Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra under Act No. XXIX of 2014)
P.O.: Lonere, Dist.: Raigad, Pin 402103, Maharashtra
Telephone and Fax.: 02140 – 275142
www.dbatu.ac.in

Course Structure
for
M. Tech. in
Advanced Manufacturing and Mechanical Systems Design
(Only for Affiliated Institutes)

Syllabus as per the guidelines of National Education Policy 2020

Academic Year 2024-25

Vision

The vision of the Department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after the holistic development of students and conducting need-based research and extension activities.

Post Graduate Attributes

ThePostGraduateAttributesaretheknowledgeskillsandattitudeswhichthestudentshaveatthetime of post-graduation.

ThesePostGraduateAttributesidentifiedbyNationalBoardofAccreditationareasfollows:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of engineering problemsinvolvingresearch.
2. **Problemanalysis:** Identity, formulate, researchliterature,andanalyzecomplexengineeringproblemsreachingsubstantiatedconclusi onsusingfirstprinciplesofmathematics,natural sciences, and engineeringsciences.
3. **Design/development of solutions:** Design solutions for engineering problems involvingresearch and design system components or processes that meet the specified needs withappropriate consideration for the public health and safety, and the cultural, societal, andenvironmentalconsiderations.
4. **Conductinvestigationsofcomplexproblems:**Useresearch-basedknowledgeandresearch methods including design of experiments,analysisand interpretation of data,andsynthesis of theinformation to provide validconclusions.
5. **Modern tool usage:**Create, select, and apply appropriate techniques, resources, andmodern engineering and IT tools including prediction and modeling to research activitieswithan understandingofthe limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge toassess societal, health, safety, legal and cultural issues and the consequent responsibilitiesrelevantto the professional engineeringpractice.
7. **Environmentandsustainability:**Understandtheimpactoftheresearchbasedengineering solutionsinsocietalandenvironmentalcontexts,anddemonstratethe knowledgeof,and need forsustainabledevelopment.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilitiesandnorms of the engineeringpracticeto researchproblems.
9. **Individual and team work:** Function effectively as an individual, and as a member orleaderin diverseteams,and in multidisciplinarysettings.
10. **Communication:**Communicate effectively on complex engineering activities with theengineering community and with society at large, such as being able to comprehend andwrite effective reports and design documentation, make effective presentations, and giveandreceive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of theengineering and management principles and apply these to one's own work, as a memberandleaderofateam,tomanageprojects and inmultidisciplinaryenvironments.
12. **Life-long learning:** Recognize the need for, and have the preparationand ability toengage in independent and life-long learning in the broadest context of technologicalchange.

ProgramEducationalObjectives

PEO1	Totrainstudentswithin-depthandadvancedknowledgetobecomeprofessionaland capableofidentifying,analyzingandsolvingcomplexproblemsintheareas of MechanicalDesign Engineering.
PEO2	To enable post graduates to carry out innovative and independent research work,disseminatetheknowledgeinAcademia/Industry/ResearchOrganizationstodevelop systemsandprocessesin therelatedfield.
PEO3	Topreparethestudentstoexhibitahighlevelofprofessionalism,integrity,effective communicationskillsandenvironmentalandsocialresponsibility.
PEO4	Toprovideanacademicenvironmentthatgivesadequateopportunitytothestudentst cultivatelife-longindependent learningabilityfortheirsuccessful professional career.

ProgramOutcomes

Atthe end ofthe program thestudent will beable to:

PO1	Acquire,demonstrateandapplyadvancedknowledgeintheareaofMechanical DesignEngineering.
PO2	IdentifyproblemsinthefieldofMechanicalDesignEngineering,formulatethem andsolve byusingadvancedtechniques.
PO3	Conductindependentresearchandgeneratenewknowledgeforthebenefitof community,societyIndustryandcountry.
PO4	Applyvariousnumericalmethods,advancedsoftwareandengineeringtoolsto model,analyzeandsolveMechanicalDesignEngineeringproblems.
PO5	Workeffectivelyininterdisciplinaryteamsforsolvingreallifeproblemsinthe relatedfield.
PO6	Applyengineeringandscientificprinciplesfortheeffectivemanagementof Mechanicalsystems.
PO7	Effectivelycommunicatethroughtechnicalreports,presentationsandscientific publications withtheengineeringcommunityas wellas societyatlarge.
PO8	Demonstratetraitsofmanagementinhandlingengineeringprojects,relatedfinance,andcoo rdinatewith workforcetowards achieving goals.
PO9	Demonstratehighlevelofprofessionalandintellectualintegrity,ethicsofresearch and scholarlystandards.
PO10	Examinecriticallytheoutcomesofone'sactionsandmakecorrectivemeasures subsequently.
PO11	Demonstrate the ability to work in team in the laboratory in achievingmultidisciplinarytasksrequired forthe project.
PO12	Engageinlife-longreflectiveandindependentlearningwithhighlevelofenthusiasm andcommitment.

DEPARTMENTOFMECHANICALENGINEERINGMASTE ROFTECHNOLOGY

(M. TECH.ADVANCED MANUFACTURING AND MECHANICAL SYSTEMS DESIGN)

Syllabus (as per NEP2020) with effective from 2 024-2025

Semester-I

Course Categorization	Course Code	Name of the Course	L	T	P	C
PCC1	MMDE101	Advanced Methods in Engineering Design	03	01	--	04
PCC2		Modeling and Analysis of Manufacturing Systems	03	01	--	04
PCC3	MMF103	Advanced Joining Technology	03	01		04
PEC1		Elective-I	03	--		03
PEC2		Elective-II	03	--		03
PCC4		Design Lab		--	02	01
BHS	BSH101	Communication Skills	02	--	-	02
AU1	MMDE105	**Yoga for stress management**	--	--	--	Audit
		Total for Semester-I	**17**	**03**	**02**	**21**

List of Elective – I

Course Categorization	Course Code	Name of the Course
PEC1	MMF104C	Sheet Metal Engineering
PEC1	**MMF101**	Theory of Machining
PEC1	**MMF201**	Metal Forming Processes
PEC1	**MMF202**	Casting and Moulding Technology
PEC1	MMF203B	Lean Manufacturing

List of Elective – II

Course Categorization	Course Code	Name of the Course
PEC2	**MMD104B**	Experimental Stress analysis
PEC2	**MMD104D**	Failure Analysis and Design
PEC2	**MMD104E**	Theory of Elasticity and Plasticity
PEC2	**MMD104F**	Process Equipment Design
PEC2	**MMD104G**	Tribology in Design

Semester-II

Course Categorization	Course Code	Name of the Course	L	T	P	C
PCC5	23UD2608PC103	Additive Manufacturing	03	01	--	04
PCC6	MMDE202	Design Optimization	03	01	--	04
PEC3		Elective- III	03	--		03
PEC4		Elective- IV	03	--		03
OE1		Open Elective - I	03	--		03
PCC7		Manufacturing Lab		--	02	01
IKS1	AEC/VEC/IKS	IKS Bucket	02	--	04	02
AU2		Industrial Waste Management				Audit
		Total for Semester-II	**17**	**02**	**06**	**20**

List of Elective -III

Course Categorization	Course Code	Name of the Course
PEC3	**23UD2608PE105B**	Manufacturing Automation
PEC3	ME-XX15B	Artificial Intelligence and Expert System in Automation
PEC3	MCADM15C	Digital Manufacturing

List of Elective IV

Course Categorization	Course Code	Name of the Course
PEC4	MMD203E	Computational Techniques in Engineering Design
PEC4	**MMD201**	Finite Element Method
PEC4	MMD104F	Process Equipment Design

List of Open Elective -I

Course Categorization	Course Code	Name of the Course
OE1	MMF204 OE	Research Methodology
OE1	MMF203P	Machine Learning Techniques
OE1	MMF104K	Technology and Knowledge Management

Semester-III

List of

Course type	Course code	Name of the subject	L	T	P	C
OE2		**Open Elective -II**	**03**	**--**		**3**
MDM1		**Multidisciplinary minor**	**03**	**--**		**3**
ELC2		**Seminar**	**--**	**--**	**02**	**2**
ELC3	**PRO1**	**Dissertation stage -I**	**--**	**--**		**12**
		Total for Semester -III	**06**	**--**	**02**	**20**

open Elective -II

Course Categorization	Course Code	Name of the Course
OE2	MMF104H	Quality Control and Reliability
OE2	MMF203I	Metrology and Computer Aided inspection
OE2	MCADM14E	Project Management
OE2	23UD2608PE105C	Sustainable Manufacturing
OE2	MMD203G	Design for Manufacture and Assembly

MDM -I

Course Categorization	Course Code	Name of the Course
MDM1	23UD2608OE302A	Applications of IoT and Industry 4.0
MDM1	23UD2608OE302B	e-Commerce Technologies
MDM1	23UD2608OE302C	Entrepreneurship & Start-ups

Semester-IV

Course type	Course code	Name of the subject	L	T	P	C
ELC4	**PRO2**	**Dissertation stage -II**				**20**
		Total for Semester- IV				**20**

Credit Details

Semester -I	Semester -II	Semester -III	Semester -IV	Total Credits
21	20	20	20	81

Semester-I

Advanced Methods in Engineering Design

MMDE101	Advanced Methods in Engineering Design	PCC	3-1-0	4 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Pre-Requisites: Mechanics of Materials, Machine Design

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

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes → Course Outcomes↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1-Means least contribution 2- Means medium contribution 3-Maximum contribution

Course Contents:

Unit1 **(8 Hrs)**

DESIGN PHILOSOPHY: Design process, Problem formation, Introduction to product design, Various design models- Shigley model, Asimov model and Norton model, Need analysis, Strength considerations-standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability.

