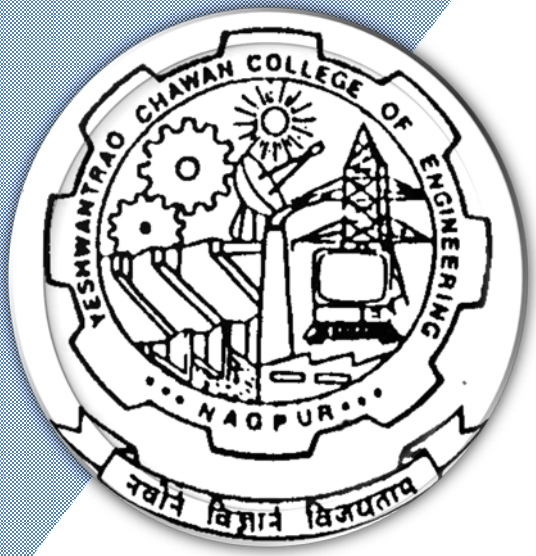
Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110



SoE & Syllabus 2019

M.Tech. CAD/CAM

28 June 2019

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M. TECH. SCHEME OF EXAMINATION 2019

CAD / CAM

SN	Sem	Sub Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
					L	T	P	Hrs		MSEs*	TA	ESE	
I SEMESTER													
1	1	ME3901	Stress Analysis	T	3	0	0	3	3	30	10	60	3
2	1	ME3902	Computer Integrated Manufacturing	T	3	0	0	3	3	30	10	60	3
3	**1**		**Professional Elective- I**	**T**	3	0	0	3	3	30	10	60	3
4	1	ME3907	Computer Graphics and Solid Modeling	T	3	0	0	3	3	30	10	60	3
5	1	ME3908	**Lab:** Computer Graphics and Solid Modeling	P	0	0	2	2	1		40	60	
6	1	ME3909	CNC Technologies	T	3	0	0	3	3	30	10	60	3
7	1	ME3910	**Lab:** CNC Technologies	P	0	0	2	2	1		40	60	
8	1	ME3911	Product Design & Development	T	3	0	0	3	3	30	10	60	3
Total					**18**	**0**	**4**	**22**	**20**				

List of Professional Electives-I

1	ME3903	PE I: Project Engineering
1	ME3904	PE I: Tool Design
1	ME3905	PE I: Object Oriented Programmings
1	ME3906	PE I: Reliability Engineering

II SEMESTER

1	2	ME3915	Robotics	T	3	0	0	3	3	30	10	60	3
2	2	ME3916	Modelling & Simulation	T	3	0	0	3	3	30	10	60	3
3	2	ME3917	Finite Element Method	T	3	0	0	3	3	30	10	60	3
4	2	ME3918	**Lab:** Finite Element Method	P	0	0	2	2	1		40	60	
5	2	ME3919	Artificial Intelligence	T	3	0	0	3	3	30	10	60	3
6	**2**		**Professional Elective-II**	**T**	3	0	0	3	3	30	10	60	3
7	**2**		**Professional Elective - III**	**T**	3	0	0	3	3	30	10	60	3
8	2	ME3928	Seminar	P	0	0	2	2	1		100		
Total					**18**	**0**	**4**	**22**	**20**				

List of Professional Electives-II

2	ME3920	PE II: Product Data Management
2	ME3921	PE II: Mechatronics
2	ME3922	PE II: Machine Tool Design
2	ME3923	PE II: Plant Design

List of Professional Electives-III

2	ME3924	PE III: Computational Fluid Dynamics
2	ME3925	PE III: Design Optimization Techniques
2	ME3926	PE III: Rapid Prototyping
2	ME3927	PE III: Design for Manufacturing and Assembly

III SEMESTER

1	3	ME3939	Project Phase -I	P	0	0	16	16	8		100		
Total					**0**	**0**	**16**	**16**	**8**				

IV SEMESTER

1	4	ME3940	Project Phase-II	P	0	0	24	24	12		40	60	
Total					**0**	**0**	**24**	**24**	**12**				
Grand Total of Credits									**60**				

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

		June 2019	**1.00**
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for Sem 1 & 2 AY 2019-20 & Sem 3 & 4 AY 2020-21 Onwards

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Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M. Tech. Scheme of Examination & Syllabus 2019

CAD/CAM

I Semester

ME3901	**Stress Analysis**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Objectives:

- To develop the student understands of the foundations of stress and strain.
- To develop students skills in analyzing two dimensional problems.
- To provide the student with knowledge stress & strain analysis

Unit-I

Two Dimensional Problems in. Cartesian Coordinate system -Fundamentals of stress & strain, stress-strain relationship, Elastic constant, plane stress, plane strain., differential equation of equilibrium Boundary conditions, Saint Venant's principle, compatibility equation, Airys stress function. Stress analysis of cantilever subjected to concentrated load at its end and simply supported beam subjected to uniformly distributed load.

[7hrs]

Unit-II

Two dimensional problem in polar coordinate systems -General equations of equilibrium in polar coordinate compatibility equation, stress distribution about symmetric. axis, stress analysis of cylinder subjected to internal & external pressure, Pure bending of curved beams, effect of hole on the stress distribution in plates, Stress analysis of rotating circular disk

[7hrs]

Unit-III

Two Dimensional Photoelasticity - Introduction to basic optics related to photo elasticity, stress optic law, plane & circular polariscope arrangements, effect of stressed model in plane & circular polariscope, Isoclinic & Isochromatics, stress trajectories, calibration of photo elastic material (determination of fringe constant). Various photoelastic materials and their properties, Casting of photoelastic models, Tardy's compensation technique, Separation techniques like, shear difference, oblique incidence & electrical analogy.

