Universal, CNC and DNC machines

Detailed Syllabus:

Unit 1	**Machine Tool Drives and Mechanism:** Machine tool drives, Hydraulic transmission, mechanical transmission, different types of driving mechanisms used in machine tools, requirements of machine tool design, force analysis in cutting in turning drilling and milling
Unit 2	**Regulation of Speed and Feed Rates in Machine Tools:** Speed and feed rates regulation, design of speed box, design of feed box, Machine tool drives in multiple speed motors, special cases, gearing diagram, determination of number oftooth.
Unit 3	**Design of Machine Tool Structures and Guide ways:** Design criteria for machine tool structures, Static and Dynamic stiffness, Design procedure for design of bed, column, housing, bases and tables, Modern techniques in design ofstructures
Unit 4	**Design of Guide ways, Power screws and Spindles:** Design of slide ways, design of aerostatic slide ways, combination guide ways, protecting devices of slide ways, design of power screws, design calculations of spindles. Antifriction bearings and sliding bearings, stability of machine tools, forced vibrations of machine tools
Unit 5	**Machine Tool Control and Advance Design:** Control systems for changing speed and feeds, automatic control of CNC machines, numerical control systems, design of NC and CNC machine tools

Reference Books

1. Basu S. K., “Design of Machine Tools”, AlliedPublishers
2. Acharkan, “Metal Cutting Machine Tools”, Technical PublishingHouse
3. Bhattacharya A., Sen G. C., “Principles of MachineTools”,
4. Mehta N. K., “Machine Tool Design”, Tata McGrawHill
5. “Vibrations of Machine Tools”, Machinery Publishing Co. Ltd.,London
6. “Numerical Control”, John Wiley,London.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1			3				
CO2	1	3	2		3	1				
CO3		1	3			2				
CO4	1	3	2		3	1				

1 – High 2 – Medium 3 – Low

ME 51014 : COMPUTER AIDED OPTIMIZATION	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Prerequisites: Engineering mathematics.

Course description: In this course we are going to learn about optimization technique and Variable Optimization Algorithms.

Objectives:
1 Understanding and Analysis of optimizationproblems.
2 Understanding of single variable and multi variableoptimization.
3 Analysis of problems within the definedlimits.
4 System development and problem solving by using specificalgorithms.
5 Modeling and performance analysis various optimizationmethods.

Course Outcome

After completing the course, students will able to:

CO1	Comparative analysis of optimizationmethods.
CO2	Analysis and use of single variableoptimization.
CO3	Understanding and Analysis of constrains inoptimization.
CO4	Selection and use of reliable optimization method for problemsolving.

Detailed Syllabus:

Unit 1	**Introduction:** Optimal problem formulation, engineering optimization problems, optimizationalgorithms. Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient based methods, root finding using optimizationtechniques.
Unit 2	**Multivariable Optimization Algorithms:** Optimality criteria, unidirectional search, direct search methods, gradient based methods, Computer programs on above methods.
Unit 3	**Constrained Optimization Algorithms:** Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearised search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, Computer programs on above methods.
Unit 4	**Special Optimization Algorithms:** Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods.
Unit 5	**Optimization in Operations Research:** Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivityanalysis

Reference Books

1. Deb Kalyanmoy, " Optimization in Engineering Design", PHI, NewDelhi
2. Rao S. S. "Engineering Optimization", John Wiley, NewDelhi.
3. Deb Kalyanmoy, " Multi-objective Algorithms using Evolutionary Algorithms", John Wiley, New Delhi.
4. Paplambros P. Y. and Wilde D. J., "Principles of Optimum Design: Modeling and Computation", Cambridge University Press,UK
5. Chandrupatla, "Optimization in Design", PHI, NewDelhi.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1			2	2	1					
CO2	1	3	2		3					
CO3	1		3	2						
CO4	2	3	1							

1 – High 2 – Medium 3 – Low

ME 51015: ENGINEERING ECONOMICS	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

1. To built up the knowledge of managerial economics and analysis of project considering economical concepts.
2. Expertise in costing, finance and accounting related to the organization. Able to do corporate planning

Course Outcome

After completing the course, students will able to:

CO1	Implement the knowledge of economics to the production engineering includes costing, finance and cost accounting through analyzing engineering problems and economic analysis of projects.

Detailed Syllabus:

Unit 1	**Engineering Economics and estimation:** The principle and use of economic analysis in engineering practice. Discounted cash flow analysis, corporate tax and investment, Depreciation and economic studies, replacement analysis, valuation ofassets. Estimating: Importance and aim, objectives, functions, Estimating Procedure, Constituents of Estimation. Concept of direct tax, indirect tax as GST.
Unit 2	**Depreciation & break even analysis:** Introduction, purpose, methods for calculating depreciation-straight line method, Diminishing balance method, sum of year digit method, machine hour basis method. **Break even analysis:** Introduction, assumptions in break even analysis, important terms and definitions, calculation of breakeven point, advantages and limitations.
Unit 3	**Economic analysis of projects**: analysis of risks and uncertainty, elements of demand analysis and forecasting, production function, output and pricing decisions **Labor costing:** Introduction, factors influencing wage rate, methods of wage payments for direct and indirect labor-time wage system, Wage incentives: different plans, labor, indirect expenses
Unit 4	**Costing:** Definition, aims, procedure for Costing, types of costs, Costing controls, Control of Costs, Profit and Pricing Policy. Costing methodology for raw materials, Products and Services, Nature of Costs-Direct, Traceable and Non traceable. Determining of Cost of manufactured products, methods of overhead allocation
Unit 5	**Corporate Planning:** Corporate objectives, goals and policies, process of corporate planning, SWOT analysis, GAP analysis, strategy formulation, investment evaluation, capital budgeting, industrial dynamics, Business case development.