Unit2 **(8 Hrs)**

PRODUCT DESIGN: Product strategies, value, planning and specification, concept generation, concept selection, concept testing.

Unit3 **(8 Hrs)**

DESIGN FOR MANUFACTURING: Forging design, casting design, Design process for non-metallic parts, Plastics, Rubber, Ceramic, Wood and Glass parts like. Material selection in machine design.

Unit4 **(8 Hrs)**

FAILURE THEORIES: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory, Fatigue mechanisms, Fatigue failure models, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles ,Fatigue failure theories ,cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation.

Unit5 **(8 Hrs)**

SURFACE FAILURES: Surface geometry, mating surfaces, oil film and their effects, design values and procedures, adhesive wear, abrasive wear, corrosion wear, surface fatigue, different contacts, dynamic contact stresses, surface fatigue failures, surface fatigue strength.

ECONOMIC FACTORS INFLUENCING DESIGN: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design.

Texts/References:

1. Smith Seely, "Advanced Mechanics of Materials", John Willey & Sons Publications.
2. Timosh enko, "Strength of Materials"
3. Kocanda, "Fatigue Failure of Metal", Sijthoff and Noordhoff International Publications.
4. Frost N.E., "Metals Fatigue", Oxford University Press, London.
5. Benhan&Crawford, "MechanicsofEngineeringMaterials",JohnWilley&SonsPub.
6. Spotts M. F., "Mechanical Design Analysis", PHI Publications, New Delhi.

Modeling and Analysis of Manufacturing Systems

	Modeling and Analysis of Manufacturing Systems	PCC2	3-1-0	4 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Outcome

At the end of course, the student will be able to:

CO1 Understand types and models of manufacturing systems
CO2 Apply line balancing algorithms
CO3 Prepare shop schedules for flow shops and job shops
CO4 Design ware house systems
CO5 Design flexible manufacturing systems
CO6 Design of material handling systems

Unit 1. Manufacturing Systems and Models (8 Hrs)

Introduction to manufacturing models- types and principles of manufacturing system, manufacturing models - types and uses- physical models, mathematical models, model uses, model building.

Unit 2. Assembly Lines (8 Hrs)

Introduction- line balancing algorithms- COMSOL Random sequence generation, Ranked positional weight heuristics, optimal solutions- practical issues - mixed models – sequencing- unpaced lines-

Unit 3. Scheduling (8 Hrs)

Shop scheduling with many products, Order release, flow shop sequencing – single and two machine flow shops- job shop scheduling- Dispatching rules and Schedule generation

Unit 4. Ware Housing – Storage and Retrieval Systems (8 Hrs)

Introduction – ware house components – ware house design, stacking pattern, location in ware houses – dedicated storage, open storage, class base storage, storing complementary items- Order picking – forming pick list, pick sequencing

Unit 5 Flexible Manufacturing Systems (8 Hrs)

Introduction - Components of FMS – Machines, Part movement system, work stations, system controller. Planning and control hierarchy- System design, system set up, scheduling and control. Flexible assembly system. - Group technology – principles, coding schemes, assign machines to groups- production flow analysis, binary ordering algorithm. Assigning parts to machines.

References:

1. Ronald G. Askin and Charles R. Standridge, “Modeling and analysis of manufacturing systems” John Wiley & Sons, Inc. 2000
2. Groover M.P., “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice-Hall of India Pvt. Ltd., New Delhi, 1996.
3. Jha, N.K., “Handbook of Flexible Manufacturing Systems”, Academic Press Inc., 1991.
4. Kalpakjian, “Manufacturing Engineering and Technology”, Addison-Wesley Publishing Co.,

1995.
5. Taiichi Ohno, Toyota, “Production System Beyond Large-Scale production”, Productivity Press (India) Pvt.Ltd., 1992.

MMF103 Advanced Joining Technology

MMF103	**Advanced Joining Technology**	PCC3	3-1-0	4 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)
Introduction to metal joining processes, heat sources for joining of metals.

Unit 2 (8 Hrs)
Modern welding processes like EBW, LBW, USW, diffusion bonding etc.

Unit 3 (8 Hrs)
Pulsed current welding processes, welding of ceramics, plastics, composites, joint design and design of weldments.

Unit 4 (8 Hrs)
Metallurgy of welding, heat treatment, residual stresses and stress relief methods.

Unit 5 (8 Hrs)
Failure of welds, NDT of welds, inspection codes for weldments, Introduction to adhesive bonding, soldering and brazing

TEXTS / REFERENCES:
1. C. Howard, Modern Welding Technology, Prentice Hall, 1979.
2. P. T.Houldcroft , Welding Process Technology, Cambrige University Press, 1985.
3. M. M.Schwartz , Metal Joining Manual, McGraw Hill, NewYork, 1979.
4. L. P.Connur , Welding Handbook, Vol. 1 & 2, American Welding Society, 1989, 1990.

ELECTIVE –I

Sheet Metal Engineering

	Sheet Metal Engineering	PEC1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 **(8 Hrs)**

Production of high-quality sheet metal and control of its properties during processing.

Unit 2 **(8 Hrs)**

Basic applications: shearing processes like blanking, piercing, and punching.

Unit 3 **(8 Hrs)**

Drawing processes like shallow and deep drawing of cylindrical and rectangular bodies forming and bending including estimation and control of spring back.

Unit 4 **(8 Hrs)**

Computer applications in sheet metal with particular reference to nesting, tool selection and process planning, die design with special reference to compound and progressive dies.

Unit 5 **(8 Hrs)**

Equipment for sheet metal working: mechanical and hydraulic presses, design features and force diagrams. Formability studies: forming limit diagrams, their creation and use, soft tool processes:
hydro-forming analysis and applications.

TEXTS / REFERENCES:

1. D. Eary and E. Reed, Techniques of Press Working, Prentice Hall, 1989.
2. Die Design Handbook, ASTME, 1989.
3. A. S. Deshpande, Sheet Metal Engineering, 1999.
4. ASM Handbook (10th edition) Vol. 15 on Metal Forming, ASM Publication, Metals Park, Ohio, 1989.
5. C. W.Hinman , Press Working of Metals, McGraw Hill, NY, 1980.
6. J. A.Waller, Press Tools and Press Work, Porttoculis Press, 1978.

MMF101 Theory of Machining

	Theory of Machining	PEC1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

Machine Tools and machining operation: Introduction, generating motions of machine tools, machines using single point tools, machines using multipoint tools, machines using abrasive wheels, summary of machine tool characteristics and machining equations.

Unit 2 (8 Hrs)

Mechanics of Metal Cutting: Introduction, terms and definitions, chip formation, forces acting on the cutting tool and their measurement, specific cutting energy, plowing force and the “size effect”,

The apparent mean shear strength of the work material, chip thickness, friction in metal cutting.

Temperature in Metal Cutting: Heat generation in metal cutting, heat transfer in moving material, temperature distribution in metal cutting, the measurement of cutting temperatures.

Unit 3 (8 Hrs)

Tool life and tool Wear: Introduction, progressive tool wear, forms of wear in metal cutting, the tool material, the work material. Cutting Fluid and Surface roughness: Cutting fluids, the action of coolants, the action of lubricants, application of cutting fluids, surface roughness.

Unit 4 (8 Hrs)

Economics of Metal Cutting Operation: Introduction, choice of feed, choice of cutting speed, tool life for minimum cost and minimum production time, estimation of factors needed to determine optimum conditions, example off a constant-cutting-speed operation, machining at maximum efficiency, facing operations, operations with interrupted cuts, economics of various tool materials and tool designs, machinability data systems.

Unit 5 (8 Hrs)

Grinding: Introduction, the grinding wheel, effect of grinding conditions on wheel behavior, determination of the density of active grains, testing of grinding wheels, analysis of the grinding process, thermal effects in grinding, cutting fluids in grinding, grinding wheel wear, nonconventional grinding operations.

Nonconventional Machining Processes: Introduction, range of nonconventional machining processes, ultrasonic machining, water-jet machining, abrasive-jet machining, chemical machining, electrochemical machining, electrolytic grinding, electrical discharge machining, wire electrical discharge machining, laser beam machining, plasma arc machining, comparative performance of cutting processes.

Surface integrity: Effect of machining on surface/subsurface, various types of surface alterations, assessment of surface integrity, concept of engineered surfaces.

TEXTS/REFERENCES:

1. G. Boothroyd and W.A. Knight, Fundamentals of Machining and Machine Tools, 2nd Edition, Mercell Dekker, New York, 1989.

2. A. Ghosh and A.K. Mullick, Manufacturing Science, Affiliated East-West Press, 1985.

3. J. McGeough, Advanced Methods of Machining, Chapman and Hall, London, 1988.

MMF201 Metal Forming Processes

	Metal Forming Processes	PEC1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

Introduction to basic concepts, theory of plasticity, yield criteria (isotropic).

Unit 2 (8 Hrs)

Hot, cold, and warm working, bulk forming like rolling.

Unit 3 (8 Hrs)

Forging, extrusion and wire drawing, analytical techniques like upper bound equilibrium (slab).

Unit 4 (8 Hrs)

Slip line field analysis, forming tools, tools and dies for forging.

Unit 5 (8 Hrs)

Design of rolls for forging, design of rolls for rolling, extrusion dies. Latest trends: forming from mashy stage, isothermal forging, near-net-shape manufacturing.