[8hrs]

Unit-IV

Introduction to 3-D photo elasticity -Phenomenon of Stress freezing, Method of stress freezing, slicing techniques, determination of material fringe constant at critical temperature. Scaling Model- Prototype relations. Birefringerent coating method - Reflection polariscope. Introduction to fringe sharpening & fringe multiplication.

[8hrs]

Unit V

Strain gage technique for stress & strain analysis -Introduction to electrical resistance strain gages, gage . factor, bridge circuit, bridge balance, output voltage of Wheatstone bridge, balancing of bridge, temperature compensation, various bridge configurations, bonding of strain gages to the specimen, determination of principle strains & stresses using strain rosettes. Environmental effects on performance of strain gages, Strain gages response to dynamic strains, Effect of lead wires. Introduction to Strain measurement on rotating components, Static & Dynamic Strain Measurement introduction to semiconductor gages, high temperature strain gages & self-temperature compensated gages. Introduction to Commercial strain indicators.

[8hrs]

Unit VI

Grid technique of strain analysis, Brittle coating method for stress & strain analysis, Moire fringe method for stress & strain analysis implementation, ACIS & DXF.

[7 hrs]

Suggested books:

1) Theory of Elasticity -S.P. Timoshenko
2) Experimental Stress Analysis -Dally & Riley
3) Experimental Stress Analysis -T.K. Ray
4) Experimental Stress Analysis -L.S. Srinath
5) Cook and Young, "Advanced Mechanics of Materials", Prentice Hall, 2nd edition (August 28, 1998).
6) Richard G Budynar, "Advanced strength and Applied stress analysis", McGraw Hill.
7) Boresi/Schmidt/Sidebottom, "Advanced Mechanics of Materials", Willey.
8) Timoshenko and Goodier, "Theory of elasticity", McGraw Hill, 1970.
9) Timoshenko, "Advance Strength of Materials", vol 1 & 2, CBS.
10) Den Hartog, "Advance Strength of Materials" McGrawHill, 1952.
11) Advanced strength of material – Timoshenko.
12) Photoelasticity vol I & II – M. M. Frocht.

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I Semester

ME3902	**Computer Integrated Manufacturing**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Objectives:

- To develop in the engineering students the ability to analyze any engineering problem related to CIM, introduction of Group Technology, Material handling systems and integrated process planning system and its components

UNIT 1 Concept and scope of CIM, components of CIM, benefits, limitations, selection criteria for CIM. **[7hrs]**

UNIT 2 Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT .cellular manufacturing system. **[7 hrs]**
Part families , classification and coding , Production flow analysis , Machine cell design , Benefits.

UNIT 3 Introduction & Components of FMS , Application work stations , Computer control and functions , selection criteria for FMS,Planning, scheduling and control of FMS , Scheduling , Knowledge based scheduling , Hierarchy of computer control , Supervisory computer Manufacturing data systems , data flow , CAD/CAM considerations , Planning FMS database, case studies on practical applications. **[8 hrs]**

UNIT 4 Automated material handling systems, AS/RS, general considerations , selection, evaluation and control . Inspection and Quality control, CAQC ,CMM types, working, applications. **[8 hrs]**

UNIT 5 Process Planning in the Manufacturing cycle , Process Planning and Production Planning Process Planning and Concurrent Engineering, CAPP, Variant process planning , Generative approach , Forward and Backward planning, Input format, **[8 hrs]**
Logical Design of a Process Planning , Implementation considerations ,manufacturing system components,

UNIT 6 Totally integrated process planning systems , An Overview , Modulus structure , Data Structure, operation , Report Generation, Expert process planning. **[7 hrs/]**
Agile manufacturing ,Introduction to ERP concept(SAP).

Books for Reference:

1. Nanua Singh,"Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, 1996.
2. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice-Hall of India Pvt. Ltd., New Delhi, 2002
3. Jha, N.K., "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 1991.
4. Burbidge, J.L. "Group Technology in Engineering Industry", Mechanical Engineering pub. London, 1979.
5. Askin, R.G. and Vakharia, A.J., "G.T Planning and Operation, in The automated factory-HandBook: Technology and Management", Cleland, D.I. and Bidananda, B (Eds), TAB Books, NY, 1991.
6. Irani, S.A. "Cellular Manufacturing Systems", Hand Book.
7. Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), " Planning, design and analysis of cellular manufacturing systems" , Elsevier, 1995.
8. Gideon Halevi and Roland D. Weill, " Principles of Process Planning", A logical approach, Chapman & Hall, 1995.
9. Parashar BSN," Cellular Manufacturing" (PHI).
10. R.V.Rao, "Decision making in manufacturing".

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I Semester

ME3903	**PE I: Project Engineering**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Objectives:

To understand the project identification, planning and execution techniques. To learn the designing and erection of steel structure. To plant layouts, cost estimations, material handling and design and selection of pumps, blocks, compressors, etc.

Unit 1 INTRODUCTION **[7 hrs]**
The nature of projects. Project Identification considering objectives and SWOT analysis, Screening of Project Ideas, Technical, Market, Financial, Socioeconomic and Ecological Appraisal of a project.

