GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Mechanical Engineering

Program: M. Tech CAD/CAM

Scheme: 2018 – 2020

Date of BoS: 15.06.2019

Curriculum

Semester 1									
Sl. No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	MATH5001	Advanced Numerical and Statistical Methods	3	1	0	4	**20**	**50**	**100**
2	MCDM5001	Advanced Strength of Materials	3	0	0	3	**20**	**50**	**100**
3	MCDM5002	Advanced Materials and Processing	3	0	0	3	**20**	**50**	**100**
4	MCDM5003	Advanced Manufacturing Technology	3	0	0	3	**20**	**50**	**100**
5	MCDM5004	Product Design and Life Cycle Management	3	0	0	3	**20**	**50**	**100**
6	MCDM5005	Advanced Computer Aided Design	3	0	0	3	**20**	**50**	**100**
		Total	**18**	**1**	**0**	**19**			
Semester II									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	CENG5001	Professional and Communication Skills	0	0	4	2	**50**	**-**	**50**
2	MCDM5006	Finite Element Methods	2	1	0	3	**20**	**50**	**100**
3	MCDM5007	Computer Integrated Manufacturing	3	0	0	3	**20**	**50**	**100**
4	MCDM5008	Advanced Vibration Engg.	3	0	0	3	**20**	**50**	**100**
5	MCDM5009	Computer Aided Process Planning	0	0	2	1	**50**	**-**	**50**
6		Elective 1	3	0	0	3	**20**	**50**	**100**
7		Elective 2	3	0	0	3	**20**	**50**	**100**
		Total	**14**	**1**	**6**	**18**			
Semester III									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	MCDM6001	Advanced Computer Aided Design and Manufacturing Lab	0	0	2	1	**50**	**-**	**50**
2	MCDM9998	Dissertation-1	-	-	-	5	**50**	**-**	**50**
3		Elective 3	3	0	0	3	**20**	**50**	**100**
4		Elective 4	3	0	0	3	**20**	**50**	**100**
5		Elective 5	3	0	0	3	**20**	**50**	**100**
Semester IV									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	MCDM9999	Dissertation-2	-	-	-	15	**50**	**-**	**50**

List of Electives

Basket-1

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MCDM5010	Rapid Prototyping	3	0	0	3	**20**	**50**	**100**
2	MCDM5011	Tool Engineering	3	0	0	3	**20**	**50**	**100**
3	MCDM5012	Advanced Computer Aided Manufacturing	3	0	0	3	**20**	**50**	**100**
4	MCDM5013	Performance Modelling and Analysis of Manufacturing Systems	3	0	0	3	**20**	**50**	**100**
5	MCDM5014	Design for Manufacturing	2	1	0	3	**20**	**50**	**100**
6	MCDM5015	Quality Management	2	1	0	3	**20**	**50**	**100**
7	MCDM5016	Reliability Engineering	3	0	0	3	**20**	**50**	**100**
8	MCDM5017	Metrology and Non-Destructive Testing	3	0	0	3	**20**	**50**	**100**
9	MCDM5018	Design and Analysis of Experiments	3	0	0	3	**20**	**50**	**100**
10	MCDM5019	Research Methodology	3	0	0	3	**20**	**50**	**100**
11	MCDM5020	Optimization Methods	2	1	0	3	**20**	**50**	**100**

Detailed Syllabus

Name of The Course	**Professional and Communication Skills**			
Course Code	**CENG 5001**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	0	0	2	1

Course Objective:

1. To develop the professional and communicational skills of learners in a technical environment.
2. To enable students acquire functional and technical writing skills.
3. To enable students acquire presentation skills to technical and non-technical audience.

Course Outcomes:

CO1	Improve their reading fluency skills through extensive reading
CO2	Use and assess information from academic sources, distinguishing between main ideas and details
CO3	Compare and use a range official support through formal and informal writings
CO4	The students will be able to exhibit language proficiency in comprehending, describing, and investigating.

Text Books

Rajendra Pal and J.S.Korlahalli. Essentials of Business Communication. Sultan Chand & Sons. New Delhi.

Reference Books

1. Kaul. Asha. Effective Business Communication.PHI Learning Pvt. Ltd. New Delhi.2011.
2. Murphy, Essential English Grammar, CUP.
3. J S Nesfield, English Grammar: Composition and Usage
4. Muralikrishna and S. Mishra, Communication Skills for Engineers.

Course Content:

UNIT 1:
Aspects of Communication; Sounds of syllables; Past tense and plural endings; Organizational techniques in Technical Writing; Paragraph Writing, Note taking, Techniques of presentation
UNIT 2:
Tense, Voice, conditionals, Techno-words; Basic concepts of pronunciation; word stress; Business letters, email, Techniques for Power Point Presentations; Dos and don'ts of Group Discussion
UNIT 3:
An introduction to Modal and Phrasal verbs; Expansion; Word formation; Technical Resume; Company Profile Presentation; Interview Skills

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Name of The Course	Advanced Numerical and Statistical Methods			
Course Code	MATH5001			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	1	0	4

Course Objective:

With ever growing demand of computational techniques, scope of numerical methods is penetrating aggressively into major and important fields including Science, Engineering &Technology, Medical, Space Science, Economics, Business and Environment. The objective is to achieve knowledge and understanding of numerical methods and to apply appropriate methods to model and solve problems where ordinary analytical methods fail.

Statistical methods are used in manufacturing, development of food product, computer software, energy sources, pharmaceuticals and many other areas. The objective of statistics and probability is to analyze data to make scientific judgments in the face of uncertainty and variation for the improvement of the desired quality.

Course Outcomes:

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

CO1	Apply various numerical methods to solve system of linear and non-linear equations.
CO2	Apply standard interpolation methods to interpolate required/ missing value.
CO3	Apply appropriate methods of numerical differentiation /integration to solve related problems.
CO4	Solve ordinary differential equations and partial differential equations using appropriate numerical methods.
CO5	Identify the type of distributions and apply a suitable test to draw the conclusion.

Text Books:

1. Numerical Methods for Scientific and Engineering Computation (6^{th} edition) by Jain, Iyengar & Jain, New Age International publishers.
2. Probability & Statistics for Engineers & Scientists (9^{th} edition) by R.E.Walpole, R,H,Myers & K.Ye.

Reference Books:

1. Numerical Methods by E Balagurusamy, Tata McGraw Hill
2. Curtis F. Gerald and Patrick O Wheatley, Applied Numerical Analysis, Pearson Education Ltd.
3. Introductory Methods of Numerical Analysis by S.S. Sastry, PHI learning Pvt Ltd.
4. Numerical methods for Engineers (6^{th} edition), Steven C. Chapra and Raymond P. Caynale.
5. Numerical Methods in Engineering & Science (9^{th} edition), by B.S.Grewal
6. Statistical Methods by S.P. Gupta, Sultan Chand and Sons
7. Probability and Statistics by Schaum's series (3^{rd} edition)

Course Content:

Unit –I System of Linear Equations: Direct Methods- Gauss elimination – Pivoting, Partial and Total Pivoting, Triangular factorization method using Crout LU decomposition, Cholesky method, Iterative Method- Gauss-Seidel and Jacobi method, ill conditioned matrix System of Non-linear equation- Newton Raphson and Modified Newton Raphson Method. Iterative methods
Unit -II Interpolation and Approximation: Lagrange, Spline and Hermite interpolation, Approximations, Error of approximation, Norms for discrete and continuous data, Least square approximation.
Unit -III Numerical Integration: Newton Cotes closed Quadrature, Gauss Legendre Quadrature, Multiple Integration An introduction to Modal and Phrasal verbs; Expansion; Word formation; Technical Resume; Company Profile Presentation; Interview Skills
Unit -IV Numerical Solution of Differential Equations: Finite Difference Schemes, Numerical solution of Ordinary differential equation using Modified Euler's method, Runge-Kutta method of 2nd, 3rd and 4th orders, Predictor- Corrector method, Solution of Laplace's and Poisson's equations by Liebman's method, Solution of one dimensional time dependent heat flow.
Unit -V Probability and statistics: Review of concept of probability, Random Variables, Continuous and discrete distribution function, moments and moments generating functions, Binomial, Poisson, Negative Binomial, Geometric and Hyper-geometric Distributions, Uniform, Normal, Exponential, Gamma and Beta distributions. Point and Interval estimation, Testing of Hypothesis (t-test and chi square test), Analysis of variance and Introduction of Design of experiments

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Advanced Strength of Materials**				
Course Code	**MCDM5001**				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1. To introduce the students to the behavior of structural and mechanical systems subjected to various types of loading.
2. To evaluate the resulting stresses, strains and deflections as well as failure criteria of these systems.