Reference Books

1. Owler W., Brown J. L., "Cost Accounting and Cost Methods", 14th Ed., McDonald and EvansPublications
2. Kuchal S. C., Financial Management - An Analytical and Conceptual Approach", 10th Ed., Chaitanya PublishingHouse
3. Shukla M. S. and Grewal T. S., "Advance Accounts", S. Chand and Co., NewDelhi
4. Mechanical Estimating and Costing By B.P. Sinha. Tata McGraw Hill Publishing Co. Ltd. N. Delhi
5. Mechanical Estimating and Costing T.R. Banga and S.C.Sharma, Khanna Publishers, Delhi-6
6. Industrial Engineering & Operations management by S.K.Sharma&SavitaSharma,Kataria publishers
7. Process Planning & Cost Estimation by R. Kesoram& others, New Age International Pub., N. Delhi
8. Handbook of Engineering Management- Edited by Dennis Lock, Butterwork&Heinemanky Ltd.
9. Theusan and Theusan, "Engineering Economics", 5th Ed., PHI, NewDelhi
10. Dean Joel, "Managerial Economics", PHI, NewDelhi
11. Hussey D. D., "Introducing Corporate Planning", Pergamon Press, New York,1982

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		1		2		2				

1 – High 2 – Medium 3 – Low

ME 51016 : MATERIALS AND LOGISTICS MANAGEMENT	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Course description: In this course we are going to learn material logistics and management

Objectives:

1) Understand and analyze the material related functions, planning and decisions in the industry
2) Able to understand purchase policies and procurement of inventory and vendor development in the legal aspects of purchasing
3) To know the buying procedures, rate and running contract, stores procedures
4) To understand international buying procedures and licensing
5) To illustrate need of inventory, Genesis of logistics

Course Outcome

After completing the course, students will able to:

CO1	Enable to decide material policies and planning in industry
CO2	Able to execute purchase policies and procurement and vendor development
CO3	To implement buying procedures, running contract and store procedures
CO4	To analyze various inventory models and execute logistic decisions

Detailed Syllabus:

Unit 1	**Material Management**: Concepts, objective and scope, organizing for materials function, various administrative practices. Interaction with production and sales, material management planning and budgeting, various techniques, ABC analysis, standardization and codification, make and buy decision
Unit 2	**Purchasing Scheme**: Purchasing system, ordering, post purchase activity, price forecasting and analysis, purchasing under uncertainty vendor development and evaluation, purchase negotiation and pricing, purchasing of capital equipment tendering, purchase aerosol lease, import substitution, import regulations and procedure, legal aspects of purchasing
Unit 3	**Public Buying and Stores Management:** Buying procedure related to various governmental organizations like DGS and D registration of suppliers, rate and running contracts, indenting procedure Purchase of stores location and layout, various types of stores, stores procedures, stores accounting and stock checking management of scrap, obsolute, damage and unwanted stocks.
Unit 4	**International Buying and Import Purchasing**: Import procedures and documents, categories of import, basics of licensing, Import purchasing procedures, Registration of licenses at port

Unit 5	**Logistics Management and Inventory**: Genesis of logistics-logistics decision on facility location, need for inventory and its control, types of inventories, cost of inventory, determination of safety stock, EOQ, Q system or re-order point system, P system or replenishment system, S policy, store keeping and inventory control

Reference Books

1. Dobler Bunt, "Purchasing and Material Management", TMH Publications
2. Farrel, Heinritz, Smith,"Purchasing Principle and Application", Prentice Hall of India.
3. Gopalkrishnan and Sudershan, "Purchasing and Material Management", PHI Publications
4. Smolik, Nostrands, "Material Requirements and Manufacturing"
5. Ballou Ronald H., "Business Logistics Management", Prentice Hall of India.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1			2	2	1					
CO2	1	3	2		3					
CO3	1		3	2						
CO4	2	3	1							

1 – High 2 – Medium 3 – Low

ME 51017: Computer Integrated Manufacturing	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

6. Develop an understanding of classical production system, management technology.
7. Develop an understanding of computer integrated manufacturing and its impact on productivity, product quality.
8. Obtain an overview of computer technologies including computers, database and data collection networks, machine control etc

Course Outcome

After completing the course, students will able to:

CO1	Develop the ability of analyzing Computer integrated manufacturing
CO2	Applying knowledge of database networking for manufacturing.

Detailed Syllabus:

Unit 1	**Introduction:** Brief introduction to CAD and CAM , Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM, Concurrent Engineering-CIM concepts, Computerized elements of CIM system, Types of production, Manufacturing models and Metrics , Mathematical models of Production Performance, Simple problems, Manufacturing Control, Simple Problems , Basic Elements of an Automated system , Levels of Automation, Lean Production and Just-In-Time Production.
Unit 2	**Integration Of Manufacturing:** Integration of manufacturing activities and operations, CIM architecture, various models, CAD-CAM integration, CAPP, Automatic inspection systems, use of CMM, application of principals of Artificial Intelligence (AI) and expert systems to CAPP
Unit 3	**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.
Unit 4	**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.

Unit 5	**Planning & Implementation Of CIM:** Key aspects of planning and implementation, process management considerations. Various phases and steps in CIM implementation. Interfacing of computers to real life system such as machine tools, robots and other handling devices such as AGV, RGV and storage system AS/RSetc.