TEXTS / REFERENCES:

1. K. Lange, Handbook of Metal Forming, McGraw Hill, 1985.

2. A. M. Sabaroff, Forging material and Practices, Reinhold Publishers, 1982.

3. C. Pearson, Extrusion of Metals, Wiley, NewYork, 1980.

4. G. W. Rowe, Manufacturing Technology, Vol. I & Vol. II, Ellis Horwood, Chichester, John Willy, New York, 1987.

MMF202 Casting and Moulding Technology

MMF202	**Casting and Moulding Technology**	PEC1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

Metal casting processes part and tool materials, foundry layout and equipment, patterns and cores.

Unit 2 (8 Hrs)

Melt flow: Flow in gating channels and Mold cavity, fluidity, gating systems, flow analysis.

Unit 3 (8 Hrs)

Solidification: Heat transfer, shrinkage, feeding, growth structures, simulation, casting defects type:

attributes, causes and remedies, inspection techniques, expert system.

Unit 4 (8 Hrs)

Plastics for moulding types, chemical composition and structures, polymerization, synthesis techniques.

Unit 5 (8 Hrs)

Processing methods: calendaring, injection, compression, blow, extrusion and transfer molding, casting and reaction injection molding. Plastic flow in mold pressure and shear stress distribution, gating layout, cooling analysis,

CAD/CAM for casting and molding: review of existing packages.

TEXTS / REFERENCES:

1. R.W. Heine, C. R. Loper and P.C. Rosenthal, Principles of Metal Casting, McGraw Hill, Newyork, 1976.

2. P. C.Mukherjee, Fundamentals of Metal Casting Technology, Oxford and IBH Publ. Co. 1979.

3. J. H.Dubois And W. I.Pribble, Plastics Mold Engineering Handbook, Van Nostrand Reihnhold, New York, 1987.

4. A. C. Street , The Die Casting Book, Portcullis Press Ltd., Surrey England, 1986.

MMF203B Lean Manufacturing

MMF203B	**Lean Manufacturing**	PEC1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1. (8 Hrs)

What is lean production? – Introduction, background, and lean thinking.

Unit 2. (8 Hrs)

Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production System.

Unit 3. (8 Hrs)

Lean production preparation – System assessment, process and value-stream mapping Sources of waste.

Unit 4. (8 Hrs)

Lean production processes, approaches and techniques. —Importance of focusing upon flow. Tools include: Workplace organization – 5S, Stability, Just-In-Time – One piece flow – Pull, Cellular

systems, Quick change and set-up reduction methods, Total productive maintenance, Poka-Yoke – mistake proofing, quality improvement, Standards, Leveling, Visual management.

Unit 5. (8 Hrs)

Employee involvement – Teams – Training – Supporting and encouraging involvement – Involving people in the change process -- communication -- Importance of culture. Startup of lean processes and examples of applications. Sustaining improvement and change, auditing, follow-up actions.

TEXTS/REFEENCES:

1. The Toyota Way Field book, Jeffrey Liker and David Meier, McGraw-Hill, 2006.

2. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.

ELECTIVE -II

MMD104B Experimental Stress Analysis

MMD104 B	**Experimental Stress Analysis**	PEC2	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

INTRODUCTION: Need of stress analysis; Why experimental methods? Merits and demerits of experimental methods.

Unit 2 (8 Hrs)

BASICS OF ELASTICITY: Stress at a point; stress equations of equilibrium; 2-D state of stress; Strains and displacements; Stress strain relationship for 2-D state of stress; Plane stress and plane strain approach.

Unit 3 (8 Hrs)

MEASUREMENT OF STRAIN: Strain gauges: Mechanical, optical, electrical, acoustical and semiconductor; Grid method of strain analysis.

Unit 4 (8 Hrs)

ELECTRICAL STRAIN GAUGES: Gauge construction; Strain gauge adhesives and mounting techniques; Gauge sensitivity and gauge factor; Strain gauge linearity, hysteresis and zero shift; Temperature compensation; Environmental effects: moisture, humidity and hydrostatic pressure, high and cryogenic temperatures; The Wheatstone bridge; Calibration of strain gauge circuit; Strain analysis method: 3-element rectangular rosette, torque gauge.

Unit 5 (8 Hrs)

BASICS OF OPTICS: Nature of light; Wave theory of light; Optical instruments; Plane and circular polariscopes.

THEORY OF PHOTOELASTICITY: Stress optics law; Effects of a stressed model in a plane polariscope; Effects of principal stress directions; Effects of principal stress difference; Effects of a stressed model in circular polariscope in dark and light field arrangements; 2-D Photoelasticity; Isochromatic and isoclinic fringe patterns; Materials for 2-D Photoelasticity; Introduction to moiré fringe technique and coating methods.

Texts/References:

1. Doyle, J.F.: Modern Experimental Stress Analysis. J. Wiley, 2004.

2. Dove Adams, Experimental Stress Analysis, McGraw Hill, 1992.

3. CC Perry and HR Lissner, "The Strain Gage Primer", McGraw-Hill, 2000.

4. Abdul Mubeen, "Experimental Stress Analysis", DhanpatRai and Sons, 2001.

5. PS Theocaris, "Moire Fringes in Strain Analysis", Pergammon Press, 2002.

MMD104D Failure Analysis and Design

MMD104D	**Failure Analysis and Design**	PEC2	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

THEORIES OF FAILURE: Maximum shear stress theory, Maximum normal stress theory, Maximum distortion energy theory, Maximum strain theory, Applicability of theories of failure.

Unit 2 (8 Hrs)

FRACTURE: Type of fracture, Theoretical cohesive strength of metals, Griffith theory of brittle fracture, fracture single crystals, Metallographic aspects of fracture, Dislocation theories of brittle fracture, Ductile fracture, Notch effects, Fracture under combined stresses.

Unit 3 (8 Hrs)

ELEMENTS OF FRACTURE MECHANICS: Strain- energy release rate, Stress intensity factor, Fracture toughness, Plane - strain toughness testing, Crack-opening displacement, J- Integral to solve energy of crack formation, R-curves, Toughness of material.

FATIGUE FAILURE: Stress cycle, S-N curve, Description of fatigue fractured parts, Phases of fatigue fracture, Fatigue crack propagation, Effects of metallurgical variables, Temperature, Stress concentration, Size and surface factors, Fatigue under combined stresses.

Unit 4 (8 Hrs)

CREEP FAILURE: Creep curve, Structural changes and mechanisms during creep, Activation

energy for steady-state creep, Fracture at elevated temperature.

BRITTLE FRACTURE: Transition temperature curves, Fracture analysis diagrams, Various types of embitterment, Fracture under very rapid loading.

Unit 5 (8 Hrs)

DUCTILE FRACTURE: Condition for necking, Dislocation and void formation activities, Types of fractured parts.

ASSESSMENT OF TYPES OF FRACTURES BY OBSERVATION: Comparison between different fractured parts undergoing various type of fracture.

DESIGN APPLICATION OF THE KNOWLEDGE OF FAILURE: Design considering fatigue-Geber's parabola, Soderberg equation, lubricating optimally to combat bearing failures. Selection of materials to prevent seizure, galling, etc. Wear reduction techniques, Fracture toughness consideration in design.

Texts/ References:

1. Madoyag, F., Metal Fatigue Design and Theory.

2. Sors, L., Fatigue Design of Machine Components, Pergamon Press.

3. Rolfe, S.T. and Barson, J.M., Fracture and Fatigue Control Structures, Prentice Hall.

4. Broek, D., Elementary Engineering Fracture Mechanics, Noordnoff.

MMD104E Theory of Elasticity and Plasticity

MMD104E	**Theory of Elasticity and Plasticity**	PEC2	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

INTRODUCTION: Stress transformation and Strain transformation at a point in an elastic body, 3D Problems, Rigid body translation and rotation of an element in space. Generalized Hook law,Separation of Elastic Strains and rigid body displacement for a general displacement field u, v, w. Principal Stress and Strains.

Unit 2 (8 Hrs)

TWO DIMENSIONAL PROBLEMS IN ELASTICITY: Plane Stress and Plane Strain Problems. Differential equations of equilibrium and compatibility equations. Boundary Conditions & amp; Stress Functions. Problems in Rectangular coordinates, Polynomial solutions, Cantilever loaded at the end, simply supported load beam under uniformly distributed load, linear loading, Two dimensional problems in polar coordinated, stress distribution symmetrical about an axis, pure bending of curved bar, Displacement for symmetric loaded cases, Bending of curved bar by forces at end. Effect of circular hole in plate under in plane loading. Concentrated load at point of Straight boundary. Stresses in circular disk. Forces acting on end of wedge.

Unit 3 (8 Hrs)

THREE DIMENSIONAL PROBLEMS IN ELASTICITY: Differential equation of equilibrium in 3D, Condition of Compatibility, Determination of Displacement, Principal of superposition, Uniqueness theorem, Problems of Rods under axial stress, Bar under its own weight, Pure bending of Prismatic roads, Torsion of Prismatic bars of Elliptical, rectangular, triangular and other sections, Membrane Analogy-Torsion of narrow rectangular bars. Torsion of hollow shaft and thin tubes.

Unit 4 (8 Hrs)

BENDING OF PRISMATIC BARS AS A PROBLEM OF ELASTICITY IN 3D: Bending of a cantilever, Stress function, Circular and rectangular sections, Non-symmetrical cross section. Shear Centre for different cross sections of bars, Calculation of deflections.

Unit 5 (8 Hrs)

ENERGY THEOREMS: Applications of complimentary energy theorems to the problems of elasticity.