Course Outcomes

CO1	Develop a physical understanding of how mechanical and structural systems respond to a wide variety of loading (K3)
CO2	Analyze and compute the stresses and deflection in symmetrical and asymmetrical bending for various sections and evaluate failure criteria of a variety of mechanical and structural systems (K4)
CO3	Analyze and compute the stresses in curved flexural members, closed and open geometrical shapes (K4)
CO4	Develop an understanding of torsion of non-circular shafts of different cross-sections (K3)
CO5	Calculate the stresses due to rotation in elements of circular geometry with different thicknesses and at different speeds (K3)

Text Book (s) and Reference Book (s)

1. Boreshi and Sidebottom (1952), *Advanced Mechanics of Materials*, John Wiley International Edition.
2. Kamal kumar and R C Ghai (1990), *Advanced Mechanics of Materials*, Khanna publishers. ISBN- 978-8-174-09281-6.
3. Den Hartong (1952), *Advanced strength of Materials*, Mc Graw – Hill Book Co. New York.
4. Timoshenko and Goodier, *Theory of Elasticity*, Tata McGraw – Hill publishing company Limited. ISBN-978-0-070-70122-9.

5. Robert D Cooki, Warren C. Young (1952), *Advanced Mechanics of Material*, Mac Millian publishing Co. ISBN- 978-0-133-96961-0.

6. L S Srinath (1990), *Advanced Mechanics of Solids*, Tata McGraw – Hill publishing Company Limited, ISBN- 978-0-070-13988-6.

Course Content:

Unit-1 Introduction	**7 hours**
Elasticity: Stress-strain relations and general equations of elasticity in Cartesian polar and spherical co-ordinates, differential equations of equilibrium – Compatibility – boundary conditions – representation of 3-dimensional stress of a tensor – Generalized Hook's law St.Venant's principle –plane strain – plane stress – Airy's stress function.	
Unit-2	**8 hours**
Shear centre and Unsymmetrical bending: Location of shear centre for various sections – shear flow. Stresses and deflection in beams subjected to unsymmetrical loading, kern of a section.	
Unit-3	**9 hours**
Curved flexural members : Circumferential and radial stresses – deflections curved beam with restrained ends – closed ring subjected to concentrated load and uniform load – chain links and crane hooks.	

Unit-4	**9 hours**
Torsion of non-circular shafts: Torsion of rectangular cross sections – St.Venant's theory – Elastic membrane analogy – Prandtl's stress function – Torsional stresses in hollow thin–walled tubes.	
Unit-5	**7 hours**
Stresses due to Rotation: Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – allowable speeds.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Advanced Materials and Processing				
Course Code	MCDM5002				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the knowledge on mechanical behavior of materials.
2. To acquire knowledge in various class of materials and their applications.
3. To import knowledge on various surface modification techniques.

Course Outcomes

CO1	Analyse the mechanical behaviour of metallic systems and its importance (K4)
CO2	Develop an understanding of engineering alloys and their applications (K3)
CO3	Evaluate the various methods of surface modification of materials (K5)
CO4	apply the knowledge to classify the properties and applications of metallic and non-metallic materials, and learn the selection of them (K3)
CO5	Categorize the modern materials and alloys, and analyse their behaviour and applications (K4)

Text Book (s)

1. Callister W.D, (2006) *Material Science and Engineering- An introduction*, Wiley –Eastern. ISBN- 978-0-471736967.

2. Raghavan, V, (2003) *Physical Metallurgy*, Prentice Hall of India. ISBN- 978-8-120-33012-2.

Reference Book (s)

1. Thomas H. Courtney, (2000*), Mechanical Behavior of Materials*, McGraw Hill. ISBN-978-0-073-22824-2.
2. Flinn R. A. and Trojan P. K., (1999), *Engineering Materials and their Applications*, Jaico. ISBN-978-0-395-18916-0.
3. Kenneth Budinski (1988), *Surface Engineering for wear resistance*, Prentice Hall. ISBN- 978-0-138-77937-5.
4. Avner S.H. (2006), *Introduction to physical metallurgy*, Tata McGraw Hill, ISBN-978-0-074-63006-8.

Course Content:

Unit-1 Review of Mechanical Behaviour of Materials **12 hours**
Plastic deformation in poly phase alloys - Strengthening mechanisms - Griffith's theory of failure modes – Brittle and ductile fractures - Damping properties of materials - fracture toughness - Initiation and propagation of fatigue cracks - Creep mechanisms - Hydrogen embitterment of metals, Selection of materials for various applications.
Unit-2 Engineering Alloys **6 hours**
Cast iron , steels , alloy steels and stainless steels – an overview of phases and microstructure, types, specifications applications, heat treatment, effect of alloying elements, Aluminum, Magnesium and Ti wrought and cast alloys used in engineering applications –Types, specifications, applications, heat treatment
Unit-3 Surface Modifications of Materials **6 hours**
Mechanical surface treatment and coating - Case hardening and hard facing - thermal spraying – vapour deposition-ion implantation - Diffusion coating - Electroplating and Electrolysis - Conversion coating - Ceramic and organic coatings – Diamond coating

Unit-4 Nonmetallic Materials	**6 hours**
Composite materials, ceramics, plastics -Introduction, an overview of processing, their characteristic features, types and applications.	
Unit-5 Modern Materials and Alloys	**9 hours**
Super alloys- Refractory metals - Shape memory alloys- Dual phase steels, Micro alloyed, High strength low alloy steel, Transformation induced plasticity (TRIP) steel, Maraging steel –SMART materials, Metallic glass – Quasi crystal and Nano crystalline materials., metal foams.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Advanced Manufacturing Technology				
Course Code	MCDM5003				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		3	0	0	3

Course Objectives:

The course is aimed at understanding of the following

1. To provide a through coverage of traditional and non-traditional machining processes.
2. To develop and understanding of various fundamental mechanics of machining processes.
3. To provide awareness of high speed machining, micro-machining and nano-fabrication techniques.
4. To introduce the semi conductor, IC chips and micro actuator fabrication techniques.

Course Outcomes

CO1	Develop and understanding of metal cutting &analyze the properties of tools, workpieces and cutting fluids (K3)
CO2	Analyze and categorize the special machining processes (K4)
CO3	Investigate the high speed machining processes and their applications (K4)
CO4	Correlate the non-traditional machining processes, their mechanism of metal removal and th applications (K4)
CO5	Evaluate various micro-machining processes and their applications in diverse fields (K6)

Text Book (s) and Reference Book (s)

1. Boothroyd G., and Knight W.A. (1989), *Fundamentals of Metal Machining and Machine Tools*, Marcel Dekker. ISBN- 978-1-574-44659-3.
2. Serope Kalpakjian and Steven R.Schmid (2001), *Manufacturing Engineering and Technology*, Pearson Education. ISBN- 978-8-177-58170-6.
3. Battacharya, "Theory of Metal Cutting", NCB Agency, 1984.
4. Benedict G. (1987), *Non Traditional Manufacturing Processes*, Marcel Dekker, ISBN-978-0-824-77352-6.
5. Mishra.P.K. (1997), *Non-conventional Machining*, Narosa publishing house, ISBN- 978-8-173-19192-3.
6. Bert T. Erdel (2003), *High Speed Machining*, Society of Manufacturing Engineers. ISBN- 978-0-872-63649-1.
7. Madou, M.J. (1997), *Fundamentals of Micro fabrication*, CRC press. ISBN- 978-0-849-30826-0.
8. Rai-Choudhury P. (1997), *Handbook of Microlithography, Micromachining, and Micro fabrication, Vol.1 and Vol.2*, Editor: IEEE Materials and Devices Series 12, London, ISBN- 978-0-819-42378-8.