Reference Books

1. Teicholz Eric, NorrJoel,"CIM Handbook", McGraw HillInternational.
2. Krieger, Harrington J., "Computer IntegratedManufacturing"
3. "An analysis of CAD/CAM application with introduction to CIM", PrenticeHall.
4. Bedworth David, "Computer Integrated Design and Manufacturing", McGrawHill,
5. "CIM Interfaces by CIM Technology", DelmerPublication
6. Scholz B and Reiter, "CIM Interfaces", Chapman andHall

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		1		2		2				
CO2	1	2	2	1		1				

1 – High 2 – Medium 3 – Low

ME 51018: FACILITY PLANNING AND MATERIAL HANDLING SYSTEMS	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

(1) Analysis of the material flow in anorganisation.
(2) Analysis of Material Handling equipments and their effectiveuse.
(3) Understanding of Human factor in Materialhandling.
(4) Improvement in the organisational layout and departmentalinterrelationship.
(5) Space analysis in the economics of aplant.

Course Outcome

After completing the course, students will able to:

CO1	Improvement in the techniques of material flow in anorganisation.
CO2	Effective utilisation of material handlingequipments.
CO3	Improvement in the safety environment by proper selection of Material handlingsystems.
CO4	Improvement in Layout of the organisation as awhole.
CO5	Improvement in the economics of plantlayout.

Detailed Syllabus:

Unit 1	**Introduction:** Basic material handling concepts. Unit load concept, principles of material handling. Classification: Unit bulk: Relationship to safety, material management, project management principles as applied to material handling. Material flow: Master flow pattern, material or product handling methods, processes, general flow patterns, flow planning criteria, design of a flow pattern, techniques for analyzing materials flow
Unit 2	**Materials handling equipments:** classification, Industrial hand trucks: Two wheeler hand trucks, multiple wheel floor trucks, hydraulic and mechanical handling trucks, powered trucks-automated guided vehicles, Conveyors: Package handling, vertical lift, overhead trolley, power and unit load conveyers, Cranes, hoists and monorails-bridge, gantry and jib cranes, Storage equipment and systems, positioning equipment such as lift tables, power dumpers, die handling, industrial robots, Bulk material handling: Bins, hoppers, feeders belt, chain, screw, vibratory conveyers, pneumatic conveyers bucket elevators, escalators.
Unit 3	**Selection of material handling system** for various applications like production shop, foundry etc., factors affecting handling systems, constructing a layout, Safety environment and human factor in material handling, safety in industry, dust control, noise control

Unit 4	**Facilities design function:** Scope, importance, objectives, enterprise design process, types of layout problems, good layout organization of layout department and relationship with other department. Common problems in plant layout, planning activity relationship, Types of activities Relationship, diagrams production and physical plant services, receiving storage, office, parking, equipment, line balancing, flexibility, expansion facility
Unit 5	**Space determination and area allocation:** Space planning for offices, storage, production and other activities, factors considered in area allocation such as expansion, selection and economics of site, economic of plant layout.

Reference Books

1. Apple James M., "Plant Layout and Material Handling", John Wiley andSons.
2. Moore James M., "Plant Layout and Design", Macmillan Publishing Inc. NewYork.
3. Kuwiec Raymond A., "Material Handling Handbook", Sponsored by the American Society of Mechanical Engineering & International Material Management Society, John Wiley & Sons New York.
4. Rudenko, "Material HandlingEquipment"
5. Alexander, "Material Handling Equipment", MIRPublications

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		1	2	2						
CO2	1	3	2			1				
CO3	1	1	3	2						
CO4						2				
CO5						2	3			

1 – High 2 – Medium 3 – Low

ME 51019 : PRODUCTION MANAGEMENT	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

1. Able to understand production/ operation management objectives and various manufacturing strategies.
2. Able to develop new product design concept and technology forecasting and development also able to designprocess
3. Analyze the capacity planning and strategies and various balancingmethods
4. Carry out process flowanalysis
5. To apply the concepts of supply chain management and forecasting techniquesanalysis

Course Outcome

After completing the course, students will able to:

CO1	Implementation of various manufacturing strategies and able to work out manufacturing excellence
CO2	Development of product design procedures and implementation of forecasting techniques and various designprocesses
CO3	To derive capacity strategies of various processes and itsimplementation
CO4	Enable to develop the use of various process flow charts and balancingmethods
CO5	Implementation and execution of SCM concepts and forecastingtechniques

Detailed Syllabus:

Unit 1	**Production Function:** Definition of production/operation management, objectives, scope and functions, frame work of production management, manufacturing strategy and competitiveness, frame work of manufacturing strategy, operations effectiveness stage, manufacturing excellence, evolving-manufacturing perspectives like lean manufacturing, agile manufacturing, material and labourproductivity
Unit 2	**Product and Process Design:** Product Design: New product concept, strategies for new product development process, concurrent engineering, designing for costumer, Quality function deployment, designing products for manufacturing and assembly, technology forecasting and technology developmentprocess. **Process Design**: Choice of technology, process flow characteristics, process selection decisions, process strategies, use of Break-even analysis in process/machine selection, product mix decisions, and use of linear programming techniques.
Unit 3	**Strategic Capacity Planning:** Capacity planning concept, long-range and short-range capacity strategies, economics scale, experience curve, capacity focus and flexibility, capacity planning, capacity planning in service verses manufacturing, adding capacity multi-site service growth