INTRODUCTION TO PLASTICITY: Criteria of yielding, strain hardening, rules of plastic flow, different stress strains relations. Total Strain theory, theorems of limit analysis. Elastoplastic bending and torsion of bars.

Texts/References:

1. Wang, "Applied Elasticity", McGraw hill book Co.

2. Timoshenko, "Theory of Elasticity", McGraw hill book Co.

3. J. Chakrabarti, "Theory of Plasticity", McGraw hill book Co.

MMD104F Process Equipment Design

MMD104F	**Theory of Elasticity and Plasticity**	PEC2	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

DESIGN CONSIDERATIONS FOR PRESSURE VESSEL: Introduction; Selection of type of vessel, Methods of fabrication, Effect of fabrication methods, Various criteria in vessel design, Economic considerations, Types of process equipment, Constructional requirement and applications, Fabrication and testing, Inspection and non-destructive testing of equipment.

Unit 2 (8 Hrs)

STORAGE VESSEL: Design methods of atmospheric storage vessel: storage of fluids, storage of non-volatile liquids, storage of volatile liquids, storage of gases, Optimum tank proportion, Bottom

design, Shell design, Wind girder for open top tank, Rub curb angle, Self supported roof, Design of rectangular tank.

Unit 3 (8 Hrs)

PRESSURE VESSEL: Unfired process vessel with internal and external pressure, Operating condition, Selection of material, Design condition, Stresses, Design criteria, Design of shell subjected to internal and external pressure, cylindrical vessel under combined loading, Design of heads and closures: flat head and formed heads for vessel. Design consideration for rectors and chemical process vessels. Flange facings, Gaskets, Design of flanged joint, Flange thickness, and Blind flanges.

Unit 4 (8 Hrs)

HIGH PRESSURE VESSEL: Design of thick-walled high-pressure vessel, Constructional features, Materials for high-pressure vessels, Multilayer vessel with shrink fit construction, Thermal expansion for shrink fitting, stress in multi-shell or shrink fit construction, autofrettage, Pre-stressing. Tall vessels and their design, Stress in shell, Determinations of longitudinal stresses, Longitudinal bending stresses due to eccentric loads, Determination of resultant longitudinal stresses.

Unit 5 (8 Hrs)

AGITATED VESSEL: Type of agitators, Baffling, Power requirement for agitation, Design based on torque and bending moment, Design based on critical speed, Blade design, Hub and key design, Stuffing box and gland design, Turbine agitator design, SUPPORT FOR PRESSURE VESSEL: Bracket or lug support: Thickness of the base plate, Thickness of web (gusset) plate, Column support for bracket base plate for column or leg support. Skirt Support: Skirt design, Skirt bearing plate, and Anchor bolt design, Design of bolting chair. Saddle Support: Longitudinal bending moment, Stresses in shell at saddle.

Texts/References:

1) Process Equipment Design by V.V .Mahajani and S. B. Umarji. Macmillan Publisher India Ltd.

2) Process equipment design by L.E.Brownell and E.H.Young, John Wiley and Sons.

3) Introduction to process Equipment Design by B.C. Bhattacharya

4) Pressure Vessel Design Manual by Dennis Moss, Elsevier

5) Theory and Design of Pressure Vessels by John F. Harvey, P. E., CBS Publication

MMD104G Tribology in Design

MMD104G	**Theory of Elasticity and Plasticity**	PEC2	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit1 (8 Hrs)

SURFACES, FRICTION AND WEAR: Topography of Surfaces, Surface features, Surface interaction, Theory of Friction, Sliding and Rolling Friction, Friction properties of metallic and non - metallic materials, Friction in extreme conditions, Wear, types of wear, Mechanism of wear, wear resistance materials, Surface treatment, Surface modifications, Surface coatings.

Unit 2 (8 Hrs)

LUBRICATION THEORY: Lubricants and their physical properties lubricants standards, Lubrication Regimes in Hydrodynamic lubrication, Reynolds Equation, Thermal, inertia and turbulent effects.

Unit 3 (8 Hrs)

OTHER TYPES OF LUBRICATION: Electro-hydrodynamic (EHD), Magneto hydrodynamic lubrication, Hydro static lubrication, Gas lubrication, Solid lubrication.

Unit 4 (8 Hrs)

DESIGN OF FLUID FILM BEARINGS: Design and performance analysis of thrust and journal bearings, Full, Partial, Fixed and pivoted journal bearings design, Lubricant flow and delivery, Power loss, Heat and temperature of steady and dynamically loaded journal bearings, Special bearings, Hydrostatic Bearing design.

Unit 5 (8 Hrs)

ROLLING ELEMENT BEARINGS: Geometry and kinematics, Materials and manufacturing processes, Contact stresses, Hertzian stress equation, Load divisions, Stresses and deflection, Axial loads and rotational effects, Bearing life capacity and variable loads, ISO standards, Oil films and their effects, Rolling Bearings Failures.

TRIBO MEASUREMENT AND INSTRUMENTATION: Surface Topography measurements, Electron microscope and friction and wear measurements, Laser method, Instrumentation, International standards, Bearings performance measurements, bearing vibration measurement

Texts/References:

1. Cameron A., “Basic Lubrication Theory”, Ellis Horwood Ltd., UK, 1981

2. Halling J. (Editor) – “Principles of Tribology “, Macmillian, 1984.

3. Williams J.A., “Engineering Tribology”, Oxford Univ. Press, 1994.

4. Neale, M.J., “Tribology Hand Book”, Butterworth Heinemann, 1995.

5. StolarskiT.a., “Tribology in Machine Design”, Industrial Press Inc., 1990.

Communication Skills

BSH1101	**Communication Skills**		2-0-0	2 Credits
Continuous Assessment (25Marks)		Practical/Oral (25)		Total (50 Marks)

Course Contents:

Unit 1:

COMMUNICATION AND COMMUNICATION PROCESSES: Introduction to Communication, Forms and functions of Communication, Barriers to Communication and overcoming them, Verbal and Non-verbal Communication, Ways of Effective Communication.

Unit 2:

ORAL COMMUNICATION: Use of Language in Spoken Communication, Features of Good Communication, Principles and Practice of Group Discussion, Public Speaking (Addressing Small Groups and Making Presentation), Interview Techniques, Appropriate Use of Non-verbal Communication, Presentation Skills, Telephonic Etiquettes, Extempore, Elocution, Describing Experiences and Events.

Unit 3:

STUDY OF SOUNDS IN ENGLISH: Introduction to phonetics, Study of Speech Organs, Study of Phonemic Script, Articulation of Different Sounds in English, Stress Mark.

Unit 4:

ENGLISH GRAMMAR: Grammar: Forms of Tenses, Articles, Prepositions, Use of Auxiliaries and Modal Auxiliaries, Synonyms and Antonyms, Common Errors, Sentence Formation and Sentence Structures, Use of Appropriate Diction.

Unit 5:

WRITING SKILLS: Features of Good Language, Difference between Technical Style and Literary Style, Writing Emails, Formal and Informal English, Business Writing, Advertisements, Essay Writing, (Technical, Social, and Cultural Topics), Technical Reports: Report Writing: Format, Structure and Types, Writing Memorandum, Circulars, Notices, Agenda and Minutes, Technical Manuals, Brochures
Letter Writing: Types, Parts, Layouts, Letters and Applications, Use of Different Expressions and Style, Writing Job Application Letter and Resume.

Unit 6:

READING SKILLS & LISTENING SKILLS:

Reading: Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning, Fast Reading, Strategies for Reading, Comprehension.

Listening: Importance of Listening, Types of Listening, Barriers to Listening.

Texts/Reference:

1. Mohd. Ashraf Rizvi, Communications Skills for Engineers, Tata McGraw Hill
2. Sanjay Kumar, Pushp Lata, Communication Skills, Oxford University Press, 2016
3. Meenakshi Raman, Sangeeta Sharma, Communication Skills, Oxford University Press

Design Lab

BSH1101	**Design Lab-I**		0-0-2	1 Credits
Continuous Assessment (40Marks)		Practical/Oral (60)		Total (100Marks)

Perform any eight practical's from below given list

Course Contents:

1. Experiment on damped vibration
2. Torsional vibration analysis
3. Experiment based on failure analysis of mechanical component.
4. Design of mechatronic system for mechanical application 37
5. Demonstration of process control such as temp, level, flow, etc control using PID controller

(Experiments No 6 to 15 to be performed using commercially available software)

6. 2D element problem linear static analysis
7. 3D element problem linear static analysis
8. Static analysis of any mechanical component
9. Dynamic anlysis of any mechanical component
10. Modal analysis of cantilever beam
11. Thermal analysis of mechanical component
12. Design and modeling of mechanical component using commercial software
13. Stress Analysis of composite shaft
14. Modal analysis of composite shaft
15. Optimization techniques using MATLAB

SEMESTER -II

23UD2608PC103 Additive Manufacturing

23UD2608PC 103	**Additive Manufacturing**	PCC5	3-1-0	4 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

Introduction - Overview - Historical Development - Need – Classification - Additive Manufacturing Technology in product development – Materials for Additive Manufacturing Technology – Traditional v/s Additive Manufacturing – Tooling – Benefits and Applications.

Unit 2 (8 Hrs)

Geometric Model & Reverse Engineering, Basic Concept – Digitization Techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology, CAD model preparation – Interface Formats - Part Orientation and support generation – Model Slicing – Tool path generation – Software for Additive Manufacturing Technology: RP software.