Unit 2 PROJECT PLANNING **[7 hrs]**
Basic Scheduling, Critical Path. Scheduling under probabilistic durations, Time Cost tradeoffs, Project Monitoring with PERT/Cost, Organizational aspects, Computer packages and Project Completion

Unit 3 DESIGN OF STEEL STRUCTURE **[8 hrs]**
Introduction to stability and buckling concepts; Structural steel and properties; Riveted, bolted and welded connections; Working stress and plastic design Methods.

Unit 4 DESIGN OF STEEL STRUCTURE **[8 hrs]**
Design of tension, compression and flexural members (including built-up members); Column bases; Roof trusses Specification and design of simple structural members;

Unit 5 PLANT DESIGN **[8hrs]**
Plant layout, Flow sheeting, Auxiliaries, Cost estimation, Selection and detailed design of equipments e.g Pumps, Blowers and compressors ,Mixers, etc.;

Unit 6 MATERIAL HANDLING SYSTEM DESIGN **[7 hrs]**

Materials handling equipments, offsite facilities, Selection and detailed design of equipments e.g Conveyors etc.

Reference Books:

- **Prasanna Chandra- Project Management**
- **Couper, Penny, Roy-Chemical Process Equipment (Selection and Design)**
- **Iger karasik- Pump Handbook**

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I Semester

EL3904	**PE I: Tool Design**	L= 3	T = 0	P = 4	Credits = 2

Evaluation Scheme	TA	ESE	Total	ESE Duration
	40	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

To learn the mechanism of metal cutting and the design of metal cutting tools. Also to understand various presses working operations along with tools to dies design with the help of computer software.

Unit 1 **[8 Hrs]**

Theory of metal Cutting. Cutting tool materials, dynamics of metal cutting, Single point cutting tool, Merchant's Theory, Cutting power, Energy consideration in metal cutting, Tool life and dynamometry, Tool life criteria, variable affecting tool life, Machinability.

Unit 2 **[8 Hrs]**

Design of single Point Cutting Tool .Form tools- design of form tools. Design of milling cutters. Design of Gauges, Materials, heat treatments, Taylor's Principals of gauge design, design of limit gauges. Design of broaching and reamers.

Unit 3 **[10 Hrs]**

Press tool Design

Introduction, Press operations - Press working equipment - Classification, Rating of a press, Press tool Equipment, working of dies and their components.

Unit 4 **[10 Hrs]**

Bending Forming & Drawing dies Bending methods, Design Principles, Design consideration.

Unit 5 **[7 Hrs]**

Forging Die Design .Die design for machine forging Tools for flash trimming & hole piercing, materials & manufacture of forging dies. Mould Design.

Unit 6 **[10 Hrs]**

Design of jigs & fixture: - Introduction, locating & clamping - principle of location, principle of pin location, locating devices, radial or angular location, V - location, bush location. Design principle for location purpose, principle for clamping purposes, clamping devices, design principles common to jigs & fixtures. Drilling Jigs: - Design principles, drill bushes, design principles for drill bushings, Types of drilling jigs - Template jig, plate type jig, open type jig, swinging leaf jig, Box type jig, channel type jig . Jig feet. Milling Fixtures: - Essential features of a milling fixtures, milling machine vice, Design principles for milling fixtures, Indexing jig & fixtures, Automatic clamping Devices.

Books for reference:

1. Donaldson, –Tool design‖
2. ASTME, -Fundamentals of Tool design‖
3. Pollock, –Fundamentals of Tool design‖
4. Grant, —Unconventional Clamping Systems‖
5. Kempster, –Fundamentals of Tool design‖

I Semester

EL3905	**PE I: Object Oriented Programmings**	L= 3	T = 0	P = 4	Credits = 2

Evaluation Scheme	TA	ESE	Total	ESE Duration
	40	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

This engineering course focuses on detail study of various data structures used in computer environment. Also learning the concept of OOPs and programming for data structures using OOPs

UNIT1 Review of basic Concepts of OOPs, objects, classes, polymorphism, inheritance, application in CAD/CAM codes **[7 hrs]**

UNIT 2 Introduction to data structures, abstract data types, array as an adt, using one-dimensional arrays, arrays as parameters, character string operations, multi-dimensional arrays, structures and classes. **[8 hrs]**

UNIT 3 Stack and its Application, Definition and Examples, Primitive Operations, Recursion, Fibonacci sequence, Binary Search, Recursive Chains, Recursive Definition of Algebraic Expressions **[8 hrs]**

UNIT 4 Queues and Lists, the queues representation insert operation, priority queue, array implementation of a priority queue, linked lists, inserting and removing nodes from a list, linked implementation of stacks, linked implementation of queues, linked list as a data structure, non integer and non homogeneous lists, dynamic and array implementation of lists, simulation using linked lists simulation process, data structures, other list structures, circular lists, doubly linked lists , multiple linked lists **[7 hrs]**

UNIT 5 Trees, Binary Trees Operations, Applications Representations of Binary Tree. Internal and External Nodes, Implicit Array Representation of Binary Trees, Choosing a Binary Tree Representation, Binary Tree Traversals, Heterogeneous Binary Trees, **[7 hrs]**

UNIT 6 Sorting, Efficiency Considerations, O Notation, Efficiency of Sorting, Exchange Sorts, Bubble sort, Quick sort, Selection and Tree Sorting, Straight Selection Sort, Binary Tree sorts, Heap sort, Insertion Sorts, Simple Insertion, Shell Sort,
searching, basic search techniques, algorithmic notation, sequential searching, reordering a list searching an ordered table, indexed sequential search, binary search, interpolation search, tree searching, inserting/deleting in a binary search tree **[7 hrs]**

Books for Reference:

1. Langsam Y., Augenstein M. J. And Tenenbaum A. M., "Data Structures Using C and C++", Prentice Hall of India Pvt. Ltd.
2. Trembly J. P. And Sorenson P. G., "An Introduction to Data Structures with Applications", Tata McGraw Hill Pub. Co. Ltd.
3. Horowitz E. And Sahani S., "Fundamentals of Computer Algorithms", Galgotia Publications Ltd.