Unit 4	**Process Flow Analysis and Layout Design:** Types of processes, process flow structures, product-process matrix, process analysis, process flow design, process analysis, process flow chart, basic layout types computerized layout planning, travel chart and relationship chart, layout of line processes, assembly line balancing, and various balancing methods
Unit 5	**Supply Chain Management:** Supply chain, outsourcing, make or buy decision, value density, supplier selection, JIT purchasing, global sourcing and distribution. **Forecasting:** Time series analysis techniques, linear regression, moving average, exponential smoothing, casual relationship forecasting, forecast error, choice of forecasting techniques, aggregate planning, operation planning overview, production planning environment, production strategies and aggregate planning strategies

Reference Books

1 TelsangMartand, "Industrial Engineering and production Management", S. Chand andco. Ltd. New Delhi.
2 Monks Joseph, "Operation Management Theory and problems", McGraw Hill Inc. NewYork
3 "Production and Operation Management (Manufacturing & Services) ", TMH NewDelhi.
4 Korgaonkar, "Just in Time Manufacturing", Tata McGraw Hill Co. Ltd. NewDelhi
5 Panneenselvam R., "Production and Operation Management", PHI NewDelhi.
6 Riggs James, "Production System: Planning, Analysis and Control", John-Wiley and Sons New York

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		1		2		2			2	3
CO2	1	2	2	1		1				
CO3		2	3							
CO4							2			
CO5	2	2	3			2				

1 – High 2 – Medium 3 – Low

ME 51020 : RELIABILITY ENGINEERING	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Objectives:

1. To inculcate the knowledge of reliability and its applications to various engineering problems, with the use of probability theories matrices and decision making using event tree analysis, AGREE, ARINC techniques.
2. To analyze engineering design using reliability concepts.
3. Use of accelerated methods in reliability testing and FMEA

Course Outcome

After completing the course, students will able to:

CO1	To analyze engineering design and failure problems with implementation of reliability technique knowledge and its execution.
CO2	To implement decision making process using event tree analysis and enhance the use of graph theory, RAM, RCM, CBM, HUM in engineering design along withFMECA

Detailed Syllabus:

Unit 1	**Introduction to Reliability and its applications to engineering**, discussions on Reliability failure rate, Patters of Failure Distribution and Bathtub curve, Failure data collection and life estimation and Monte Carlo simulation of cumulative probability of failure of consistent components.
Unit 2	**Survival probabilities of various systems having subsystems in series**, parallel or combined configuration, Assessment of overall reliability by various methods: i) Star Delta, ii) Set theory, iii) Conditional Probability, iv) Matrix Method, v) Event Tree Analysis, Allocation of Reliability through programming and other algorithms, through proper appointment of unreliability's, AGREE, ARINC and other methods
Unit 3	**Reliability in Engineering Design:** Carter's concept of reliability, and Safety Margin in a structural mechanical design, Hazard Analysis through RPN & Graph theory, Through stacking of dimensional tolerance, Reliability Effort Function, Reliability, Availability and Maintainability (RAM), Life Cycle Cost – algorithms, mathematical models &nomograms, Non-Parametric Analysis: Mean and Median Ranking Statistics
Unit 4	**Accelerated Method of Reliability Testing-**Variable, attribute and K Statistic, Truncated Test, Reliability Centered Maintenance (RCM): Predictive Preventive Maintenance, Diagnostic Techniques used in PPM, Condition Monitoring leading to CBM, HUM
Unit 5	**Failure Modes and Effect Analysis** (FMEA), Failure Modes, Effects and Criticality Analysis (FMECA)

Reference Books

1. DhillonBalbir S., "Reliability Engineering in Systems Design & Operation", N.Y. Van

Nostrand Reinhold, 1983

2. "Handbook of Reliability Engineering & Management", McGraw Hill, New York, 1988
3. Shrinath L. S., "Rliability Engineering", 3rd Edition, Revised Affiliated East West Press, 1991
4. Misra K. B., "Reliability Analysis and Prediction : A Methodology Oriented Treatmebnt

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	2	2	1	3				
CO2	2	3		2	2	1	2			
CO3										
CO4										

1 – High 2 – Medium 3 – Low

ME 51021: SUSTAINABILITY IN MATERIALS AND DESIGN	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 0 Hrs/Week** **Credits: 3**	**Examination Scheme** **Class Test I : 20Marks** **Teachers Assessment : 20Marks** **End Semester Exam : 60 Marks**

Prerequisites: Nil

Course description: In this course we intend to learn the various design techniques for improving sustainability of materials

Objectives:
1 Understanding the concept of sustainability
2 Understanding and analysis of Lifecycle of materials
3 Analysis of carbon footprints of materials
4 System development and problem solving by using GaBi
5 Modeling and performance analysis of smart materials

Course Outcome

After completing the course, students will able to:

CO1	Comparative analysis of product sustainability
CO2	Analysis and use of LCA for material selection
CO3	Understanding and analysis of carbon footprints of various materials
CO4	Selection and use materials for sustainable development

Detailed Syllabus:

Unit 1	Introduction to Sustainability, Sustainability Manufacturing, Product Sustainability, Introduction to GaBi , Introduction to Life cycle analysis
Unit 2	Carbon footprint analysis, calculation of carbon footprint, Materials for environment, Life cycle analysis of eco friendly materials
Unit 3	Green supply chain, Sustainability through unit process and enterprise level, Design for disassemble, Product design for better environment, Numericals on Product design.
Unit 4	Sustainable smart materials, Green machining and numericals, Matrial selection with life cycle analysis, Sustainable smart manufacturing with Industry 4.0 approach
Unit 5	Sustainability with additive manufacturing, Sustainable ergonomics, Minimum level lubrication (MQL) sustainability, Numericals on LCA of PET bottle, Cement etc

Reference Books

1) Maddock M. and Uriarte L. (2011). *Brand New: Solving the Innovation Paradox – How Great Brands Invent and Launch New Products, Services and Business Models.*John Wiley & Sons, Inc., Hoboken, New Jersey.