Course Content:

Unit-1 Theory of Metal Cutting **8 hours**
Mechanism of metal cutting – Orthogonal and Oblique cutting, derivation of equations for forces and shear angles etc., various shear angle theories. Tool materials – Tool life and tool wear – Temperature in metal cutting – Cutting fluids and surface roughness.
Unit-2 Special Machining **8 hours**
Deep hole drilling – Gun drills – Gun boring – Trepanning – Honing – Lapping – Super finishing – AFM – MAF – Burnishing – Broaching – Hard machining – Hot machining.
Unit-3 High Speed Machining **8 hours**
The high performance machining of components – Application of HSM – Tools for HSM - Design of tools for HSM – High speed and high performance grinding – Ultra precision machining.
Unit-4 Non-traditional Machining **8 hours**

USM, WJM, AWJM, EDM, ECM, LBM, EBM, Plasma machining and Hybrid machining processes – Mechanism of metal removal, characteristic features and applications
Unit-5 Micro Machining **8 hours**
Importance of micro machining, various micro machining processes, application of micro machining in semi-conductor IC technology, micro actuator and micro sensors – CVD, PVD and Ion Implantation.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Product Design and Life Cycle Management				
Course Code	MCDM5004				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		3	0	0	3

Course Objectives:

To make the student to be familiar with

1. The new product management process.
2. Product lifecycle management stages.
3. The DFx concepts from the conception to recovery or disposal.
4. Applying analytic methods for all stages of product planning, development, launch, and control.

Course Outcomes

CO1	Illustrate the product development processes and their different stages(K3)
CO2	Analyze the first stage of the product development cycle using various models(K4)
CO3	Appraise and design in detail the product and its prototyping(K4)
CO4	Analyze the producibility and reliability of a product(K4)
CO5	Evaluate the issues in supply chain management, ergonomics, safety and failure mode analysis(K5)

Text Book (s)

1. John W. Priest and Jose M. Sanchez (2001), *Product development and design for manufacturing- A collaborative approach to producibility and reliability*, Marcel Dekker Publications, ISBN- 978-0-824-79935-9.

Reference Book (s)

1. Stephen C. Armstrong (2001), *Engineering and product development management – the holistic approach*, Cambridge university press, ISBN- 978-0-521-83253-3.
2. Thomas A. Sabomone, (1995), W*hat every engineer should know about concurrent engineering*, Marcel Dekker Publications, ISBN- 978-0-824-79578-8.
3. Karl T. Ulrich, Ateven D. Eppinger (2003), *Product Design and Development*, Tata McGraw-Hill, ISBN- 978-0-070-58513-3.

Course Content:

Unit-1 Introduction **10 hours**
Product development – Trends affecting product development – Best practices for product development – Product development process and organizations – Collaborative product development – concurrent engineering – risk management - Stages of Product development.
Unit-2 Product Development Life cycle – I **8 hours**
Early design – Requirement Definition and Conceptual design - Trade-off Analysis – Optimization using cost and utility metrics – Trade-off analysis models and parameters- design to cost – Design to Life cycle cost – Design for warranties.
Unit-2 Product Development Life cycle – II **8 hours**
Detailed design – Analysis and modeling – Best practices for detailed design – Design analyses – Prototypes in detailed design – Test and Evaluation – Design review, prototyping – simulation and testing – Manufacturing – Strategies – planning and methodologies
Unit-4 Producibility and Reliability **7 hours**

Producibility – strategies in design for manufacturing – requirements for optimizing design and manufacturing decisions – Simplification – commonality and preferred methods – Modularity and scalability – part reduction – functional analysis and value engineering – Reliability – Strategies and practices – Testability – Design for test and inspection.
Unit-5 Product Development Life cycle – III **7 hours**
Supply chain – Logistics, packaging, supply chain and the environment – ISO 14000/210 – Design for people – Ergonomics, Repairability, maintainability, safety and product liability – Task analysis and failure mode analysis.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Advanced Computer Aided Design			
Course Code	MCDM5005			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To introduce the CAD concepts both theoretically and application wise.
2. To provide students the necessary foundation to advance understanding of both design and manufacturing
3. To enable the students to model geometry of objects using curves and surfaces, so that the models can be used further for downstream applications.

Course Outcomes

CO1	Analyze the hardware and software requirement of CAD with the latest developments
CO2	Develop an analytical ability to represent transformations and projections of rigid bodies using CAD
CO3	Interpolate or fit curves through given points, and design curves to achieve the required shape using C method in two and three dimensions
CO4	Design surfaces to model shapes of objects in the nature mathematically.
CO5	Develop programs to employ the mathematical techniques for geometric modeling and transformatio

Text Book (s)

1. Newman & Sprawl (1978), Principles of interactive Computer Graphics, Mcgraw hill college, ISBN-978-0-074-63293-2
2. Michel E. Mortenson (2006), Geometric modeling, Industrial press, ISBN-978-0-201-84840-3
3. Van Dam, Hughes Jhon, James Foley (2002), Computer graphics, principles and practices Pearson, ISBN- 978-0-201-84840-3

Reference Book (s)

1. Foley & van dam (1982), Fundamental of Interactive computer graphics, Addison Wesley longman publishing co, ISBN- 978-1-852-33818-3
2. David Rogers (2001), Procedural elements of Computer graphics, TMH, ISBN- 978-0-070-53529-9
3. Rogers and Adams (2002), Mathematical elements of Computer Graphics, TMH,ISBN- 978-0-070-53529-9
4. Hearn & baker (2011), Computer Graphics, Pearson,ISBN- 978-8-177-58765-4

Course Content:

Unit-1 Introduction **8 hours**
Hardware and software requirement of CAD; Video display devices- Refresh cathode ray tubes, Raster-scan displays, Random-scan displays, Color CRT Monitors; Input devices- keyboard, joy-stick, mouse, scanner; Hard copy devices- dot matrix, inkjet, laser printers.
Unit-2
Geometric Transformation - Basic transformation, translation, rotation, scaling, reflection, homogeneous coordinates; Composite Transformation- Introduction, translation, rotation, scaling.
Unit-3

3-D transformation- translation, rotation, scaling, reflection; 3-D composite transformation- generalized rotation, generalized reflection; 3 D projections- orthographic projection, axonometric projection, oblique projection, perspective projection.
Unit-4
Introduction to curves, parametric continuity condition, geometric continuity condition, spline representation, spline specification, geometric and algebra forms, cubic spline interpolation method, natural cubic spline, Bezier curves, B-spline curves, curve animation.
Unit-5
Quadric surfaces- sphere, ellipsoid, torus; Super quadrics- superellipse, superellipsoid; Bezier surfaces; B-spline surfaces.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Finite Element Methods			
Course Code	MCDM5006			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis
2. To understand the characteristics of various finite elements.
3. To develop finite element equations for simple and complex domains.

Course Outcomes

CO1	Apply the knowledge of mathematics and engineering to solve problems in structural and thermal engineering by approximate and numerical methods.
CO2	Design a new component or improve the existing components using FEA.
CO3	Solve the problems in solid mechanics and heat transfer using FEM.
CO4	Analyze the vibration problems and transient state problems dynamically.
CO5	Use commercial FEA packages like ANSYS and modern CAD/CAE tools for solving real life problems.

Text Book (s)

1. Seshu, P.(2010), *Textbook of Finite Element Analysis*, Prentice-Hall of India Pvt. Ltd. ISBN- 978-8-120-32315-5.
2. Tirupathi R. Chandrapatla, Ashok D. Belegundu, *Introduction to Finite Element in Engineering Prentice-Hall of India Private limited*, New Delhi – 110 001. ISBN-978-0-130-61591-6.

Reference Book (s)

1. Bathe, K.J, (1996), *Finite Element Procedures*, Prentice-Hall of India Pvt. Ltd., third Edition. ISBN-978-0-979-00490-2.
2. Zienkiewicz O.C. (1989), *The Finite Element Method*, McGraw-Hill. ISBN- 978-0-070-84072-0.
3. Reddy J.N. (1993), *The Finite Element Method*, McGraw-Hill, Third Edition, 1993. ISBN- 978-0-072-46685-0.
4. C.S. Krishnamoorthy, (1994), *Finite Element Analysis Theory and Programming*, Tata McGraw-Hill, ISBN- 978-0-074-62210-0.
5. Robert cook, R.D. et. Al., (2004), *Concepts and Applications of Finite Element Analysis*, John Wiley & sons, ISBN- 978-0-471-35605-9.