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I Semester

EL3906	**PE I: Reliability Engineering**	L= 3	T = 0	P = 4	Credits = 2

Evaluation Scheme	TA	ESE	Total	ESE Duration
	40	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit 1: **[8 Hrs]**
Introduction to reliability- Reliability definition, Failure rate, hazard rate, Reliability function and their variation with respect to time, MTTF and its calculations for discrete data. Reliability analysis and its relation with other parameters like strength etc.

Unit 2: **[8 Hrs]**
Reliability analysis for continuous data. Probability density function, failure rate and derivation of Reliability for various types of failures like constant failure rate, logarithmic failure rate in increasing/ decreasing failure rate etc. and there physical significance

Unit 3: **[7 Hrs]**
System Reliability series parallel and mixed configuration, system Reliability for complex systems using various tech. like successful path method, composite method etc. Redundancy, various types, parallel operations.

Unit4: **[8 Hrs]**
Reliability allocation and improvement, life cycle estimation, fault tree analysis, FMEA, FMECA etc,

Unit 5: **[7 Hrs]**
Reliability testing, accelerated life testing, sequential testing.

Unit 6: **[7 Hrs]**
Reliability availability, maintainability, maintainability improvement, Reliability economics.

Suggested Books:-
1. Introduction to Reliability Engineering by E.E.lewis and John wiley and sons
2. Reliability Engineering by L.S. Srinath
3. Reliability and engineering systems by L. Ryabinir
4. Practical Reliability Engineering by Patric Dtoconnor

II Semester

ME3907	Computer Graphics and Solid Modeling	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

UNIT-I: CAD TOOLS

Definition of CAD Tools, Types of system CAD/CAM system evaluation Criteria, functional areas of CAD, Modeling and viewing, efficient use of CAD software.

Wire frame modeling -Types of mathematical representation of curves, wire frame models, wire frame entities, parametric representation of analytical and synthetic curves – Hermite cubic splines, Bezier curves, B-Splines, rational curves-NURBS.

[8hrs]

UNIT-II: SURFACE MODELING

Mathematical representation of surfaces, Surface model, Surface entities, surface representation, parametric representation of surfaces, plane surface, ruled surface, surface of revolution, Tabulated surface.

[7hrs]

UNIT-III: PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES

Hermite Bicubic surface, Bezier surface, B-Spline surface, COONs surface, Blending surface, Sculptured surface, Surface manipulation - Displaying, Segmentation, Trimming, Intersection, Transformations - 2D and 3D, Orthogonal and Perspective transformations.

[9hrs]

UNIT-IV: SOLID MODELLING

Solid Representation - Boundary Representation (B-rep), Constructive Solid Geometry (CSG) and other methods, Design Applications: Introduction to Feature based and Assembly modelling.

[7hrs]

UNIT V:ADVANCED MODELING CONCEPTS

Feature Based Modeling, Assembly Modeling, Behavioral Modeling, Conceptual Design & Top-down Design. Techniques for visual realism – hidden line – Surface removal – Algorithms for shading and Rendering. Parametric and variational modeling, Feature recognition, Design by features, Assembly and Tolerance Modeling, Tolerance representation – specification, analysis and synthesis, AI in Design.

[8hrs]

UNIT VI: CAD/CAM DATA EXCHANGE

Evaluation of data- exchange formats, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

[6 hrs]

Text books:

1	CAD/CAM, Theory & Practice	1st Edition (1991)	Ibrahim Zeid	McGraw-Hill
2	Procedural elements for computer Graphics	1st Edition (1998)	D Rogers	WCB/McGraw-Hill
3	Introduction to Finite Elements in Engineering	2nd Edition (2002)	Chandrupatla&Belegundu A.D	Prentice Hall
4	Optimization for Engineering Design	1st Edition (2005)	Kalyanmoy Deb	Prentice Hall
5	P. N. Rao,	-	CAD/CAM	McGraw Hill
6	Martenson, E. Micheal	1995	Geometric Modelling	John Wiley & Sons
7	P. Radhakrishnan, S. Subramanyam		CAD/CAM/CIM	New Age International

Reference books:

1	Computer Graphics	McGraw-Hill	Hearn D. & Baker M.P	Prentice Hall
2	Computer Graphics	2nd Edition (1987)	S. Harrington	Mcgraw-hill Professional
3	Mathematical Elements for Computer Graphics	1st Edition (1990)	RoggersDravid F., Adams J. Alan	McGraw-Hill
4	Theory & Problems of Computer Graphics	1st Edition (1986)	Roy A. Plastock, Gordon Kalley	McGraw-Hill
5	V. Ramamurti	1992	Computer Aided Mechanical Design and Analysis	Tata Mc Graw Hill

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I Semester

EL3904	**Lab : Computer Graphics and Solid Modeling**	L= 3	T = 0	P = 4	Credits = 2

Evaluation Scheme	TA	ESE	Total	ESE Duration
	40	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Objective: To study/ perform the practical based on syllabus Advanced power electronics Laboratory
The list of practical will be according to the syllabi of Advanced power Electronics

1. Study of SCR as a switch
2. Characteristic of MOSFET
3. Characteristic of IGBT
4. Study of series inverter
5. Study of series inverter as resonant inverter
6. Study of MOSFET based inverter
7. Study of buck-boost chopper
8. Simulation of SPWM
9. Simulation of 4-leg inverter
10. Study of 3-phase inverter
11. Study of v/f control of induction motor

I Semester

ME3909	**CNC Technologies**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

To understand the need and process of automation in industry. Study the Computer Numerically Controlled machines their components, functions, functions, programming and applications and integration of machines with the computers , PLC , machine control through computers, data acquisition.