2) Burkus D. (2014). The Myths of Creativity: *The Truth About How Innovative Companies and People Generate Great Ideas.* Jossey-Bass- A Wilery Brand, San Francisco, California.

3) Goos P. and Jones B. (2011). *Optimal Design of Experiments: A Case Study Approach.*John Wiley & Sons, Ltd. Chichester, West Sussex, United Kingdom.

4) Ries E. (2011). *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses.* Crown Publishing Group, New York, NY.

5) Sawyer K. (2012). *Explaining Creativity: The Science of Human Innovation, 2nd Edition*.Oxford University Press, New York, NY.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	2			2			
CO2	1	2	2		3		3			
CO3	1	3	2	2	3		1			
CO4	2	3	1		1		2			

1 – High 2 – Medium 3 – Low

ME 51022 : LAB– III(Robotics and Automation)	
Teaching Scheme **Practical: 4 Hrs/Week** **Credits: 2**	**Examination Scheme** **Term Works : 25 Marks** **Viva voce : 25 Marks** **Total : 50Marks**

Objectives:

1. To understand robot anatomy and characteristic of different type, dynamic performance of robotic system and its kinematics.
2. To know the different sensors, their selection and dynamic performance analysis.
3. To accustom with robot programming To know the CNC, PLC and DC servo systems and machine interfacing.

Experiments:

1) Study of Robot Anatomy

2) Experiment on Various Robotic sensors and its use in practice

3) Robot programming methods and languages

4) PLC:Various hardware types of PLC (CPU and I/O modules).Centralized configuration of PLC.

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Term Work**	**Practical Examinations & Viva Voce**
S1	Implementation	04	05
S2	Manipulation	07	10
S3	Precision	14	05
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks 50		25	25

Preparation S1	04	05
Conduct of Experiment S2	04	07
Observation & analysis of Results S3	08	05
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	05
Total	**25**	**25**

ME 51023 : LAB IV –(Advanced Manufacturing Techniques II)	
Teaching Scheme **Practical: 4 Hrs/Week** **Credits: 2**	**Examination Scheme** **Term Works : 25 Marks** **Viva voce : 25 Marks** **Total : 50 Marks**

Objectives:

1. Understand and apply concepts of 3D printers.
2. Analyze the TIG and MIG welding techniques.
3. AnalyzeCNC Technique.

Experiments:

1. Experiments of 3D Printing/ Rapid Prototyping Process
2. Experiments on TIG and MIG welding and study of mechanical properties of welded joints
3. Experiments of Mechanical properties of metals by using UTM.
4. Programming and experiments on CNC milling for different profiles.

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Term Work**	**Practical Examinations & Viva Voce**
S1	Implementation	04	05
S2	Manipulation	07	10
S3	Precision	14	05
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks 50		25	25

Preparation S1	04	05
Conduct of Experiment S2	04	07
Observation & analysis of Results S3	08	05
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	05
Total	**25**	**25**

ME 51024: Mini Project	
Teaching Scheme 3-4 weeks Industrial Training Credits: 2	**Examination Scheme** Teachers Assessment- 00 Marks Term Work- 50 Marks Practical/Viva- 50Marks

Course description: The student shall identify the industrial mini/ small problem and collect, review, compile, comprehend the related information and generate its solution.

Course Objectives:

1. To make the student conversant with Industrial Activities, Organizational behavior and ethics
2. To understand various industrial aspects viz. Manufacturing Processes, Industrial Design, Productivity Improvement, Quality Control and Product Development,CAD/CAM/CAE.
3. Student will able to analyze and solve Industrial Mini problem as mini project.

Course Outcomes:

After completing the course, students will be able to:

1. Work in industrial environment.
2. Understand various industrial problems and prepare technical report from collected information.
3.Analyze and Solve engineering mini problems by using the present knowledge.
4. Prepare a report on mini project.

Term Work:

1. Identification and collection of pragmatic industrial information.
2. Student shall submit detail report in a prescribed format based on above as mini project under the guidance of faculty advisor and Industry Advisor.
3. Student shall deliver a seminar based on above report(It consists of a comprehensive report based on student's industrial observations, training received and assignments completed during 3 to 4 weeks of training. The mini project shall also include drawings, figures, process sheets, machine/ product specifications etc. with solution to industrial problem)

Students shall obtain a Certificate of successful completion of training from concerned industry authority in standard format.

End Semester Evaluation for 50 marks:

Student should prepare a technical report in prescribed format and present the power point presentation based on above mini project before the panel of examiners, industrial experts and students.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	2			2	2		
CO2	1	2	2		3		3	2		
CO3	1	3	2	2	3	1	1		3	
CO4	2	3	1		1	2	2		3	

1 – High 2 – Medium 3 – Low

OPEN ELECTIVE: PRINCIPLES OF CASTING TECHNOLOGY

Credits : 3

Description:

The course focuses on understanding the basics of science and technology of casting processes. Metal casting industries have evolved during the past hundred years because of advancements in technologies. The properties of the cast metals significantly depends upon the type of molding, melting, solidification and post treatment practices. This needs to be understood by the young students as well as practicing shop floor engineers so that products with superior qualities can be cast. The basic purpose of this course is to provide a sound understanding of concepts and principles of casting technology so as to enable them to be conversant with advances in these methods in the long run towards increasing the productivity of casting industries.