Course Content:

Unit-1 Fundamental Concepts **6 hours**
Matrix Algebra, Gaussian Elimination, Definition of Tensors and indicial notations, Plane strain- Plane stress hypothesis. Physical problems, Mathematical models, and Finite Element Solutions, Finite Element Analysis as Integral part of Computer Aided Design, Stresses and Equilibrium; Boundary Conditions; Strain-Displacement Relations; Stress –strain relations, Temperature Effects.
Unit-2 Finite Element Formulation from Governing Differential Equations and on Stationary of a Functional **6 hours**

Weighted Residual Method for Single Continuous Trail Function and General Weighted Residual Statement, Weak Variational Form of Weighted Residual statement, Comparison of Differential Equation, Weighted Residual and Weak forms, Piece-wise Continuous Trail function solution of weak form, One dimensional bar finite element and one dimensional heat transfer element, Functional of a differential equation forms, Rayleigh-Ritz Method, Piece-wise Continuous trail functions, Finite Element Method and Meaning of Finite Element Equations.
Unit-3 One-Dimensional Finite Element Analysis **9 hours**
General form for Total Potential for 1-D, Generic form of finite element equations, Linear Bar Finite element, Quadratic Bar Element- Shape function and Element matrices, Beam element- selection of nodal d.o.f., Determination of Shape functions and Element matrices, 1-D Heat transfer problem.
Unit-4 Unit IV: Two-Dimensional Finite Element Analysis **9 hours**
Approximation of Geometry and Field variable: Three-noded triangular element, Four-noded rectangular element, six-noded triangular elements, natural coordinates and coordinate transformation, 2-D elements for structural mechanics, Numerical integration, Incorporation of Boundary Conditions and Solution.
Unit-5 Dynamic Analysis using Finite Elements **9 hours**
Introduction to vibration problems, Consistent and Lumped mass matrices, Form of finite element equations for vibration problems, Eigenvalue Problems, Transient vibration analysis and unsteady heat transfer problem.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Computer Integrated Manufacturing				
Course Code	MCDM5007				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To acquaint the students with the CIM concepts and role of CAD in manufacturing
2. To enable the students learn the analysis tools for manufacturing
3. To help students know the control structures for manufacturing systems in the CAM area

Course Outcomes

CO1	Evaluate the functions of manufacturing systems and CIM concepts
CO2	Apply the methods of CAD in manufacturing
CO3	Apply the simulation tools and AI methods for manufacturing
CO4	Plan the manufacturing processes and optimize them
CO5	Apply the knowledge of control structures for manufacturing systems in the CAM area

Text Book (s) and Reference Book (s)

1. U.Rembold (1993), *Computer Integrated Manufacturing and Engineering*, Addison Wesley Publishers, 1993 edition. ISBN- 978-0-201-56541-6.

2. Rajan Suri(1998), *Quick Responsive Manufacturing*, Productivity Press, ISBN- 978-1-563-27201-1.

Course Content:

Unit-1 Concepts of Computer Integrated Manufacturing System **6 hours**
Functions of Manufacturing Systems, Hierarchical planning and Control Concept – Future Developments, CIM Models and concepts, Unsolved Problems in CIM
Unit-2 CAD – Its role in Manufacturing **6 hours**
Introduction – Design Hierarchy, Methods of Constructing geometric elements in CAD, CAD/CAM Interface programming, Graphics Standards, Requirements of Product Model, Tolerance Practices in Manufacturing, Quality methods in design, Life Cycle cost in design.
Unit-3 Analysis Tools for Manufacturing **9 hours**
An Integrated approach to manufacturing systems planning, Simulation tools, AI methods for manufacturing, Knowledge- Based Systems, Quick Responsive Manufacturing (QRM) – a company wide approach to reduce Lead Time.
Unit-4 Computer-Aided Process Planning **9 hours**
Design data and automated process planning, Feature based Generation and Optimization of Process Planning, MRP.
Unit-5 Control structures for manufacturing systems in the CAM area **9 hours**
Introduction – Function oriented structure, Software and Hardware oriented structures, Programming NC equipment, Flexible Manufacturing and Assembly equipment, Information Systems Integration, Global Manufacturing Networks – Interoperability, Next Generation Manufacturing Conceptual Model, Product Geometry Standards – IGES, STEP, XML, XVL, Virtual Business, e-Commerce Technologies.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Advanced Vibration Engineering			
Course Code	MCDM5008			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To introduce classical Vibration theories, relating to discrete and continuous systems with applications.
2. To teach various numerical techniques including FE for analysis of complex structures and modal testing for natural frequencies and mode shapes.
3. To introduce special cases of non-linearity and random phenomena in vibrating systems including their stability.

Course Outcomes

CO1	Demonstrate an understanding of the concepts of Mechanical vibrations starting from single, two, Multi degree freedom systems. (K3)
CO2	Analyse free and forced vibrations in single, two, Multi degree freedom systems. (K4)
CO3	Examine advanced concepts like Continuous, Non-linear and Random Vibrations. (K3)
CO4	Apply FEM to formulate the mechanical vibrations (K3)
CO5	Analyse systems utilizing different modes of vibration (K4)

Text Book (s) and Reference Book (s)

1. W. T. Thomson (1999), *Theory of Vibration*, Kluwer Academic Pub; 4th edition. ISBN- 978-0-748-74380-3.

2. TSE, Morse and Hinkel (1991), *Mechanical Vibrations*, Chapman and Hall, ISBN-978-0-205-05940-9.

3. Den Hartong (1986), Mechanical Vibrations, McGraw Hill. ISBN- 978-0-486-64785-2.

4. V.P.Singh (1988), *Mechanical Vibrations*, Dhanput Rai & Co. ISBN-978-0-000-27184-7.

5. S.Timoshenko, D.H.Young (1991), Vibrations Problems in Engineering, D.Van Hostrand Company, Inc, Afiliated East-West Press Pvt. Ltd. ISBN-978-0-471-63228-3.

Course Content:

Unit-1 Single and Two degrees of freedom system	**8 hours**
Introduction to free, forced, transient and damped vibrations, terminology and applications. Discrete systems – single degree and two degree systems, response to free forced motions (steady state and transient) applications to vibration isolation and absorption.	
Unit-2 Several degrees of freedom	**6 hours**
Multi degree systems – techniques of analysis such as Dunkerley, Rayleigh, Holzer, Matrix iteration, Transfer matrices and modal analysis.	
Unit-3 Continuous and Torsional Vibration	**9 hours**
Continuous systems Free and forced vibrations of bars for longitudinal, shear, torsional and transverse vibrations, Beams with attached masses rotor dynamics and FEM applications.	
Unit-4 Non-linear Vibrations	**9 hours**
Non-linear vibrations, jump phenomenon and stability. Applications including self excited and parameter excited vibrations.	
Unit-5 Random Vibrations	**8 hours**

Random vibrations – stationary and non-stationary, ergodic systems, response of single degree systems to random excitation.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Computer Aided Process Planning				
Course Code	MCDM5009				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		2	0	0	2

Course Objectives:

To provide the student with an understanding of the importance of process planning role in manufacturing and the application of Computer Aided Process Planning tool in the present manufacturing scenario

Course Outcomes

CO1	Distinguish the concepts of process planning applicable to manufacturing in consideration with production planning, concurrent engineering and group technology (K4)
CO2	Execute part design representations for process planning using different coding systems(K3)
CO3	Apply process engineering skills for different process panning methods (K3)
CO4	Implement logical design concepts for computer aided process planning systems (K3)
CO5	Interpret totally integrated process planning systems and generate reports (K3)

Text Book (s) and Reference Book (s)

1. Gideon Halevi and Roland D.Weill (1995*), Principle of Process Planning-A logical Approach*, Chapman & Hall, ISBN- 978-0-412-54360-9.
2. Tien-Chien-Chang, Richard A.Wysk (1985), *An Introduction to automated process planning systems*, Prentice Hall. ISBN- 978-0-134-78140-2.
3. Chang.T.C. (1985), *An Expert Process Planning System*, Prentice Hall.
4. Nanua Singh (1996), *Systems Approach to Computer Integrated Design and Manufacturing*, John Wiley & Sons, ISBN-978-0-471-58517-6.
5. P. N. Rao, N. K. Tewari, T. K. Kundra (2000), *Computer Aided Manufacturing*, Tata McGraw Hill Publishing Co. ISBN- 978-0-074-60205-8.