UNIT 1 **Introduction** to Numerical control. Development of NC system. Concepts of NC, CNC, DNC. Classification of CNC machines, Machine configurations, Advantagges and limitations. . **[6 hrs]**

UNIT 2 **Constructional Features of CNC Machines**: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors. Timing belts and pulleys, Spindle bearing, Arrangement and installation. Slide ways. Re - circulating ballscrews, Backlash measurement and compensation, linear motion guide ways. Tool magazines, ATC, APC, Chip conveyors **[6 hrs]**

UNIT 3 **Control Systems, Feed Back Devices and Tooling** **[9 hrs]**
Description of a simple CNC control system. Types of control, CNC controller's characteristics, Interpolation systems. Incremental and absolute rotary encoders, linear scale – resolver – Linear inductosyn – Magnetic Sensors for Spindle Orientation. Carbide inserts classification, qualified; semi qualified and preset tooling , Principles of location, Principles of clamping–Workholdingdevices.

UNIT4 **Programming CNC machines**, Part print analysis and Process planning,. APT part programming using CAD/CAM, Parametric Programming. Manual part programming for CNC turning, milling and machining center.. Computer assisted part programming techniques, Conversational and Graphics based software, Solids based part programming. Freeform surface machining. Simulation and Verification of CNC programs, **[8 hrs]**

UNIT 5 **Advanced Programming features**, Canned cycles, Subroutines, Macros, special cycles etc for CNC lathe and milling machines. **[8hrs]**

UNIT 6 Adaptive CNC control techniques, types and benefits. Integration of CNC machines for CIM. Introduction to multiaxes CNC machines. **[8 hrs]**
Case studies of completed jobs.

Books Recommended::

1. Krar, S., and Gill, A., "CNC Technology and Programming", McGraw Hill publ Co, 1990.
2. Gibbs, D., "An Introduction to CNC Machining", Casell, 1987.
3. Seames, W.S., "Computer Numerical Control Concepts and Programming", Delmar Publishers, 1986.
4. Lynch, M., "Computer Numerical Control for Machining", McGraw Hill, 1992.
5. Koren Y, "Computer Control of Manufacturing Systems", McGraw, 1986.
6. Fu K.S., Gonzalez R.C., and Lee C.S.G.," Robotics control, sensing, vision, and intelligence", McGraw-Hill Book Co., 1987.
7. Klafter R.D., Chmielewski T.A. and Negin M.," Robot Engineering An Intergrated approach", Prentice Hall of India, New Delhi, 1994.
8. Craig J.J., "Introduction to Robotics Mechanics and Control", Addison-Wesley, 1999.

Reference Books:

- Richard D. Klafter , Thomas A. Chemielewski, Michael Negin, Robotic Engineering : An Integrated Approach , Prentice Hall India, 2002.

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I Semester

EL3910	**Lab : CNC Technologies**	L= 3	T = 0	P = 4	Credits = 2

Evaluation Scheme	TA	ESE	Total	ESE Duration
	40	60	100	3 Hrs

LIST OF PRACTICALS:

1. Study of Automation through development in machines.
2. Numerical control – Fundamental & Application.
3. Manual Part Programming.
4. APT Part Programming.
5. CNC- Lathe – Features, Specification,
6. CNC Lathe – Programming , Simulation & Actual Machining of Part. (Facing , Turning , Multiple turning cycles, etc.)
7. CNC Lathe – Programming , Simulation & Actual Machining of Part. (Advance programming like Thread Cutting , Grooving etc.)
8. CNC- Milling – Features, Specification,
9. CNC Milling – Programming , Simulation & Actual Machining of Part. (Profile Cutting , Various Interpolation , etc.)
10. CNC Milling – Programming , Simulation & Actual Machining of Part. (Advanced programming like Pocketing , Mirroring, etc.)

I Semester

ME3911	Product Design and Development	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

To understand the Product Life Cycle. Study different design techniques, product development phases, process selection, material selection and costs associated with PDD.

Unit 1 **Introduction** **[7 hrs]**

Importance of product design, types of design, product definition, product specification, Phases of product development: conceptual, embodiment and detailed design, product and technology development cycle, concept generation and evaluation methods.