Unit 3 (8 Hrs)

Liquid Based and Solid Based Additive Manufacturing Systems Classification – Liquid based system – Stereolithography Apparatus (SLA) – Principle, process, advantages and applications – Solid based system – Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing

Unit 4 (8 Hrs)

Powder Based Additive Manufacturing Systems Selective Laser Sintering (SLS) – Principle, process, advantages and applications – Three- Dimensional Printing – Principle, process, advantages and applications – Laser Engineered Net Shaping (LENS), Electron Beam Melting – Shape deposition manufacturing, Laser deposition, Lamination, Electro-optical sintering.

Unit 5 (8 Hrs)

Rapid Casting and Segmental Object Manufacturing, Visible Slicing Implementation Rapid casting using wax patterns, acrylic patterns, dense polystyrene patterns – Expanded polystyrene process –

Rapid manufacturing of metallic objects, Rapid tooling, Medical and Bio-Additive Manufacturing Customized implants and prosthesis, Design and production, Bio-Additive Manufacturing – Computer Aided Tissue Engineering (CATE) – Case Studies.

TEXT/REFERENCES:

1. Chua C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.

2. Gephardt A., "Rapid Prototyping", Hanser Gardener Publications, 2003.

3. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.

4. C. P. Paul, A. N. Jinoop , Additive Manufacturing- Principles, Technologies and Applications, 1st Edition, 2021,McGraw Hill

MMDE202 Design Optimization

MMDE202	**Design Optimization**	PCC6	3-1-0	4 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

INTRODUCTION: Optimal problem formulation, engineering optimization problems, optimization algorithms. Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient based methods, root finding using optimization techniques.

Unit 2 (8 Hrs)

MULTIVARIABLE OPTIMIZATION ALGORITHMS: Optimality criteria, unidirectional search, direct search methods, gradient based methods, Computer programs on above methods.

Unit 3 (8 Hrs)

CONSTRAINED OPTIMIZATION ALGORITHMS: Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearized search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, Computer programs on above methods.

Unit 4 (8 Hrs)

SPECIAL OPTIMIZATION ALGORITHMS: Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods.

Unit 5 (8 Hrs)

OPTIMIZATION IN OPERATIONS RESEARCH: Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis
STOCHASTIC PROGRAMMING: Basic concepts of probability theory, random variables Distributions – mean, variance, Correlation, co variance, joint probability distribution stochastic linear, dynamic programming.

Texts/References:

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

5. Chandrupatla, "Optimization in Design", PHI, New Delhi.

23UD2608PE105B Manufacturing Automation

23UD2608PE105B	**Design Optimization**	PEC3	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

UNIT 1 (8 Hrs)

Product cycle, manufacturing functions, types of automation, degree of automation, technical, economic and human factors in automation.

UNIT 2 (8 Hrs)

Technologies- mechanical, electrical, hydraulic, pneumatic, electronic, hybrid systems, comparative evaluation.

UNIT 3 (8 Hrs)

Development of small automation systems using mechanical devices, synthesis of hydraulic circuits.

UNIT 4 (8 Hrs)

Circuit optimization techniques, illustrative examples of the above types of systems

UNIT 5 (8 Hrs)

Industrial logic control systems logic diagramming, programmable controllers. Applications, designing for automation, cost-benefit analysis

Texts/References:

1. A.N.Gavrilov, Automation and Mechanization of Production Processes in Instrument

Industry, Pergaman Press, Oxford, 1967.

2. G.Pippengerm, Industrial Hydraulics, MGH, New York, 1979.

3. F.Kay , Pneumatics for Industry, The Machining Publishing Co., London,1969.

4. Ray, Robots and Manufacturing Assembly, Marcel Dekker, New York, 1982.

ME-XX15B **Artificial Intelligence and Expert System in Automation**

ME-XX15B	**Artificial Intelligence and Expert System in Automation**	PEC3	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1: Expert system Architecture (8 Hrs)
Expert system Architecture, knowledge base, inference engine, expert system shell, applications.

Unit 2: Fuzzy Logic (8 Hrs)
Fuzzy sets, membership functions, operation on fuzzy sets; fuzzy control system, Fuzzification, knowledge base, inference, defuzzification, application.

Unit 3: Neural Network (8 Hrs)
Neuron structure, classification, artificial neural network, back propagation training and algorithm, neuro-fuzzy controllers, applications.

Unit 4: Genetic algorithms (8 Hrs)
Concepts, encoding and selection methods, genetic operators (crossover and Mutation), applications.

Unit 5 Hybrid systems (8 Hrs)
Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing-based hybrid fuzzy controllers.
Artificial intelligence and machine learning:
Definition, knowledge representation techniques, problem solving, search techniques, game playing, knowledge and logic, learning methods, applications of AI.

Text Books / References:

1. Haykin “Neural Networks – A comprehensive Foundation” (Mc-millan)
2. J.M. Zureda “Introduction to artificial neural networks” (Jaico)
3. A Cichocki& R Unbehauen “Neural Networks for optimization and signal Processing” John Wiley
4. George J. Klin& Tina A Polgar “Fuzzy sets, uncertainty and Information”
5. BaertKosko “Neural network and fuzzy systems”
6. Peterson “Introduction to Artificial Intelligence and expert system (PHI)
7. Michell “Introduction to Genetic Algorithm” (PHI)

8. Vidyasagar M "Theory of learning and generalization" Springer
9. S. Rajasekaran, G.A. VijaylakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algotithm", PHI.
T.J. Ross: "Fuzzy Logic with Engineering Applications" Second Edition John Wiley India.

MCADM15C Digital Manufacturing

MCADM15C	Digital Manufacturing	PEC3	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

UNIT 1 INTRODUCTION TO DIGITAL MANUFACTURING: (8 Hrs)
A Brief History of Manufacturing, Digital Manufacturing Today, Digital Design, Digital Materials, Digital Fabrication, Digital Products, Technology Development, Applications Development, People and Business, The Digital Economy, Transition from Industrial Manufacturing

UNIT 2 PROCESS SIMULATION AND VALIDATION: (8 Hrs)
Assembly and component manufacturing, process simulation and validation, Ergonomic/ human simulation, Robotic simulation and OLP

UNIT 3 PLANT DESIGN, SIMULATION & OPTIMIZATION: (8 Hrs)
Station / work-cell layout design, Throughput simulation, Discrete event simulation, Optimization of material flow and logistic

UNIT 4 MANUFACTURING PROCESS SIMULATION SOLUTION CUSTOMIZATION: (8 Hrs) Functionality enhancements as extensions of OOTB software solution, Reports customization, User interface customization

UNIT 5 SPECIAL TOPICS: (8 Hrs)
Informatics platform for designing and deploying e-manufacturing systems, framework for integrated design of Mechatronic systems, Collaborative supplier integration for product design and development. Reconfigurable manufacturing systems design, Virtual Reality based platform for collaborative product review and customization, managing collaborative process planning activities through extended enterprise, rapid product development, desktop assembly factories, Information sharing in digital manufacturing based on STEP and XML

Texts/References: 1. Collaborative Design and Planning for Digital Manufacturing, Springer, 2009

MMD203E Computational Techniques in Engineering Design

MMD203E	Computational Techniques in Engineering Design	PEC4	3-0-0	3 Credits

Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)	Total (100Marks)

Course Outcomes:

At the end of the course, student should be able to:
CO1 Solve a set of algebraic equations representing steady state models formed in engineering problems
CO2 Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables
CO3 Predict the system dynamic behavior through solution of ODEs modeling the system
CO4 Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.
CO5 Demonstrate proficiency of using MATLAB, VB, ANSYS, EES etc.,
Mapping of course outcomes with program outcomes

Course Contents:

Unit1 DATA ANALYSIS AND CURVE FITTING: (8 Hrs)
Errors in numerical calculations, Interpolation by central differences, sterling Bessel & Everett Formulae, Interpolation Formula for unequal Intervals, Spline Interpolation, Cubic Splines. Least square method for linear & non-linear functions, weighted least square methods.

Unit 2 SOLUTION OF LINEAR SYSTEM OF EQUATIONS: (8 Hrs)
Gauss Elimination with Pivoting, LU Decomposition method, Iterative methods, Eigen vectors-Jacobi method, Jacob's method, Gauss Siedel method.

Unit 3 (8 Hrs)
Solution of Ordinary Differential Equation, Numerical Differentiation & Integration: Differentiation by Finite Differences, Numerical Integration by Newton-Cotes formula & Gauss Quadrature. Picard's Method, Euler's & Modified Euler's Method, Runge-Kutta Method (up to fourth order), Predictor-Corrector Methods, Milne Sompson, Adams Bashforth Moulten Methods.

Unit 4 (8 Hrs)
BOUNDARY VALUE AND EIGEN VALUE PROBLEMS: Shooting method, finite difference method to solve boundary value problems, Polynomial method, power method to solve Eigen value problems.

Unit 5 (8 Hrs)
SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS: Finite difference method, solution of Laplace &Parabolic equations. Mathematical Modeling of Physical Problems, modeling Concept, Modeling of Linear Differential Equations of Second order.