Course Content:

Unit-1 Introduction	**8 hours**
The Place of Process Planning in the Manufacturing cycle- Process planning and production planning – Process planning and Concurrent Engineering, CAPP, Group Technology.	
Unit-2 Part Design Representation	**9 hours**
Design Drafting – Dimensioning – Conventional Tolerencing – Geometric Tolerencing- CAD – input/output devices – Topology – Geometric transformation – Perspective transformation – Data Structure– Geometric modeling for process planning –GT coding – The OPITZ system – The MICLASS System.	
Unit-3 Process Engineering and Process Planning	**9 hours**
Experience based planning – Decision table and Decision trees – Process capability analysis – Process planning – Variant process planning – Generative approach – Forward and backward planning, Input format, A1	
Unit-4 Computer Aided Process Planning Systems	**8 hours**
Logical Design of process planning – Implementation considerations- Manufacturing system components, Production Volume, No. of production families- CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.	
Unit-5 An Integrated Process Planning Systems	**6 hours**
Totally integrated process planning systems – An Overview – Modulus structure – Data structure –Operation – Report Generation, Expert process planning.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Advanced Computer Aided Design and Manufacturing Lab				
Course Code	MCDM6001				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		0	0	4	2

Course Objectives:

To provide students the necessary foundation for advanced understanding of both design and manufacturing problems in a systematic manner.

Course Outcomes

CO1	Gain practical experience in handling 2D drafting and 3D modeling software systems
CO2	Examine and handle design problems in a systematic manner
CO3	Develop the use of the concepts of G and M codes and manual part programming.
CO4	Apply the knowledge of CNC machines for machining simulation
CO5	Apply the knowledge of specialized softwares for modelling as well as analysis of machining operations

Reference Book (s)

1. CAD/CAM Lab Manual (Prepared by Staff)
2. Bathe K.J, (2007), Finite Element Procedures, Prentice-Hall of India Pvt. Ltd., third edition ISBN: 978-0-979-00490-2
3. Zienkiewicz O.C.(1979), The Finite Element Method, McGraw-Hill, ISBN- 978-0-750-66431-8
4. ANSYS Help manual
5. Hyper mesh Help manual
6. CATIA Help manual
7. Yorem Koren (1983), Computer Integrated Manufacturing Systems, McGraw Hill, ISBN- 978-0-891-16874-4
8. Ranky, Paul G.(1986), Computer Integrated Manufacturing, Prentice Hall International, ISBN- 978-0-131-65655-0
9. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen (1985.), Design rules for a CIM system, North Holland Amsterdam, ISBN- 978-0-444-87812-0
10. Pro-E Help manual
11. Master CAM Help manual

List of experiments

1. 3-D part modeling, assembling and drafting by using Pro-E/CATIA/Solid Works/ Unigraphics etc. of following components :
   - i. Piston Head
   - ii. Connecting rod
   - iii. Crank shaft
   - iv. Controller arm
2. By using Ansys/Nisa/Hyper-mesh/Solid-Works/CATIA software, perform the analysis of the above components by using 1D, 2D and 3D elements for:
   - i. Static analysis
   - ii. Modal analysis
   - iii. Harmonic analysis
   - iv. Buckling analysis

3. Write the part program for the following and simulate it by using Master-CAM/ Solid CAM/ Cimatron/ EXSL Win/ CNC Pro build/ CMAS simulator:
    i. Turning operation
        a. Centre turning
        b. Taper turning
        c. Threading
    ii. Milling operation
        a. Edge cutting
        c. Boring Pocketing

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
50	-	50	100

Name of The Course	**Dissertation-1**				
Course Code	**MCDM9998**				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	**T**	**P**	**C**
		0	**0**	**0**	**5**

Course Objectives:

1. To make literature survey for various recently emerging technologies.
2. To select any topic of interest and to review the related literature in detail.
3. To compare and analysis the various topologies for the selected topic of interest.
4. To give more emphasize to the one of best topology and to obtain a network model for it.
5. To analysis the simulation results of the particular topology obtained from various simulation tools.
6. To get realize the hardware implementation of the above topology for which we obtained simulations.

Course Outcomes

CO1	Analyze the relevance of knowledge obtained from literature for the research work taken up
CO2	Evaluate the recently advanced techniques.
CO3	Extract detailed information about the topic of interest
CO4	Plan an innovative work in the area of interest
CO5	Apply the different simulation tools applicable to the area of research

Text Book (s)

Depending upon the area of interest student may choose any text book of relevant field.

Reference Book (s)

As per the chosen area of research.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
50	Nil	50	100

Name of The Course	**Dissertation-II**				
Course Code	**MCDM9999**				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	**T**	**P**	**C**
		0	**0**	**0**	**15**

Course Objectives:

1. To make literature survey for various recently emerging technologies.
2. To select any topic of interest and to review the related literature in detail.
3. To compare and analysis the various topologies for the selected topic of interest.
4. To give more emphasize to the one of best topology and to obtain a network model for it.
5. To analysis the simulation results of the particular topology obtained from various simulation tools.
6. To get realize the hardware implementation of the above topology for which we obtained simulations.

Course Outcomes

CO1	Design a project relevant to the field of study
CO2	Demonstrate expertise in the selected area of research
CO3	Conduct an innovative work in the selected area of research
CO4	Apply the different simulation tools applicable to the area of research
CO5	Demonstrate a thorough understanding of the chosen topic of dissertation

Text Book (s)

Depending upon the area of interest student may choose any text book of relevant field.

Reference Book (s)

As per the chosen area of research.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
50	Nil	50	100

Name of The Course	Tool Engineering				
Course Code	MCDM5011				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		3	0	0	3

Course Objectives:

The main objective of the course is to give students the basic concepts of tool engineering. The student is guided to use these concepts in the design of jigs, fixtures and various types of dies used in production industry through assigned projects and factory visits.

Course Outcomes

CO1	Compare the materials used to make different types of tooling components including tool steels, low carbon steels, cast iron, aluminum, plastics and cutting tool materials.
CO2	Integrate CAD techniques into the design of production tooling to help understand the advantages and disadvantages for productive tool design.
CO3	Develop an understanding of the factors involved in the design of special production inspection gages, cutting tools for production machines and the selection of tool geometries for metal cutting methods
CO4	Develop an understanding of the principles involved in the design of jigs and fixtures concentrating on locating methods, clamping and use of drill bushings. Standard jig and fixture designs will be reviewed.
CO5	Develop an understanding of the principles used in the design and plastic injection mold tooling and Composite tooling. To include cavity layout, sprue and runner design, gate design, venting, cooling, and selection of tooling components

Text Book (s)

1.James A Szumera, The Metal stamping Process, Industrial Press Incorp. Donaldson of al 'Tool Engineering', Tata Mc-Graw Hill.

Reference Book (s)

1. Pollack, H.W. Tool Design, Reston Publishing Company, Inc.
2. Kempster, M.H.A. Principles of Jig and Tool Design, English University Press Ltd.
3. John G. Nee, Fundamentals of Tool Design Author - Society of Manufacturing Engineers
4. Handbook of Fixture Design (SME)", Society of Manufacturing Engineers,McGraw-Hill.
5. D.F. Eary and E.A. Red, "Techniques of Pressworking Sheet Metal", PrenticeHall.
6. "Tool Engineers Handbook, ASTME", McGraw-Hill.
7. R.G.W.Pye, Injection Mould Design, Long man scientific and technical ltd.