UNIT 2 **Material selection** **[7 hrs]**

Material selection – Importance, classification, material performance characteristic, Selection criteria, Ashby Material selection chart

UNIT 3 **Process selection**

Process selection – Importance types of manufacturing processes and their classification, sources of information, selection criteria, Material and Process selection Methods- Expert systems, Computer Database Approach, Performance indices, decision matrix, AHP and fuzzy approach, introduction to material and process selection software **[8 hrs]**

UNIT 4 **Benchmarking**

Benchmarking – DFM, DFA, DFX, Early supplier involvement, robust design, QFD and concurrent engineering. **[8 hrs]**

UNIT 5 **Costing & Assembly**

Mathematics of Time Value of Money, Cost Comparison, Depreciation, Taxes, Inflation, Profitability of Investment and Investment Decision Analysis Sensitivity Analysis. Methods of Cost Estimates. Industrial Engineering Approach, Parametric Approach, **[8 hrs]**

Introduction to Assembly Modelling, Top-Down and Bottom-Up Approaches of AM, Mating Conditions, Representation Schemes, Generations of Assembly Sequences

UNIT 6 **Rapid Prototyping** **[7 hrs]**

Product Development Cycle and Importance of Prototyping, Types of Prototypes, Principle and Advantages & Different Type of Generative Manufacturing Process, Viz, Stereolithography, FDM, SLS etc. Factors Concerning to RP: Consideration for Adoptions, Advantages, Accuracy and Economic Considerations

Book for reference:

1. Dieter George E. "Engineering Design", McGraw Hill Pub. Company, 2000
2. Ulirich Karl T. and Eppinger Steven D., "Product Design and Development" McGraw Hill Pub. Company, 1995.
3. Bralla, James G., "Handbook of Product Design for Manufacturing" McGraw Hill Pub. Company, 1986
4. A. K. Chitale and R. C. Gupta, Product Design and Manufacturing, PHI Pvt. Ltd., 2002.
5. HARRY NYSTROM, " Creativity and innovation", John Wiley & Sons, 1979.
6. BRAIN TWISS, " Managing technological innovation", Pitman Publishing Ltd., 1992.
7. HARRY B.WATTON, " New Product Planning ", Prentice Hall Inc. 1992.
8. P.N.KHANDWALLA - " Fourth Eye (Excellence through Creativity) – Wheeler Publishing ",Allahabad, 1992.
9. I.P.R. Bulletins, TIFAC, New Delhi,

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II Semester

ME3915	**Robotics**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

To understand Robots, their components, functions, functions, programming and applications.

UNIT 1 Robotics, Basic concepts, Robot configurations, Basic robot motions, Types of drives, End effectors, Classification, Mechanical, Magnetic, Vacuum, and Adhesive, Drive systems, Force analysis and Gripper design **[7 hrs]**

UNIT 2 Manipulator Kinematics Transformation matrices and their arithmetic, link and joint description, Denavit-Hartenberg parameters, frame assignment to links, solvability, algebraic and geometrical methods, Velocities and Static forces in manipulators Motion of the manipulator links, Jacobians, singularities, static forces, Jacobian in force domain. **[9 hrs]**
Robot Applications :-Spray Painting
- Assembly
- Welding
- Material Handling
- Processing etc

UNIT 3 Manipulator Dynamics Iterative Newton-Euler dynamic formulation, structure of the manipulator dynamic equations, introduction to the Lagrangian formulation and generalized D'Alembert's equations of motion, Trajectory Generation Considerations in path description and generation, joint space schemes, paths with via points, Cartesian space schemes, geometrical problems with Cartesian paths **[6 hrs]**

UNIT 4 Manipulator Control: Introduction to closed loop control, second order linear systems and their control, control law partitioning, trajectory-following control, modeling and control of a single joint. Introduction to non-linear control, non-linear and time-varying systems, the control problem of manipulators, practical considerations, present industrial robot control systems, introduction to force control, brief introduction to robot actuators, need for sensors and vision system in the working and control of a robot, **[8 hrs]**

UNIT 5 Programming: Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, RAIL and VAL II programming languages **[8 hrs]**

UNIT 6 Sensory devices, Non optical and optical position sensors , Velocity and Acceleration , Range , Proximity , touch , Slip , Force ,Torque. **[7 hrs]**
Machine vision , Image components , Representation , Hardware , Picture coding , Object recognition and categorization
Integration of Robots with CNC machines for CIM.

Books for Reference:

1. Fu K.S., Gonzalez R.C., and Lee C.S.G.," Robotics control, sensing, vision, and intelligence", McGraw-Hill Book Co., 1987.
2. Klafter R.D., Chmielewski T.A. and Negin M.," Robot Engineering An Intergrated approach", Prentice Hall of India, New Delhi, 1994.
Deb S.R., "Robotics Technology and Flexible Automation", Tata McGraw-HillPublishing Co.,Ltd., 1994.
4. Craig J.J., "Introduction to Robotics Mechanics and Control", Addison-Wesley, 1999.
5. L. Sciavicco, B. Siciliano "Modelling and control of robot manipulators", The McGraw-Hill Co. Inc., 1996.
6. R.J. Schillin, "Fundamentals of Robotics: Analysis and Control", Prentice Hall.
7. K.S. Fu, R.C. Gonzales, C.S.G. Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill,1987.
8. Groover, "Industrial Robotics: Technology, Programming and Applications", McGraw Hill, 1986.
9. R. K. Mittal – Fundamentals of robotics, PHI.

Tutorials
1) Numericals on kinematics and dynamics using MatLab.

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II Semester

ME3916	**Modelling & Simulation**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

The course aims to develop the engineering - analysis capability for engg-problems using basic statistical tools and techniques. Detailed treatment of various modeling techniques leading to complete understanding and simulation the processes including its optimization is envisaged in this course. Students are able to design the electronic and informatic means to implement them on control systems.