Texts/References:
1. Dr. B.S. Grewal, Numerical methods for science & Engg., Khanna publications.
2. M.K. Jain, Numerical methods for Scientific & Engg. Computation, New age international publication. 3. E.Balagurusamy, Numerical methods, Tata Mc Graw Hill Publications.
4. K. Atkinson and W. Han, Elementary Numerical Analysis, 3rd Edition, Wiley-India, 2004.
5. J. D. Hoffman and Steven Frankel, Numerical Methods for Engineers and Scientists, 2nd Edition, McGraw-Hill, 2001

6. S. D. Conte and Carl de Boor, Elementary Numerical Analysis - An Algorithmic Approach, 3rd Edition, McGraw-Hill, 1980.
7. S. S. Shastry, Introductory methods of numerical analysis, Third edition, Prentice hall of India publications pvt. Ltd.
8. Swami, Saran Singh, Computer programming and numerical methods. 9. J.N.Kapoor, Mathematical modeling

MMD201 Finite Element Methods

MMD201	**Finite Element Methods**	PEC4	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

1-D PROBLEMS: Introduction to structural analysis and FEM, Introduction to approximate solutions and FEM, summary of linear elastic mechanics.

Unit 2 (8 Hrs)

1-D PROBLEMS: Principles of linear elastic mechanics, principles of virtual displacements and minimum potential energy, Rayleigh Ritz method, exact v/s approximate solution, beam elements.

Unit 3 (8 Hrs)

2-D PROBLEMS: Plane stress and plane strain conditions, triangular elements, constant strain triangle, linear strain triangle, Boundary conditions, body forces and stress recovery, quadrilateral elements

Unit 4 (8 Hrs)

2-D PROBLEMS: Lagrange and Serendipity shape functions, isoperimetric formulation, numerical integration, modelling with isoperimetric elements, requirements for convergence, patch test, nonconforming elements, reduced integration.

Unit 5 (8 Hrs)

3-D PROBLEMS: Axisymmetric solids, governing equations, axisymmetric elements and their applications, mixed formulations, bending of flat plates (Kirchhoff Theory), continuity requirements and boundary conditions. 3-D PROBLEMS: Discrete Kirchhoff's elements, thick plate elements, plate bending applications, shells as assemblage of flat plates, finite element formulation for dynamic problems, mass properties, introduction to elastic stability for frames and plates.

Texts / References:

1. R. D. Cook, Concepts and Applications of Finite Element Analysis, John Wiley and Sons, second edition, 1981.

2. C.S. Krishnamurti, Finite element method, Tata Mc-Graw Hill Publication.

3. K.J. Bathe, Finite Element Method and Procedures, Prentice hall, 1996.

4. Tirupathi, R., and Chandrupatla,Finite Elements in Engineering, PHI Publication, New Delhi.

5. Bruce Irons and SoharabAhmed,Techniques of Finite Elements, John Wiley and Sons, New York.

6. K.J. Bathe, Finite Element Method, Prentice Hall, 1987.

7. O.P., Gupta, Finite and Boundary Element Methods in Engineering, Oxford and IBH

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Open Elective –I

MMF204 OE **Research Methodology**

MMF204 OE	**Research Methodology**	OE1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course contents:

Unit 1 (8 Hrs)

Research Concepts – concepts – meaning – objectives – motivation. Types of research – descriptive research – conceptual research – theoretical research – applied research – experimental research.

Unit 2 (8 Hrs)

Research process – Criteria for good research – Problems encountered by Indian researchers. Formulation of Research Task – Literature Review – Importance & Methods – Sources – Quantification of Cause Effect Relations – Discussions– Field Study – Critical Analysis of Facts Generated

Unit 3 (8 Hrs)

Hypothetical proposals for future development and testing, selection of Research task.

Unit 4 (8 Hrs)

Mathematical modelling and simulation – Concepts of modelling – Classification of mathematical models – Modelling with – Ordinary differential equations – Difference equations – Partial differential equations – Graphs – Simulation – Process of formulation of model based on simulation.

Unit 5 (8 Hrs)

Interpretation and report writing – Techniques of interpretation – Precautions in interpretation – Significance of report writing – Different steps in report writing – Layout of research report – Mechanics of writing research report – Layout and format – Style of writing – Typing – References – Tables – Figures – Conclusion – Appendices.

TEXTS/REFERENCES

1. J.W Bames, Statistical Analysis for Engineers and Scientists, McGraw Hill, N.York
2. Schank Fr., Theories of Engineering Experiments, Tata Mc Graw Hill Publication.
3. C. R. Kothari, Research Methodology, New Age Publishers.
4. Willktnsion K. L, Bhandarkar P. L, Formulation of Hypothesis, Himalaya Publication

MMF203P Machine Learning Techniques

MMF203P	**Machine Learning Techniques**	OE1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Outcomes:

At the end of the course, student should be able to:
CO1 Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
CO2 Perform evaluation of learning algorithms and model selection.
CO3 Apply knowledge representation, reasoning, and machine learning techniques to real-world problems.
CO4 Proficiency with a variety of classifier methods including decision trees, neural networks, naïve bayes learning, nearest neighbor methods.
CO5 Illustrate hybrid learning methods involving domain theories and adaptive learning methods, and create algorithm by using this.
CO6 Apply these techniques to control and teach something to robot

Course Contents:

Unit 1 FOUNDATIONS OF LEARNING – (8 Hrs)
Components of learning – learning models – geometric models – probabilistic models – logic models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation generalization tradeoff – bias and variance – learning curve

Unit 2 LINEAR MODELS – (8 Hrs)
Linear classification – univariate linear regression – multivariate linear regression – regularized regression – Logistic regression – perceptrons – multilayer neural networks – learning neural networks structures – support vector machines – soft margin SVM – going beyond linearity – generalization and overfitting – regularization – validation

Unit 3 DISTANCE-BASED MODELS – (8 Hrs)
Nearest neighbor models – K-means – clustering around medoids – silhouttes – hierarchical clustering – k-d trees – locality sensitive hashing – non-parametric regression – ensemble learning – bagging and random forests – boosting – meta learning

Unit 4 TREE AND RULE MODELS - (8 Hrs)
Decision trees – learning decision trees – ranking and probability estimation trees – regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – descriptive rule learning – association rule mining – first-order rule learning

Unit 5 REINFORCEMENT LEARNING - (8 Hrs)
Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal-difference learning – active reinforcement learning – exploration – learning an action utility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control

TEXTS/REFERENCES:
1. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012.
2. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012.
3. K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.
4. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
5. D. Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press, 2012.
6. M. Mohri, A. Rostamizadeh, and A. Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
7. T. M. Mitchell, “Machine Learning”, McGraw Hill, 1997. 8. S. Russel and P. Norvig, “Artificial Intelligence: A Modern Approach”, Third Edition, Prentice Hall, 2009.

MMF104K Technology and Knowledge Management

MMF104K	**Technology and Knowledge Management**	OE1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Outcomes:

CO1 Define knowledge edge and classify drivers of knowledge management.
CO2 Study the process of conversion from information to knowledge.
CO3 Understand the different phases of knowledge management.
CO4 Study different strategies to achieve successful knowledge management system.
CO5 Explain infrastructural need and different layers for knowledge management.
CO6 Study the measuring process of knowledge growth and failure and creating the knowledge management blue print.
Course Contents:

Unit 1 **(8 Hrs)**

Introduction: Knowledge & necessity of Knowledge, KM's value proposition, behind the buzz, assumptions about your company. The Knowledge Edge: A common theme, intellectual capital, knowledge, market value, and prosperity, the 24 drivers of KM, knowledge centric drivers, technology drivers, organizational structure based, drivers, personnel focused drivers, process drivers, economic drivers, creating the knowledge edge.

Unit 2 (8 Hrs)

From Information to Knowledge: From data to information to knowledge, from data to knowledge, classifying knowledge, the three fundamental steps, knowledge management systems and existing technology, taming the tiger's tail, business and knowledge.

Unit 3 (8 Hrs)

The 10-Step Knowledge Management Road Map: The 10-step knowledge management road map, phase1: infrastructural evaluation, phase2: knowledge management system analysis, design, and development, phase3: deployment, phase4: matrices for performance evaluation.

Unit 4 (8 Hrs)

The Leveraged Infrastructure: The approach leverage, leverage, leverage, leveraging the internet, enabling technologies for the knowledge management, technology framework, knowledge server. Aligning Knowledge management and Business Strategy: From strategic programming to strategic planning, codification or personalization, knowledge maps to link knowledge to strategy, strategic imperatives for a successful km system, assessing focus.

Unit 5 (8 Hrs)

Infrastructural Foundations: Technology components of the km architecture, the seven- layer km system architecture, foundation for the interface layer, the web or notes? collaborative intelligence and filtering layer, audit knowledge. Knowledge Audit and Analysis: Measuring knowledge growth, the knowledge audit team, choosing your company's k-spots, sources of expertise, team composition and selection criteria, team life span and sizing issues, the knowledge management project leader, the km team's project space, points of failure. Creating Knowledge Management Blueprint: Analyzing lost opportunities, the knowledge management architecture, components of a knowledge management system, designing integrative and interactive knowledge applications, interoperability considerations, performance and scalability, user interface design consideration, a network view of the km architecture, future-proofing the knowledge management system

TEXTS / REFERENCES:

1. Amrit Tiwana, The Knowledge Management Tool Kit, Pearson Education Asia Pte. Ltd., 2000.
2. T.H.Davenport and Laurence, Prusak, Working Knowledge: How Organizations Manage what they Know, Harvard Business School Press, Boston, 1998.
3. I.Nonaka and H.Takeuchi, The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, Oxford University Press, New York, 1995.
4. IGNOU, Technology Management, 6 booklets viz. Block I to VI, IGNOU Publication No. MS-94, 1997.
5. J.B.Quinn, Intelligent Enterprise: A Knowledge and Service-Based Paradigm for Industry, Free Press, New York, 1992.
6. Betz Frederic, Strategic Technology Management, McGraw Hill, Inc., New York, 1993.