Course Content:

Unit-1	**10 hours**
Introduction and basic tool design principles .Broad Classification of Tools-Cutting tools, Dies, Holding and measuring tools, Tool manufacturing and Introduction to Computer aided die design applications.	
Unit-2	**8 hours**
Design of Cutting Tools: Single Point and multi-pint cutting tools; Single Point Cutting Tools: Classification, Nomenclature, geometry, design of single point tools for lathes, shapers, planers etc. Chip breakers and their	

design; Multipoint Cutting Tools: Classification and specification, nomenclature, Design of drills, milling cutters, broaches, taps etc.; Design of Form Tools: Flat and circular form tools, their design and application.
Unit-3 **6 hours**
Design of Dies for Bulk metal Deformation-Wire Drawing, Extrusion, Forging and Rolling; Design of Dies for Sheet metal: Blanking and Piercing, Bending and Deep-drawing; Design of Dies used for Casting and Moulding.
Unit-4 **5 hours**
Design of Jigs, Fixtures and Gauges: Classification of Jigs and Fixtures, Fundamental Principles of design of Jigs and Fixtures, Location and Clamping in Jigs and fixtures, Simple design for drilling Jigs, Milling fixtures etc. Indexing Jigs and fixtures.
Unit-5 **8 hours**
Design of Moulds: Mould making, General Mould Constructions, Intermediate Mould Design- Splits, Side core and side cavities, Moulding Internal undercuts, Runner less moulds, Aspects of practical mould design.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	**Advanced Computer Aided Manufacturing**				
Course Code	**MCDM5012**				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives:

Introduction to the use of computers in several extended areas of product design and manufacturing, including product data management in a sustaining engineering environment

Course Outcomes

CO1	Demonstrate a basic understanding of machining fundamentals such as tooling systems, and work-holding systems for CNC milling and turning equipment
CO2	Analyze the constructional features of CNC machines
CO3	Apply the numerical controlled (NC) programming strategies for manufacturing
CO4	Generate NC code using G-codes to machine parts to specifications.
CO5	Interpret the design of robot technology and their application in manufacturing

Text Book (s)

1. Mikell P. Groover (1997), CAD-CAM, Prentice hall of India,.ISBN- 978-8-177-58416-5
2. B.S. Pabla (2003), CNC machines, New age international publishers, ISBN- 978-8-122-40669-6
3. Koren Y (1986), Computer Control of Manufacturing systems, McGraw Hill,ISBN- 978-0-070-60743-9.
4. Petruzella F D (1989), Programmable Logic Controllers, McGraw Hill,ISBN- 978-0-071-06738-6.

Reference Book (s)

1. John W. (1980) Programmable Controllers - Principles and Applications - Merrill Publ.Co, New York, ISBN- 978-0-130-41672-8
2. Alan Overby (2010), CNC machining Handbook, McGraw Hill Professional, ISBN- 978-0-071-62302-5
3. Barry Leatham – Jones (1986), Introductions to Computer Numerical Control, Pitman, London - John willey & Sons,ISBN- 978-0-132-79497-8
4. Reinbold U, Blume C and Dilmann R (1985), Computer Integrated Mfg. Technology & Systems, Marcel Dekker, ISBN- 978-0-824-77403-5.

Course Content:

Unit-1 Introduction Introduction to CAM and automation 9 hours
Current trends in Manufacturing Engineering, the product cycle and CAD/CAM, automation and control, basic elements of an automated system, power to accomplish the automatic process, program of instructions, control system, advanced automation functions, safety monitoring, maintenance and repair diagnostics, error detection and recovery, levels of automation.
Unit-2 Fundamentals of CNC machines 12 hours
Basic Components of CNC system - Part programming, Machine control unit, Machine tool - Historical developments and their role in control of machine tools, Classification of NC / CNC systems - Based on type of Control (PTP\C\L), method of programming, Direct numerical control (DNC), adaptive control machining system
Unit-3 Constructional Features of CNC Machines 8 hours
Design considerations of CNC machines for improving machining accuracy-Structural members-Slide ways - Sides linear bearings - Ball screws - Spindle drives and feed drives - work holding devices and tool holding

devices -Automatic Tool changers. Feedback devices - Principles of Operation-Machining Centres - Tooling for CNC machines.
Unit-4 Programming for CNC Machines 9 hours
Numerical control codes - Standards - Manual Programming - Canned cycles and subroutines - Computer Assisted Programming, CAD / CAM approach to NC part programming - APT language, machining from 3D models
Unit-5 Robot Technology 6 hours
Introduction, robot physical configurations, Basic robot motion, technical features, programming the robot and languages, end effectors, robotic sensors, robot applications.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Performance Modelling and Analysis of Manufacturing Systems				
Course Code	MCDM5013				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
	L	T	P	C	
	3	0	0	3	

Course Objectives:

1. To learn the fundamental aspects of automated manufacturing system, simulation and computer control system.
2. To develop the ability to formulate and analyze problems which are encountered in manufacturing systems.

Course Outcomes

CO1	Value the importance of modelling and simulation in manufacturing
CO2	Apply the understanding of the behaviour of dynamic and stochastic queuing systems and discrete-event simulation concepts in modelling.
CO3	Model automated manufacturing system "intelligently" and come up with high fidelity models.
CO4	Develop the queuing models and Petri net models for solving manufacturing problems.
CO5	Produce codes for modelling and simulation based on the understanding of the course

Text Book (s) and Reference Book (s)

1. N. Viswanadham and Y. Narahari (1994), Performance Modeling of Automated Manufacturing Systems, Prentice hall of India, New Delhi, ISBN-
2. K.S. Trivedi (1982), Probability and Statics with Reliability, Queuing and Computer Science Applications, Prentice Hall, New Jersey, ISBN- 978-1-600-21518-6
3. S.C. Gupta and V.K. Kapoor (1988), Fundamentals Mathematical Statics", 3 rd Edition, Sulton chand and sons, New Delhi, ISBN- 978-8-170-14791-6

Course Content:

Unit-1 Manufacturing systems and simulation	**12 hours**
Modeling automated manufacturing systems- role of performance modeling-performance measures- performance modeling tools- Simulation models- Analytical models. Automated manufacturing systems- introduction product cycle-manufacturing automation- Economics of scale and scope. Manufacturing system- input-output model- plant configurations. Performance measures- manufacturing lead time- work in process-machine utilization throughput- capacity- flexibility- performability- quality. Computer control system- control system architecture- factory communications- local area networks- factory networks- open system interconnection model- net work to network interconnections- manufacturing automation protocol- data base management system.	
Unit-2 Manufacturing process	**9 hours**
Examples of Stochastic processes- Poison process, Discrete time Markov Chain models- Definitions and notation- Sojourn Times in States- Examples of DTMCs in manufacturing- Chapman-Kolmogorov equation- Steady state analysis. Continuous Time Markov chain models- Definition and notation-Sojourn times in states- Examples of CTMCs in manufacturing- Equation for CTMC evolution-Markov model of a transfer line- Birth and Death Process in manufacturing	
Unit-3 Queuing models	**6 hours**
Notation for queues- Examples of queues in manufacturing-Performance measures-the M/M/m queue-queues with general distributions- queues with breakdowns- Analysis of a flexible machining center.	
Unit-4 Queuing networks	**7 hours**

Examples of queuing network models in manufacturing- Little's Law in queuing networks- Open queuing network- closed queuing networks- Product form queuing networks.
Unit-5 PETRI NETS **6 hours**
Classical Petri nets- Stochastic Petri net- Generalized stochastic Petri nets modeling of KANBAN system- Manufacturing models.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Design for Manufacturing				
Course Code	MCDM5014				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		2	1	0	3

Course Objectives:

The course is aimed at developing students to acquire skills to analyze product design and be able to design products that are easier to manufacture, assemble, service and more friendlier to environment, etc.