Unit 1 Introduction to mathematical modeling, Need, Advantages, Limitations, Disadvantages & Applicable to mechanical, manufacturing, process, Automotive, Electrical & Control System, Software tools available for modeling [Matlab-Simulink, AutoLISP, ADAMS/Pro-Mechanica/ Visual Nastran/Working Model 4D, MathCAD/Mathematica, Lab View and computer languages [C/C++/Fortran/AutoLISP/ Simula /SIMSCRIPT/GASP/GPSS] for mathematical modelling **[7 hrs]**

UNIT 2 Introduction to automatic controls. Modeling of general second order system(mechanical systems [spring, mass, damper], flow, heat transfer and electrical, pneumatic and vibration systems). Block diagram and transfer function, Modeling of continuous system, Extraction of reduced order models. Transient and frequency response evaluation using Laplace transform, Control loop and its elements, Dynamic behaviour of first, second and higher order physical systems. Linearization of non-linear systems. Controller hardware, sensors, transmitters and control valves **[7 hrs]**

UNIT 3 Characteristics of hydraulic controller, pneumatic, electronic controller, electro hydraulic and electro-pneumatic controllers, PID control, Stability, Gain and phase margins, Control system design using root and compensation **[8 hrs]**

UNIT 4 Simulation Introduction, Advantages, Limitations, Disadvantages, Concept of System, Process, Activity, Attributes, Closed & Open System, Activities: Deterministic & Stochastic, Models: Static, Dynamic, Transient, Simulation Approaches: Event Scheduling, Process Interaction, Activity Scanning, Steps in Simulation Study **[8 hrs]**

UNIT 5 Instrumentation and Process Control-Introduction, Study of various measuring parameters of a process/system and Measuring instruments for: Temperature, pressure, level, flow, Control schemes with applications to Machine tool, Boiler, Engine Governing, Aerospace, Active vibration control, Manufacturing, Process control, etc. **[7 hrs]**

UNIT 6 Application to Control panel modeling, Virtual Instrumentations using Lab View, Auto-tuning, Sequence control, Logic diagram, Introduction to digital control, Implementation using computer language /software, Introduction to control of MIMO systems, State Space modeling

Text Books:

1. S.R Bhonsale, K.J., "Mathematical modeling for design of machine components", Weinmann, 1999, Prentice Hall.
2. A.F. D'souza V K Gar, "Englewood Cliffs Advanced Dynamics: Modelling and Analysis," N. J., Prentice Hall, 1984
3. Averal M. Law, W. David Kelton, "Simulation, Modelling and analysis", McGraw Hill, 1992.

Reference Books:

1. Reference manuals: Matlab- Simulink/AutoLISP/ADAMS/Pro-Mechanica/VisualNastran/WorkingModel 4D/ MathCAD/Mathematica, Lab View.
2. Mathematical modeling for design of machine components, S.R Bhonsale, K.J. Weinmann, 1999, Prentice Hall.
3. Advanced Dynamics: Modelling and Analysis, A.F. D'souza V K Gar, Englewood Cliffs, N. J., Prentice Hall, 1984
4. Simulation, Modelling and analysis, Averal M. Law, W. David Kelton, McGraw Hill, 1992.
5. Jean Ulrich, Thoma, "Modelling and Simulation in Thermal and Chemical Engineering: a bond graph approach", Springer, 2000, ISBN 3540663886
6. Jerry Banks, "Handbook of Simulation: Principles, Methodology, Advances, Applications, and Practice", Wiley-Interscience, 1998, ISBN: 0471134031
7. Christopher A. Chung, "Simulation Modeling Handbook: a practical approach", CRC,2003, ISBN: 0849312418
8. Averill Law, W. David Kelton, "Simulation Modeling and Analysis (Industrial Engineering and Management Science Series) ", McGraw-Hill Inc, 1999, ISBN: 0070592926
9. Philip J. Thomas, "Simulation of Industrial Processes for Control Engineers", Butter worth-Heinemann 1999,ISBN: 0750641614
10. Sheldon M. Ross, "Simulation", Academic Press, 2001, ISBN: 0125980531
11. John Montgomery, Vjekoslav Damic, "Mechatronics by Bondgraphs ", Springer, ISBN: 3540423753
12. Bernard P. Zeigler, Tag Gon Kim, Herbert Praehofer, "Theory of Modeling and Simulation"Academic Press, 2000, ISBN: 0127784551
13. Nicholas M. Karayanakis , "Advanced System Modelling and Simulation with Block Diagram Languages", CRC 1995, ISBN: 0849394791
14. Giancarlo Genta, "Motor Vehicle Dynamics: Modeling and Simulation (Series on Advances in Mathematics for Applied Sciences)",Publisher: World Scientific Publishing Company 1997, ISBN: 9810229119
15. Damian Flynn, "Thermal Power Plant Simulation and Control",Institution Electrical Engineers 2003, ISBN: 0852964196
16. Ian Cameron, K. M. Hangos, Katalin Hangos, "Process Modelling and Model Analysis (Process Systems Engineering) Elsevier Limited, 2006, ISBN: 0121569314
17. Reinhold von Schwerin , "MultiBody System SIMulation: Numerical Methods, Algorithms, and Software",Springer2005,ISBN: 1402033923

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II Semester

ME3917	**Finite Element Method**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

FEM a numerical technique will be useful subject for the students in finding approximate solutions of partial differential equations as well as of integral equations. FEM allows detailed visualization of where structures bend or twist, and indicates the distribution of stresses and displacements. FEM software provides a wide range of simulation options for controlling the complexity of both modeling and analysis of a system. Similarly, the desired level of accuracy required and associated computational time requirements can be managed simultaneously to address most engineering applications. FEM allows entire designs to be constructed, refined, and optimized before the design is manufactured.