Manufacturing Lab

	Manufacturing Lab		0-0-2	1 Credits
Continuous Assessment (40Marks)		End Semester Exam (60Marks)		Total (100Marks)

Performa any eight practical's from below given list

Course Contents:

1. Cutting force determination using force dynamometer in CNC Milling operation
2. Cutting force determination using force dynamometer in CNC Turning operation
3. Experimental study in micromachining using photo chemical machining
4. Solid modeling of structural components using modeling software
5. Solid modeling of machine components using modeling software
6. Analysis of machine components using ANSYS, LSDyna etc. software
7. Modelling and coding of different components for 3 D printing
8. 3D printing and post processing of modelled components
9. Use of statistical quality control software for process optimization
10. Study of EDM/Wire EDM for metal machining.
11. Metal casting simulation using PROCAST.
12. Sequencing of cylinders using pneumatic trainer kit.
13. Modeling of component and determination of mass properties.
14. Inspection of an engineering component using CMM.
15. Simulation of robot.

Semester III

MMF104H Quality Control and Reliability

MMF104H	**Quality Control and Reliability**	OE2	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

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

CO1 Study various approaches of quality

CO2 Understand kaizen, Deming and Juran's quality control policies.

CO3 Study design of experiments using factorial approach and analyze the experiments.
CO4 Discuss various quality improvement processes using charts, block diagram, distribution and QFD.
CO5 Understand statistical processes control in quality and reliability assessment of product.
CO6 Understand and apply Taguchi's experimental design for quality control

Course Contents:

Unit 1 (8 Hrs)

Introduction:

New culture of TQM, TQM axioms, consequences of total quality managing, cost of total quality, valuable tools for quality, the Japanese factor. The Deming Approach to management: Historical background, Deming's fourteen points for management, deadly sins & diseases, implementing the Deming's philosophy, Deming on management. Juran on Quality: Developing a habit of quality, Juran`s quality trilogy, the universal breakthrough sequence, JuranVs Deming.

Unit 2 Crosby & the Quality Treatment: (8 Hrs)

Crosby diagnosis of a troubled company, Crosby's quality vaccine, Crosby's absolutes for quality management, Crosby's fourteen steps for quality improvement. Imai`s Kaizen: The concept, Kaizen & innovation, the Kaizen management practices, Kaizen & Deming.

Unit 3 Basic Techniques for Statistical Analysis: (8 Hrs)

Introduction, measures of central tendency & dispersion, confidence intervals, hypothesis testing, frequency distributions & histograms, probability distributions, measuring linear associations. Design & Analysis of Experiments: Introductions, factorial experiments, aliasing, constructing fractional designs, analysis of variance.

Unit 4 Supporting of Quality Improvement Processes: (8 Hrs)

Affinity diagram, bar chart, block diagram brain storming, cause and effect analysis, control charts, cost benefit analysis, customer- supplier relationship check list, decision analysis, flow charts, force field analysis, line graph/run charts, pareto analysis, quality costing, quality function development (QFD), quality project approach & problem-solving process, risk analysis scatter diagrams, Weibull analysis, 6 Sigma.

Unit 5 Statistical Process Control: (8 Hrs)

Introduction, data collection plan, variables charts, attributes, interpreting the control charts. Taguchi's Approach to Experimental Design & Offline Quality Control: Introduction, background to the method, Taguchi's recommended design techniques, from Deming to Taguchi & vice-versa. Reliability: Introduction, life cycle curves & probability distribution in modeling reliability, system reliability, operating characteristic curves, reliability and life testing plans.

TEXTS / REFERENCES:

1. N. Logothetis, Managing for Total Quality From Deming to Taguchi and SPC , Prentice Hall of India, New Delhi, 2005.
2. R.F. Lochner & J. E. Matar, Designing for Quality, Chapman & Hall, 2001.
3. A. Mitra , Fundamental of Quality Control & Improvement , Prentice Hall of India, New Delhi, 2nd edition, 2003.
4. A. Zaidi, SPC: Concepts, Methodologies and Tools, Prentice Hall of India, New Delhi, 1995.

MMF203I Metrology and Computer Aided Inspection

MMF203I	**Metrology and Computer Aided Inspection**	OE2	3-0-0	3 Credits

Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)	Total (100Marks)

Course Outcomes

CO1 Explain high precision measurement requirements of industry and select instruments for high precision.
CO2 Using various measuring standards and instruments for different applications.
CO3 Calibrate basic metrology instruments used in machine shop, and Identify techniques to minimize the errors in measurement.
CO4 Employing limits and design gauges
CO5 Explain the different instruments used for linear and angular measurements, surface finish and form features of a component
CO6 Identify the advanced measurement principles with ease and operate sophisticated measurement machines

Course Contents:

Unit 1 (8 Hrs)
Metrological concepts, Abbe's principle, need for high precision measurements, problems associated with high precision measurements.

Unit 2 (8 Hrs)
Standards for length measurement, shop floor standards and their calibration, light interference, method of coincidence.

Unit 3 (8 Hrs)
Slip gauge calibration, measurement errors, various tolerances, and their specifications, gauging principles.

Unit 4 (8 Hrs)
Selective assembly, comparators, angular measurements, principles and instruments, gear and thread measurements.

Unit 5 (8 Hrs)
Surface and form metrology, computer aided metrology, principles and interfacing, software metrology, laser metrology, CMM, types, probes used applications.
Non-contact CMM using electro-optical sensors for dimensional metrology, non-contact sensors for surface finish measurements, image processing and its applications in metrology.

TEXTS / REFERENCES:
1. D.J.Whitehouse, Handbook of Surface Metrology, Inst. of Physics Bristol and Philadelphia, 1994.
2. R.K.Jain, Engineering Metrology, Khanna Publishers, 2000.
3. Galleyer and Shotbolt, Metrology for Engineers, ELBS, 1998.

MCADM14E Project Management

MCADM14E	**Project Management**	OE2	3-0-0	3 Credits

Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)	Total (100Marks)

Course Contents:

UNIT 1 (8 Hrs)

INTRODUCTION TO PM: Projects in Contemporary Organization, Project Life Cycle

UNIT 2 (8 Hrs)

PROJECT INITIATION: Strategic Management, Project Selection & Evaluation, Selection Criteria & Models, Risk Management, Portfolio Process, Project Proposals, Project manager: Demands on Project manager, selecting the Project Manager, Multicultural Communication, Project Organization: Organizational Concepts in PM, Selecting an Organizational Form,

UNIT 3 (8 Hrs)

PROJECT PLANNING: Systems integration, WBS & Responsibility Charts, Interface Coordination, Conflict and Negotiation in PM: Nature of Negotiation, Conflict and Project Life Cycle

UNIT 4 (8 Hrs)

PROJECT IMPLEMENTATION: Budgeting and Cost Estimation: Estimating Project Budgets, Improving Cost Estimation Process, Scheduling: Background, Network Techniques: PERT & CPM, Risk Analysis & Crystal Ball Simulation,

UNIT 5 (8 Hrs)

RESOURCE ALLOCATION: CPM & Crashing a Project, Resource Allocation, Resource Loading & Leveling, Constrained Resource Scheduling, Multi-project Scheduling & Resource Allocation, Goldratt's Critical Chain, Monitoring & Information System, Planning-Monitoring-Controlling Cycle: Information Needs & Reporting Process, Earned Value Analysis, Computerized PMIS, Project Control: Need for Project Control, Three Types of Control Processes, Design of Control Systems, Control of Creative Activities, Control of Change & Scope. OBJECT TERMINATION: Project Auditing: System Goals & Project Audit, Audit Report, Project Audit Life Cycle, Project Termination, Varieties of Project Termination, Termination Process, Final Report, A Project History

Texts/References:

1. P. Gopalakrishnan and V. E. Rama Moorthy, Project Management, Macmillan India Ltd., New Delhi, 1993.

2. Prasanna Chandra, Projects: Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1980.

3. B. B. Goel, Project Management: Principles and Techniques, Deep & Deep Publications, New Delhi, 1986.

4. UNIDO Series on Project Management.

23UD2608PE105C Sustainable Manufacturing

23UD2608PE105C	**Sustainable Manufacturing**	OE2	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1 (8 Hrs)

Introduction: Concept of sustainability, manufacturing, operations, processes, practices, Resources in manufacturing, five MS, system approach to manufacturing, Basic experimental design, factor identification, quantification, comparison, Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing. Metrics for Green Manufacturing, Metrics Development Methodologies, Management of waste & pollution: Types, sources and nature of wastes, waste processing, green processing & engineering operations, Energy recovery, and 3 R& 6 R principle.

Unit 2 (8 Hrs)

Types of pollution and management: Anti-pollution approaches & guide lines. Environment friendly materials: Materials for sustainability, eco-friendly and new age energy efficient and smart materials, alternative manufacturing practices, materials and selection of manufacturing processes, control on use of renewable materials, Bio-degradable materials recycling of materials, Sustainable Manufacturing Tools: Principles of green manufacturing and its efficiency, Green manufacturing and sustainability, System model architecture and module, Design and planning, control or tools for green manufacturing (Qualitative Analysis), Consumption Analysis,

Unit 3 (8 Hrs)

Life Cycle Analysis, Efficiency, Sustainability tools). Standards for green manufacturing (ISO 14000 and OHSAS 18000), Waste stream mapping and application, Design for environment and for sustainability – Discuss the Product Life Cycle of manufactured goods. Life Cycle Analysis: Remanufacture and disposal , Tools for LCA, Optimization for achieving sustainability in unit manufacturing, Green manufacturing Lean models, value analysis, carbon footprint, analysis for carbon footprint Green manufacturing: sustainability framework Green manufacturing techniques: factors effecting sustainability.