Casting Industries like BHEL, Tata Steel, Jindal Steel, Foundry units of medium and large sizes

Important For Certification/Credit Transfer:

Weekly Assignments and Discussion Forum can be accessed ONLY by enrolling

Detailed Syllabus:

1	Introduction to Casting technology, Solidification analysis for metals and alloys
2	Technology of patternmaking, study of molding sands and their testing methods
3	Technology of mould making and core making, Special sand moulding processes
4	Principles of gating design for castings
5	Principles of risering design for castings
6	Special casting methods, Melting furnaces
7	Melting and pouring practices for production of Cast Iron family, steel and non-ferrous metals and alloys
8	Fettling and Heat treatment of castings, Casting defect and its diagnostic methods

Reference Books

1. Heine, R.W., Loper, C.R., and Rosenthal, P.C., “Principles of Metal Casting”, TMH
2. Ghosh, A., and Mallik, A.K., “Manufacturing Science”, Affiliated East-West Press Pvt. Ltd.
3. Jain P. L., “Principles of Foundry Technology”, TMH
4.Chakrabarti, A. K., “Casting Technology and Cast Alloys”, PHI

CERTIFICATE:

1. Final score will be calculated as : 25% assignment score + 75% final exam score
2. 25% assignment score is calculated as 25% of average of 8 weeks course: Best 6 out of 8 assignments
3. E-Certificate will be given to those who register and write the exam and score greater than or equal to 40% final score. Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Roorkee. It will be e-verifiable atnptel.ac.in/noc.

OPEN ELECTIVE: DESIGN FOR QUALITY, MANUFACTURING AND ASSEMBLY

Credits : 3

Description:

In the context of product design, it is very important to appreciate the limitations of a design from manufacturing and assembly perspective and to produce high quality products at low cost. This course will introduce methods that can provide guidance to design teams in simplifying product structure to reduce manufacturing and assembly costs, quantify improvements and how robust design concepts can be used for ensuring quality. This course aims at introducing the need to account for variability, mathematically represent it, formulate it and control it. Concepts such as quality, robustness, six sigma and orthogonal array will be discussed.

Detailed Syllabus:

1	Introduction, course expected outcomes, discussion on quality
2	Measuring quality: Quality loss function. Discussion on robustness, six sigma concepts
3	Quantifying robustness: Signal to Noise Ratio, problem formulation using SNR. Design of experiment discussions
4	Orthogonal array, linear graphs, triangular tables, finding optimum combinations. Case
5	Design for Manufacturing: over the wall design, most influential phase in design, best practices in injection molding and sheet metal working
6	Design for additive manufacturing, single point and multipoint tools
7	Design for Assembly: Boothroyd Dewhurst method, theoretical minimum number of parts, Xerox producibility index (XPI) method
8	Do's and dont's in manual assembly, assembly time estimation, design for robotic assembly considerations
9	Design for sustainability

Reference Books:

1.MadhavPhadke, "Quality Engineering Using Robust Design", Prentice Hall, NJ, USA
2.Phillip J. Ross, Taguchi Techniques for Quality Engineering, McGraw-Hill , 1989
3.GeoffreyBoothroyd, Peter Dewhurst, "Product Design for Manufacturing and Assembly", Winston Knight, Mercel Dekker, 2001
4.Daniel E. Whitney "Mechanical Assemblies" Oxford University Press, 2004

CERTIFICATION:

1. Final score will be calculated as : 25% assignment score + 75% final exam score
2. 25% assignment score is calculated as 25% of average of Best 6 out of 8 assignments.
3. E-Certificate will be given to those who register and write the exam and score greater than or equal to 40% final score. Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Madras.It will be e-verifiable at nptel.ac.in/noc.

OPEN ELECTIVE:MECHANICS OF MACHINING

Credits : 3

Description:

Machining is a metal removal process, which can be accomplished by applying force on raw material by means of a cutting tool. This course aims at explaining the physics of the cutting process. The course will contain discussion of statics, kinematics and kinetics of the cutting process. Experimental findings relevant to mechanics of the process will also be discussed. The course will also include introductory discussion on non-traditional machining processes.

Important For Certification/Credit Transfer:
Weekly Assignments and Discussion Forum can be accessed ONLY by enrolling

Detailed Syllabus:

1	Deformation of metals, Mechanism of plastic deformation, Machining processes: Single edge tool, types of chips
2	Tool geometry: single point cutting tool specifications, Tool specifications, conversion of tool angles, Multi-point cutting tools, Mechanics of orthogonal cutting, force relationships
3	Determination of stress, strain, and strain rate Measurement of shear angle, Other analysis for force relationships
4	Mechanics of oblique cutting Measurement of cutting forces
5	Thermal aspects of machining: Temperatures in orthogonal cutting, Tool wear and tool life and tool life equations, Economics in machining
6	Practical machining operations: Turning and shaping & planning operation, Practical machining operations: milling and drilling, Grinding of metals and mechanics of grinding process
7	Abrasive machining and finishing operations, CNC machines and CNC programming
8	Introduction to advanced machining processes

Reference Books:

1. G K Lal, Introduction to Machining Science, 3rd edition, New Age International Pvt Ltd., 2007.
2. A Ghosh and A K Mallik, Manufacturing Science, 2nd edition, Affiliated East-West Press Pvt. Ltd., 1986.
3. G Boothroyd and W. A. Knight, Fundamentals of Machining and Machine Tools, CRC-Taylor and Francis, 2006.
4. V K Jain, Advanced Machining Processes, Allied Publishers, 2009.
5. P M Dixit and U S Dixit, Modeling of Metal Forming and Machining Processes: By Finite Element and Soft Computing Methods, Springer, 2010.
6. A Bhattacharya, Metal Cutting: Theory and Practice, New Central Book Agency, 2012.