Course Outcomes

CO1	Apply the general design principles for manufacturability (K4)
CO2	Produce customer-oriented, manufacturing and life-cycle sensitive approach to product design and development, with product design principles and structured design methodologies (K4)
CO3	Utilize the methods and approaches for developing, implementing, and nurturing an effective DFM process within the firm (K3)
CO4	Develop robust designs using design of experiments (K4)
CO5	Modify existing designs using design principles for specific considerations (K4)

Text Book (s)

1. Harry Peck (1983), Design for Manufacture, Pittman Publication, ISBN- 978-0-273-00008-2.

Reference Book (s)

1. Karl T. Ulrich, Ateven D. Eppinger (2003), Product Design and Development, Tata McGraw-Hill, ISBN- 978-0-070-58513-3.
2. James G. Bralla (1986), Hand Book of Product Design for Manufacturing, McGraw Hill co, ISBN-978-0-071-50178-1.
3. Jonathan C. Borg, Philip J. Farrugia, Kenneth P. Camilleri (1987), Knowledge based design for manufacture, Kogan Page Ltd, ISBN- 978-1-402-07732-6.
4. Boothroyd, G., (1994), Product Design for Manufacture and Assembly, Marcel Decker, ISBN- 978-1-420-08927-1.
5. Bralla, J.G., (1999), Design for Manufacturability Handbook, McGraw-Hill.ISBN- 978-0-070-07139-1.

Course Content:

Unit-1 Introduction	**8 hours**
General design principles for manufacturability – strength and mechanical factors, evaluation method, Process capability - Feature tolerances- Geometric tolerances-Assembly limits- Datum features- Tolerance stacks	
Unit-2 Factors influencing form Design	**10 hours**
Working principle, Material, Manufacture, Design – Possible solutions – Materials choice – Influence of materials on form design – form design of welded members, forgings and castings.	
Unit-3 Component Design – Machining Consider	**9 hours**
Design features to facilitate machining – drills - milling cutters – keyways – Doweling procedures, counter sunk screws – Reduction of machined area – simplification by separation – simplification by amalgamation – Design for Machinability –Design for accessibility – Design for assembly.	
Unit-4 Robust Design and Taguchi Method	**8 hours**

Robust design - Design of experiments – Robust design process- Orthogonal arrays: Two level orthogonal arrays, Three level orthogonal arrays, Combined inner and outer arrays.
Unit-5 Redesign for Manufacture and case studies **9 hours**
Design for economy, Identification of uneconomical design – Modifying the design –Computer Applications for DFMA – Case Studies.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Quality Management				
Course Code	MCDM5015				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
	L	T	P	C	
	2	1	0	3	

Course Objectives:

To provide student with the basic understanding of the approaches and techniques to assess and improve process and or product quality and reliability.

Course Outcomes

CO1	Demonstrate a good knowledge of quality management principles
CO2	Correlate the Total Quality Management principles and models
CO3	Apply the problem solving tools and techniques to solve real life problems
CO4	Apply the Quality Management techniques
CO5	Propose quality standards for manufacturing

Text Book (s)

1. DaleH. Beterfield et al (2001), Total Quality Management, Pearson Education Asia, ISBN- 978-8-131-73227-4.

Reference Book (s)

1. John Bank J.E. (1993), *Total Quality Management*, Prentice Hall, India, ISBN- 978-0-132-84902-9.
2. Samuel K.Ho (2002), *TQM- AN Integrated approach*, Kogan Page India Pvt. Ltd, ISBN- 978-0-749-41561-7.
3. Jill A.Swift, Joel E. Ross and Vincent K. Omachonn (1998) *Principles of Total Quality*, St.Lucie Press, US, 1998. ISBN- 978-1-574-44094-2.

Course Content:

Unit-1 Introduction to Quality Management	**6 hours**
Business scene in India and world over – quality imperatives – Efficiency & Effectiveness – Definition of Quality – Vision, Mission statement – formulation – Quality policy – Customer orientation – Quality culture and mind set – Qulaity philosophies of Deming, Crosby, Miller Comparison.	
Unit-2 Total Quality Management	**6 hours**
TQM principles – Customer satisfaction model – Customer retention model – QFD – Customer satisfaction measurement – Evolution of TQM – System & Human components – TQM models – Deming wheel principle – Top management commitment.	
Unit-3 Problem Solving Tools	**12 hours**
Old & QC Tools – Seven new management tools – Problem solving techniques – Case studies – Problems – Continuous improvement tools – Benchmarking, Quality circle.	
Unit-4 QM Techniques	**10 hours**
FMEA, BPR, JIT, KANBAN – Reliability studies – Failure rate analysis – Reliability models.	
Unit-5 Quality System Implementation	**5 hours**

ISO Certification – ISO 9000 – ISO 14000 – Principles & Methodologies, Six Sigma, Taguchi, 5S concepts, Legal aspects, TQM road map, Strategies – case studies.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	**Reliability Engineering**				
Course Code	**MCDM5016**				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives:

1. To equip the students to analyze reliability data.
2. To introduce the concepts of reliability and useful life availability of products.
3. To impart knowledge on maintainability and availability analyses of products.

Course Outcomes

CO1	Value the concept of reliability of products
CO2	Analyse the reliability through various data analysis techniques
CO3	Predict the reliability using different approaches and models
CO4	Test the reliability and monitor its growth for a given system
CO5	Assess the risk using analysis techniques

Text Book (s) and Reference Book (s)

1. Mohammad Modarres, Mark Kaminskiy, Vasiliy Krivtsov (1999), Reliability Engineering and Risk Analysis: A Practical Guide, CRC Press, ISBN-978-1-420-04705-9
2. John Davidson (1988), The Reliability of Mechanical system, Institution of Mechanical Engineers, London, ISBN-978-0-852-98881-7.
3. Charles E. Ebeling(2004), Introduction to Reliability in Design, McGraw Hill, London, 978-0-070-42138-7.

Course Content:

Unit-1 Reliability Concept	**6 hours**
Reliability function - failure rate - Mean Time Between Failures (MTBF) - Mean Time to Failure (MTTF) - a priori and a posteriori concept - mortality curve - useful life availability - maintainability - system effectiveness.	
Unit-2 Reliability Data Analysis	**6 hours**
Time-to-failure distributions - Exponential, normal, Gamma, Weibull, ranking of data - probability plotting techniques - Hazard plotting.	
Unit-3 Reliability Prediction Models	**12 hours**
Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.	
Unit-4 Reliability Management	**10 hours**
Reliability testing - Reliability growth monitoring - Non parametric methods - Reliability and life cycle costs - Reliability allocation - Replacement model.	
Unit-5 Risk Assessment	**5 hours**
Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Metrology and Non Destructive Testing				
Course Code	MCDM5017				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		3	0	0	3

Course Objectives:

1. Impart the knowledge of quality assurance and inspection techniques.
2. Familiarize with the various inspection and measurement techniques like contact and non-contact measurement by adapting Computer Aided Inspection.
3. Impart the knowledge of working principles and calibration of various Systems.

Course Outcomes

CO1	Apply the knowledge in CMM and Image Processing
CO2	Apply the concept of Laser Metrology and Computer Integrated Quality Assurance
CO3	Apply the knowledge of magnetic particle testing
CO4	Apply the knowledge of ultrasonic and Acoustic emission techniques.
CO5	Apply the knowledge to solve real life problems

Text Book (s)

1. JAIN.R.K. (1997), Engineering Metrology, Khanna Publishers, ISBN- 978-8-174-09153-6.

Reference Book (s)

1. Barry Hull and Vernon John (1988), Non Destructive Testing, Mac Millan, ISBN- 978-0-333-35788-0.
2. *American Society for Metals, Metals Hand Book*, Vol. II, 1976.
3. Progress in Acoustic Emission, Proceedings of 10th International Acoustic Emission Symposium, Japanese society for NDI, 1990.

Course Content:

Unit-1 Measuring Machines	**6 hours**
Tool Makers's microscope – Co-ordinate measuring machines – Universal measuring machine- Laser viewers for production profile checks – Image shearing microscope – Use of computers – Machine vision technology- Microprocessors in metrology.	
Unit-2 Statistical Quality Control	**6 hours**
Data presentation – Statistical measures and tools – Process capability – Confidence and tolerance limits – Control charts for variables and for fraction defectives – Theory of probability – Sampling –ABC standard – Reliability and life testing.	
Unit-3 Liquid Penetrant and Magnetic Particle Tests	**12 hours**
Characteristics of liquid penetrants – different washable systems – Developers – applications- Methods of production of magnetic fields- Principles of operation of magnetic particle test- Applications- Advantages and Limitations.	
Unit-4 Radiography	**10 hours**
Sources of ray X-ray production-properties of d and x rays – film characteristics – exposure charts – contrasts – operational characteristics of x ray equipment – applications.	