Unit 4 (8 Hrs)

Green manufacturing techniques: Dry and near-dry machining, edible oil based cutting fluids Green manufacturing techniques: cryogenic machining for eco-efficiency Green manufacturing, Lean manufacturing, Lean techniques for green manufacturing Waste assessment and strategies for waste reduction in green manufacturing, Reconfigurable manufacturing systems.

Unit 5 (8 Hrs)

Green Supply Chain: Carbon footprints in transportation Green Supply chain: techniques and implementation Green Supply chain, Logistics management Green Supply Chain as Product Life Cycle Management, Servitization. Case Studies: Green packaging and supply chain, implementation of lean manufacturing at industries

TEXTS/REFERENCES:

1. Design of Experiments, Montgomery Douglas, John Wiley and Sons, Inc. 2017.
2. Green manufacturing: fundamentals and applications. Dornfeld, D.A. Springer Science & Business Media, 2012.
3. Materials and the environment: eco-informed material choice. Ashby, M. F. Elsevier, 2012.
4. Sustainability in the process industry. Klemes, J., McGraw-Hill. 2011
5. Green Management, M.Karpagam, GeethaJaikumar,Ane Books Pvt.Ltd. 2010
6. Design for Environment: A guide to sustainable Product Development Sustainable

Development, M.K. Ghosh Roy, Ane Books Pvt.Ltd,2009

MMD203G Design for Manufacture and Assembly

MMD203G	Design for Manufacture and Assembly	OE2	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Unit1 (8 Hrs)

DESIGN FOR MANUFACTURING: reduce the cost of manufacturing process, understanding the process and constraints, standard components and process, consider the impact of DFM decisions and other factors.

Unit2 (8 Hrs)

DESIGN CONSIDERATION IN METAL CASTING: Mold and Gating System Design, Directional Solidification, and Troubleshooting.

Unit 3 (8 Hrs)

DESIGN FOR WELDING: selection of materials for joining, welding defects, minimize the residual stresses etc. Design for forging and sheet metal and powder metal process.

Unit 4 (8 Hrs)

SELECTION OF MATERIALS: choice of materials, organizing material and processes.

Unit 5 (8 Hrs)

Application of Design for manufacture and assembly with selection of materials and ranking of processes like casting, injection moulding, sheet metal working, die casting, powder metal process, investment casting and hot forging, Design for assembly and automation

Texts/References:

1. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2nd Edition
2. Harry Peck, “Design for Manufacture”, Pittman Publication 1983.
3.Robert Matousek, “Engineering Design – A systematic approach”, Blackie & sons Ltd., 1963.
4.James G. Bralla, “Hand Book of Product Design for Manufacturing”, McGraw Hill Co., 1986

5.Swift K. G. “Knowledge based design for manufacture”, Kogan Page Ltd., 1987

MDM –I Multi-disciplinary Minor

23UD2608OE302A Application of IoT and Industry 4.0

23UD2608OE 302A	**Application of IoT and Industry 4.0**	MDM1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Pre-Requisites:

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

CO1	Understand the globalization, emerging issues, smart factories
CO2	Develop cyber physical systems and next generation sensors
CO3	Examine the IoT-Business Models
CO4	Apply Big Data Analytics and software defined networks
CO5	Explore the Industrial IoT- application domains

Mapping of course outcomes with program outcomes

Program outcomes → / Course outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**					**1**						
CO2					**2**			**2**				
CO3		**1**								**3**		
CO4				**3**				**2**				
CO5	**1**			**3**								**1**

Course Contents:

Unit 1: (8 Hrs)

Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II, Industry 4.0: Globalization and Emerging Issues, the Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Unit 2: (8 Hrs)

Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis, Cyber security in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Unit 3: (8 Hrs)

IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II, Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I, Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Unit –4: (8 Hrs)

Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop, Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II, Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Unit 5: (8 Hrs)

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies, Case studies in Milk Processing and Packaging Industries, Manufacturing Industries, Student Projects,

TextBooks and references:

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress
2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.
3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.
4. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers

23UD2608OE302B **e-Commerce Technologies**

23UD2608OE 302B	**e-Commerce Technologies**	MDM1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Pre-Requisites: Engineering mathematics-I

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

Unit 1: (8 Hrs)

Introduction to e-commerce, technical components and functions of e-commerce, Advantages and disadvantages of e-commerce, Scope and applications of e-commerce, E-commerce and e business

Unit 2: (8 Hrs)

Evolution of internet, Domain names and internet organization, Types of networks, Role of internet in B2B application and building own website, Web promotion, Target email, Banner exchange and Shopping Bots, Secure transaction over internet

Unit 3: (8 Hrs)

Privacy issues, Computer crime, Threats and attacks on computer system, Software packages for privacy, Hacking and computer virus, Security algorithms, Authorization and authentication, digital signature, Firewall, Basic concepts of EDI

Unit 4: (8 Hrs)

Applications of EDI, EDI model and Disadvantages of EDI model, Introduction to electronic payment systems, Payment types, Planning e-commerce initiates, linking objectives to business strategies, managing costs, Strategies for developing e-commerce websites

Unit 5: (8 Hrs)

Pros and cons of online shopping, Case study- cons of online shopping, E-cycle of internet marketing, Internet marketing techniques, Personalization of e-commerce.

TEXTS/REFERENCES:

1. C.S.V.Murthy, E-Commerce Concepts, Models, Strategies- :- Himalaya Publishing House, 2011.
2. Kamlesh K Bajaj and Debjani Nag , E- Commerce , 2005.
3. Gary P. Schneider , Electronic commerce, International Student Edition, 2011.
4. Electronic Commerce: The Strategic Perspective, Richard T.Watson, Pierre Berthon, Leyland F. Pitt, George M. Zinkhan.
5. Rana tassabehji, Applying E-commerce in business, 2003.
6. Kalakota, Ravi and Whinston, Andrew B., Electronic Commerce – A Manager‘s Guide, Pearson Education, Inc.
7. William Stallings, Cryptography and Network security Principles and practice, Fifth edition.
8. Bharat Bhasker, Electronic commerce-framework, technologies and applications, 3rd edition.

23UD2608OE302C **Entrepreneurship & Start-ups**

23UD2608OE 302C	**Entrepreneurship & Start-ups**	MDM1	3-0-0	3 Credits
Continuous Assessment (20Marks)	Mid Sem Exam (20Marks)	End Semester Exam (60Marks)		Total (100Marks)

Course Contents:

Unit 1: (8 Hrs)

Understanding the meaning of Start-up Why Start-ups are growing immensely these days, Characteristics of Successful Entrepreneur, Theories & Types of Entrepreneurs, Understanding the Start-up Ecosystem

Unit 2: (8 Hrs)

Idea Generation: Introduction to Design Thinking, Idea Identification, Genuity of Idea, understanding what customers really want? Market Research: Validation of idea, testing your idea with real time user into the market, Selection a demographic area for implementing your idea, Building of Minimum
Viable Product

Unit 3: (8 Hrs)

Soft Skills required to handle Start-up: Leadership, Negotiation skills, Time management, Problem solving, Communication

Unit 4: (8 Hrs)

Start-up Plan: Making Business Plan of your start-up, Understanding the legal compliances of your start-up, Building marketing strategies to get your product into the market (Traditional & Digital Marketing), Understanding Cash Flow Management, Raising funds for your business

Unit 5: (8 Hrs)

MANAGEMENT OF SMALL BUSINESS Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business

TEXTS/REFERENCES:

1. Khanka S.S., Entrepreneurial Development S. Chand Pub. Dec.2007
2. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha, Entrepreneurship, 11th Edition, Mc Graw Hill pub.
3. Rohit Sinha, School to Start up, Garuda Prakashan
4. Sudeshna Goswami Mandal, Overcome fear and launch your startup, Notion Press
5. Norman Scarborough , Jeffrey Cornwall Essentials of Entrepreneurship and Small Business Management, Global Edition: Dec.2018

Seminar

	Seminar		0-0-2	2 Credits

Continuous Assessment (40Marks)		End Semester Exam (60Marks)	Total (100Marks)

Objective:

To assess the debating capability of the student to present a technical topic. Also, to impart training to a student to face audience and present ideas and thus creating self-esteem, self confidence and courage that are essential for an engineer. Individual students are required to choose a topic of their interest from Manufacturing Systems Management related topics preferably from outside the M.Tech syllabus or an extension of syllabus and give a seminar on that topic for about 30 minutes. The Seminar can also be a case study from a manufacturing organization. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Dissertation Stage -I

	Dissertation stage -I			12 Credits
Continuous Assessment (40Marks)		End Semester Exam (60Marks)		Total (100Marks)

Objective:

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

The project work can be a design project, experimental project, computer simulation project or an empirical study involving data collection and analysis from manufacturing organisations. The topic should be on Manufacturing Systems Management orany of the topics related with Manufacturing stream. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute. If found essential they may be permitted to continue their project outside the parent institute subject to the conditions of M. Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members. The student is required to undertake the masters research project phase-I during the third semester and the same

is continued in the 4th semester (Phase-II). Phase-I consists of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.

Dissertation stage -II

	Dissertation stage -II			20 Credits
Continuous Assessment (80Marks)		End Semester Exam (120Marks)		Total (200Marks)

Objectives

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Masters Research project phase-II is a continuation of project phase-I started in the third semester. Before the end of the fourth semester, there will be two reviews, one at middle of the fourth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with he thesis. The final evaluation of the project will be external evaluation.

========== END ==========