CERTIFICATION:

1. Final score will be calculated as : 25% assignment score + 75% final exam score
2. 25% assignment score is calculated as 25% of average of Best 6 out of 8 assignments
3. E-Certificate will be given to those who register and write the exam and score greater than or equal to 40% final score. Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Guwahati.It will be e-verifiable at nptel.ac.in/noc.

OPEN ELECTIVE:ROBOTICS
Credits : 3

Description: The course will start with a brief introduction to robots and robotics. The motivation behind keeping robots in modern industries will be discussed. After providing a brief history of robotics, different components of a robotic system will be identified. The method of determining degrees of freedom of a robotic system will be discussed with some examples. After classifying the robots based on certain criteria, workspace analysis of manipulators will be carried out. Applications of robots in different areas like in manufacturing units, medical science, space, and others, will be discussed. Various methods of robot teaching will be explained with some suitable examples. Economic analysis will be conducted to decide whether we should purchase a robot. Both forward and inverse kinematics problems will be solved with the help of some suitable examples. To ensure smooth variation of joint angles of the robot, trajectory planning schemes will be explained. After carrying out velocity analysis with the help of Jacobian matrix, inverse dynamics problems of robots will be solved using Lagrange-Euler formulation. Control scheme used in robots to realize the joint torques will be discussed. Besides manipulators, analysis will be carried out on wheeled and multi-legged robots. The working principles of various sensors used in robots will be explained in detail. The steps to be followed in robot vision will be discussed with some suitable examples. The principles of motion planning algorithms will be explained in detail. Thus, this course will deal with all the issues related to kinematics, dynamics, control schemes and robot intelligence.

Important For Certification/Credit Transfer:
Weekly Assignments and Discussion Forum can be accessed ONLY by enrolling here

Detailed Syllabus:

1	Introduction to Robots and Robotics
2	Introduction to Robots and Robotics; Robot Kinematics
3	Robot Kinematics
4	Robot Kinematics; Trajectory Planning
5	Robot Dynamics
6	Control Scheme; Sensors; Robot Vision
7	Robot Vision; Robot Motion Planning
8	Intelligent Robot; Biped Walking; Summary

CERTIFICATE:

1. Final score will be calculated as : 25% assignment score + 75% final exam score
2. 25% assignment score is calculated as 25% of average of Best 6 out of 8 assignments
3. E-Certificate will be given to those who register and write the exam and score greater than or equal to 40% final score. Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Kharagpur.It will be e-verifiable at http://nptel.ac.in/noc/

OPEN ELECTIVE:MANUFACTURING OF COMPOSITES
Credits : 3

Description:

Selecting manufacturing technique has emerged as one the paramount challenge in the field of composites. Composites are now being used in almost every field of industry, and students working in the area of the composites need to learn the basics, and progressive techniques of composites manufacturing. This course covers the important aspects of composites manufacturing: process selection guidelines, thermoset ad thermoplastic Composites manufacturing processes, process parameters and characterizations. Applications and use of each manufacturing process is focused and this is represented separately.

Important For Certification/Credit Transfer:
Weekly Assignments and Discussion Forum can be accessed ONLY by enrolling here

Detailed Syllabus:

1	Introduction to Composites • Introduction to Composites • Function of the Matrix and Reinforcement in Composites • Matrices: Thermosets and Thermoplastic Fiber Reinforcement
2	Properties and testing composites • Properties of Composites • Composites testing • Composites design: Laminate theory, Rule of mixtures, symmetry and balance
3	Thermoset Composites manufacturing processes • Material selection process cont. • Material selection process cont. • Design for manufacturing.
4	Thermoset composite manufacturing processes • Thermoset Composite manufacturing: Lay-up processes, Spray up process • Thermoset Composite manufacturing: Fiber placement process • Thermoset Composite manufacturing: Resin transfer moulding
5	Thermoplastic composite manufacturing processes • Thermoset Composite manufacturing: Vaccum assisted resin transfer moulding

	• Thermoset Composite manufacturing: Compression molding process • Thermoset composites manufacturing: Filament winding
6	Thermoplastic composite manufacturing processes • Thermoplastic Composite manufacturing: Sheet moulding • Thermoplastic Composite manufacturing: Injection moulding, sheet moulding, Calendaring • Thermoplastic Composite manufacturing: Extrusion, Blow molding, rotational molding, Thermoforming
7	Metal and ceramic matrix composites • Metal Matrix Composites:Metal matrix and reinforcement • Manufacturing processes for Metal Matrix Composites:Dispersionhardended and particle composite • Manufacturing processes for Metal matrix composites:Layer composites and infiltration method
8	Prevention of Damage, repair of Composites and selection of processes • Ceramic matrix composites: Hot isostatic processing • Non – destructive testing of Composites • Manufacturing process selection: Cost, performance, size shape, rate of production. Steps for process selection

Reference Books:

1. Mazumdar, S., 2001. Composites manufacturing: materials, product, and process engineering. CRC press.
2. Balasubramanian, M., 2013. Composite materials and processing. CRC press.
3. Campbell Jr, F.C. ed., 2003. Manufacturing processes for advanced composites. Elsevier.

CERTIFICATE:

1. Final score will be calculated as : 25% assignment score + 75% final exam score
2. 25% assignment score is calculated as 25% of average of 8 weeks course: Best 6 out of 8 assignments
3. E-Certificate will be given to those who register and write the exam and score greater than or equal to 40% final score. Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Kanpur. It will be e-verifiable atnptel.ac.in/noc.