Unit-5 Ultrasonic and Acoustic Emission Techniques	**5 hours**
Production of ultrasonic waves – different types of waves - general characteristics of waves – pulse echo method – A, B, C scans – Principles of acoustic emission techniques – Advantages and limitations - Instrumentation – Applications.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Design and Analysis of Experiments				
Course Code	MCDM5018				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
	L	T	P	C	
	3	0	0	3	

Course Objectives:

The objective of this course is to introduce experimental design techniques and familiarize with all of the best design techniques and study the objectives, similarities, differences, advantages, and disadvantages of each.

Course Outcomes

CO1	Develop Full and Fraction Factorial Experiment Design.
CO2	Test a design using ANOVA and Hypothesis testing.
CO3	Apply Loss function approach to Quality Control.
CO4	Setup and analyse Robust Design.
CO5	Apply orthogonal arrays for design and conduct of experiments

Text Book (s) and Reference Book (s)

1. Philip J. Rose, "Taguchi Techniques for Quality Engineering", Prentice Hall, 1989.
2. Montgomery, D.C., "Design and Analysis of Experiments", John Wiley and Sons, 1997.
3. Nicolo Belavendram, "Quality by Design: Taguchi Techniques for Industrial Experimentation", Prentice Hall, 1995.

Course Content:

Unit-1 Introduction	**8 hours**
Basic principle of DOEs, Guide lines for Designing Experiments, Terminology, ANOVA, Computation of sum of squares and Basics of quality by design	
Unit-2 Single Factor Experiments	**6 hours**
Randomized complete block design, Latin square design, Graeco-Latin square design, Incomplete block design and Tests on means.	
Unit-3 Factorial Design	**9 hours**
Two-Factor factorial design, General factorial design, 2k Factorial design, 3k Factorial design, confounding, Fractional replication and Factors with mixed levels.	
Unit-4 Robust Design Process	**6 hours**
Comparison of classical and Taguchi's approach, variability due to noise factors, principle or robustization, classification of quality characteristics and parameters, objective functions in robust design, S/N ratios.	
Unit-5 Orthogonal Experiments	**8 hours**
Selection and application of orthogonal arrays for design, Conduct of experiments, collection of data and analysis of simple experiments, Modifying orthogonal arrays, Inner and outer OA experiments, Optimization using S/N ratios, attribute data analysis, a critique of robust design.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	**Research Methodology**				
Course Code	**MCDM5019**				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

The course is aimed at understanding of the following

1. To gain familiarity with the presents status of the research.
2. To measure the frequency of occurrences of various parameters/indicators.
3. To reveal the trend and tendencies in the research, i.e., to assess the development or extension potential of the research.
4. To test the significance and validity and reliability of the results.

Course Outcomes

CO1	Evaluate a research problem using the literature survey with systematic methods
CO2	Apply data collection and sampling techniques for a given research problem
CO3	Analyse the collected and sampled data applying statistical methods
CO4	Apply non-traditional algorithms for optimization of a proposed solution
CO5	Create valid research reports

Text Book (s) and Reference Book (s)

1. Beri, (2005), Statistics for Management 3E. Tata McGraw-Hill Education, ISBN- 978-0-070-08323-3.
2. Donald R. Cooper, Pamela S. Schindler (2011.), Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., ISBN- 978-0-071-28922-1.
3. U.K. Srivastava, G.V. Shenoy and S.C. Sharma(2005), Quantitative Techniques for managerial decisions, New Age International, Mumbai, ISBN- 978-8-122-40189-9.
4. William G. Zikmund (2006), Business Research Methods, Thomson,ISBN- 978-1-285-40118-8
5. D.M.Pestonjee,(2005) (Ed.) Second Handbook of Psychological and Social Instruments, Concept Publishing, New Delhi,ISBN- 978-8-170-22652-9.

Course Content:

Unit-1 Introduction **8 hours**
Definition of Research, Qualities of Researcher, Components of Research Problem, Various Steps in Scientific Research, Types of Research; Hypotheses Research Purposes - Research Design - Survey Research - Case Study Research.
Unit-2 Data Collection **8 hours**
Sources of Data: Primary Data, Secondary Data; Procedure Questionnaire - Sampling Merits and Demerits - Experiments - Kinds - Procedure; Control Observation - Merits - Demerits - Kinds - Procedure - Sampling Errors - Type-I Error - Type-II Error.
Unit-3 Statistical Analysis **10 hours**
Introduction to Statistics - Probability Theories - Conditional Probability, Poisson Distribution, Binomial Distribution and Properties of Normal Distributions, Point and Interval Estimates of Means and Proportions; Hypothesis Tests, One Sample Test - Two Sample Tests / Chi-Square Test, Association of Attributes - t-Test - Standard deviation - Co-efficient of variations - Index Number, Time Series Analysis, Decision Tree; ANOVA, Cluster Analysis.

Unit-4 Genetic Algorithms	**8 hours**
Working principle-Genetic operators-Simulated Annealing - Neural network based optimization-Optimization of fuzzy systems-fuzzy set theory-computational procedure	
Unit-5 Research Reports	**6 hours**
Structure and Components of Research Report, Types of Report, Good Research Report, Pictures and Graphs, Introduction to SPSS.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Optimization Methods				
Course Code	MCDM5020				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
	L	T	P	C	
	2	1	0	3	

Course Objectives:

1. To understand the role of optimization in Engineering design and its importance
2. To introduce the different optimization algorithm in linear programming and non-linear programming

Course Outcomes

CO1	Formulate the design problem in mathematical form which can be solved by suitable optimization algorithm (K3)
CO2	Apply optimization techniques, linear as well as non-linear, for solving constrained as well as unconstrained design problems.(K4)
CO3	Employ the advanced non-linear optimization techniques to solve complex optimization problems (K3)
CO4	Compare the efficiency of different algorithms and employ the most efficient for a given set of problems (K2)
CO5	Apply the techniques to produce optimum designs in engineering (K4)

Text Book (s)

1. Rao, S.S. (1978), *Optimization - Theory and Applications*, Wiley Eastern, New Delhi, ISBN- 978-0-852-26756-1.

Reference Book (s)

1. Wilde, D.J. (1964), *Optimization seeking Methods*, Prentice – Hall, Englewood Cliffs, New Jersey.
2. Johnson, Ray C., *Optimum Design of Mechanical Elements*, 2nd Ed., John Wiley & Sons, Ic., New York, 1980. ISBN-978-0-471-03894-8.
3. Kalyanmoy Deb (1996), *Optimization for Engineering Design-Algorithms and Examples*, Prentice-Hall of India, 1996. ISBN- 978-8120309432

Course Content:

Unit-1 Linear Optimization	**7 hours**
Optimization problem statement – classification - single variable - multivariable unconstrained – equality constrained and inequality constrained. Simplex methods – dual simplex method – bounded variable technique for linear programming problems. Integer Programming & Dynamic Programming; Gomary's cutting plane method - branch and bound method – Bellman's principle of optimality-inventory, capital budgeting, reliability problems and simplex problem.	
Unit-2 Unconstrained Non-linear Optimization	**6 hours**
Unimodal function – Region elimination methods: Unrestricted, Dichotomous, Fibonacci, Golden Section, Bi-section - Direct search methods: Random, Univariate, Pattern search methods – Descent methods: Steepest descent, Conjugate gradient and Variable metric.	
Unit-3 Constrained Non-linear Optimization	**9 hours**

Characteristics of a constrained optimization problem - Direct methods: Cutting plane method, methods of feasible directions – Indirect methods: Interior and exterior penalty function methods – Geometric programming – Solution from differential calculus point of view – Solution from arithmetic-geometric inequality point of view.
Unit-4 Advanced Non-linear Optimization 8 hours
Genetic Algorithms -Working principle-Genetic operators-Numerical problem-Simulated Annealing - Numerical problem - Neural network based optimization-Optimization of fuzzy systems-fuzzy set theory computational procedure.
Unit-5 Optimization Design of Machine Elements 12 hours
Functional requirements- desirable and undesirable effects – functional requirements and material and geometrical parameters – adequate designs, Optimum design – primary design equation, subsidiary design equations, limit equations – basic procedural steps for methods of optimum design – constrained parameters and free variables – normal, redundant and incompatible specifications general planning.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100