ME 61001: DISSERTATION I	
Teaching Scheme **Practical : 20Hrs/ Week** **Credits: 10**	**Examination Scheme** **Term Work :50 Marks** **Teachers Assessment : 50 Marks** **End Semester Exam : 100 Marks**

Course description:

The dissertation shall consist of a report on 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 work related to production engineering that the candidate has to be executed. The dissertation will consist of two parts as dissertation part-I and dissertationII.

After completing this course, students will be able to identify the problem definition and will able to prepare detail work plan for the dissertation II

Course Objectives:

1. To acquaint with the process of undertaking literature survey/industrial visit and identifying the problem definition
2. Able to define precise problem definition
3. To identify various domain related to problem definition
4. To identify the research methodology processes and its implementation.

Course Outcome

After completing the course, students will be able to:

CO1	Identify a topic in advanced areas of research related to Production Engineering
CO2	Review literature to identify gaps and define objectives & scope of the work to decide the problem definition
CO3	Student should able to finalize the problem definition for the research

Detailed description:

Students should conduct literature survey/visit industry/analyze current trends and identify the problem for Dissertation I /Research and finalize the problem definition in consultation with Guide.

The dissertation (Part I) will be in the form of a report presented by the candidate based on the actual work (literature survey/ problem definition formation) carried out related to Production Engineering. This contribution will be assessed by oral examination and will be assessed by two examiners appointed by the DSB, one of whom wilbe the guide and other will be a faculty member from thesame department.

Mapping of Course outcome with Program Outcomes

Dissertation I Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		2						3	3	
CO2			1	1						
CO3				1		2	2	2		2

1 – High 2 – Medium 3 - Low

ME 61002 : DISSERTATION II	
Teaching Scheme **Practical : 32Hrs/ Week** **Credits: 16**	**Examination Scheme** **Term Work :100Marks** **Teachers Assessment : 150 Marks** **End Semester Exam : 250 Marks**

Course description:

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 work related to production engineering that the candidate has to be executed.

After completing this course, students will be able to familiarize with the problem definition and will able to give detail work plan for the dissertation II

Course Objectives:

1. To acquaint with the process of undertaking literature survey/industrial visit and identifying the problem definition
2. To familiarize with the research methodology process
3. To identify various domain related to problem definition
4. Able to define precise problem definition

Course Outcome

After completing the course, students will be able to:

CO1	Identify a topic in advanced areas of research related to Production Engineering
CO2	Review literature to identify gaps and define objectives & scope of the work to decide the problem definition
CO3	Student should able to finalize the problem definition for the research

Detailed description:

Students should conduct literature survey/visit industry/analyze current trends and identify the problem for Dissertation II /Research and finalize the problem definition in consultation with Guide.

The dissertation (Part II) will be in the form of a report presented by the candidate based on the actual work related to formation of problem definition, development/ performing of suitable methodology/ experimentation by analysis to find solution related to Production Engineering. This contribution will be assessed by oral examination which will be assessed by two examiners appointed by the department, one of whom will be the guide and other will be an external examiner.

Mapping of Course outcome with Program Outcomes

Dissertation I Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		2						3	3	
CO2			1	1						
CO3				1		2	2	2		2

1 – High 2 – Medium 3 – Low

SW 51001: ENGLISH FOR RESEARCH PAPER WRITING		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs./ week	**ISE I***	**15 Marks**
Tutorial: 0 hrs./ week	**ISE II***	**15 Marks**
Credits: 3	**ISE III***	**10 Marks**
	End Semester Examination	**60 Marks**

Prerequisites: NIL

Course Description:

Students will understand that how to improve their writing skills and level of readability for their project work. they will learn about what to write in each section while writing their project report. They will understand the skills needed when writing a Title and will be able to ensure the good quality of paper at *very first*- time submission.

Course Outcomes:

After completing the course, students will be able to:

	Course Outcomes
CO1	Understand that how to improve your writing skills and level of readability
CO2	Learn about what to write in each section
CO3	Understand the skills needed when writing a Title Ensure the good quality of paper at *very first*-time submission.
CO4	One should be able to select proper title for their project.
CO5	One will be able to discuss their results and conclusion with others.

Detailed Syllabus:

Unit 1	Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness **(4 Hrs)**
Unit 2	Clarifying Who Did What, Highlighting Your Findings, Hedging and - Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction
Unit 3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check **(4 Hrs.)**
Unit 4	Key skills are needed when writing a Title, key skills are. needed when waling *an* Abstract, key skills *are* needed when writing an Introduction, skills needed when writing a Review of the Literature **(4 Hrs.)**
Unit 5	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure. paper is as good as it could possibly be the first- time submission **(4 Hrs.)**

Textbooks

1. L Goldbart R (2006) Writing for Science, Yale University Press (available on Goggle Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge. University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes
1 – High 2 – Medium 3 – Low

urse outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	2											
CO2		1				2								
CO3	1				2							3	3	
CO4													1	1
CO5	1			3		2						3	2	
CO6			1										2	

Assessment:

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember	3	3	2	15
K2	Understand	3	3	2	10
K3	Apply	2	2	2	15
K4	Analyze	3	3	2	10
K5	Evaluate	2	2		5
K6	Create	2	2	2	5
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	****K3**				
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	7	8			
ISEII (15 Marks)			7	8	
ISEIII (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	12	12	12	12	12
Total Marks 100	21	22	21	22	14

Special Instructions if any:

Designed by