UNIT 1 Fundamentals of stress & strain, stress & strain components, stress strain relationship, Elastic constants, plane stress, plane strain., differential equation of equilibrium, compatibility equations, boundary conditions, Saint Venant's principle, Airy's stress function. **[7Hrs]**

UNIT 2 Fundamental concepts of FEM -' Historical background, Scope of FEM in Engg.Applications, Principle of minimum potential energy. Concept of Virtual work. Variational method. FEM analysis procedure. Mathematical understanding required for FEM, Matrix algebra & operations, Eigen values & Eigen vectors. Methods for solution of simultaneous equations. like Gauss elimination. Matrix decomposition method.
Concept of discritization of body into elements. Degrees of freedom, bandwidth, and Basic types of 2-D & 3-D elements, displacement models, convergence requirements, shape function. Commercial FE Software's. **[7Hrs]**

UNIT 3 Finite element modeling & analysis using Bar & Beam element -stiffness matrix, assembly, boundary conditions, load vector, temperature effects.
Two dimensional plane 'b11ss -Local & Global coordinate system, element stiffness matrix, assembly, boundary conditions, load vector, force & stress calculations. **[8Hrs]**

UNIT 4 Two dimensional problems using CST & LST -formulation of CST & LST elements, elemental stiffness matrix, assembly, boundary conditions, load vector. Stress calculation. Temperature effect.
Axi-symmetric solids subjected to axi-symmetric loading -axi-symmetric formulation using CST ring, element, stiffness matrix, boundary conditions, load vector, calculation of stresses. **[8Hrs]**

UNIT 5 Introduction to Isopearametric & Higher order elements. Introduction to Numerical Integration. Introduction to dynamic analysis, formulation of mass matrix for one-dimensional bar element, free vibration analysis using one-dimensional bar element. Torsion of prismatic bars using triangular elements **[7Hrs]**

UNIT 6 Steady state one dimensional & two dimensional heat conduction problems using I-D and triangular element respectively. Programming aspects of FEM -Algorithms for, reading Finite Element modeling data, formation of elemental stiffness matrix, and formation of elemental load vector. assembly of individual elemental spiffiness matrix into global' stiffness' matrix, assembly of individual elemental load vector into global load vector, application of boundary .conditions, solution of equations, determination of stresses and strains. Pre & Post processing in FEA. **[8Hrs]**

Suggested books

1) Introduction to Finite Elements in Engineering -T.R. Chandrupatla & AD. Belegundu .
2) Finite Element Analysis for engineering-T.R.Chandrupatla.
3) Theory of Elasticity -S.P. Timoshenko
4) Concept and applications of Finite element Analysis -RD. Cook
5) The Finite Element Method -A basic introduction for engineers -D. W. Griffiths, D.A Nethercot – Granada Publishing
6) Finite element methods – Krishnamurthy & Desai
7) Finite element methods – Zeinkeiwiz
8) Finite element methods – J. N. Reddy
9) Finite element methods – Finite to Infinite series

Tutorials

1) C – programming for stress analysis of elements to be carried out.
2) Comparison of a)Analytical result b) C- programming result and c) result due to Ansys to be made.

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II Semester

EL3918	**Lab : Finite Element Method**	L= 3	T = 0	P = 4	Credits = 2

Evaluation Scheme	TA	ESE	Total	ESE Duration
	40	60	100	3 Hrs

List of Practical :
Students should use the commercial software or programmes from the text-books or self developed programs, to verify the results obtained by manual calculations. The input data and output results of the problem solved using the computer programs should be included in the Journal.

1) Any two problem using bar element
2) Any two problems using truss element
3) Any two problems using CST element
4) Any one problem using axisyrmnetric element
5) Any one problem of free vibration analysis using bar element
6) Any one problem of Torsion of Prismatic bars.
7) Any one problem on Steady State Heat conduction.

II Semester

ME3919	**Artificial Intelligence**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

To learn about the automation of machines tools making the system intelligent. Understanding the different techniques used for implementation of artificial intelligence.

Unit 1 Human and machine intelligence, Artificial Intelligence (AI), Programming in AI environment,. Natural Language processing (NLP), Need of AI. **[7hrs]**

UNIT 2 Architecture of an Expert system, Knowledge base, inference engine forward and backward chaining, use of probability and fuzzy logic. Selection of inference mechanism, (Relevant case studies) **[8 hrs]**

UNIT 3 Neural Network and application artificial neural network models, NN applications in Cellular manufacturing and other areas of mechanical Engg..(Relevant case studies) **[8 hrs]**

UNIT 4 Introduction to Rule Based System. Conflict Resolution Advantages and Drawbacks of Rule Based Systems Clausal Form Logic, Rule Base Verification, Refinement and Validation.
Creating Knowledge Base, Knowledge Engineer and Domain Expert, Phases of Knowledge Engineering, Tools for Knowledge Engineering. **[7 hrs]**

UNIT 5 Fundamentals of OOP (Object oriented programming), creating structures and objects, object operations, invoking procedures, programming applications, Object oriented expert systems.
Semantic nets, structure and objects, ruled systems for semantic nets, certainty factors, automated. **[7 hrs]**

UNIT 6 Relevant case studies. **[8 hrs]**

Books for Reference:

- Addis, T.R., "Designing Knowledge Based System", Prentice Hall, 1985.
- Rolston, D.W., "Principles of Artificial Intelligence and Expert Systems Development", McGraw Hill, 1988.
- Maus, R. and Keyes, J., "Handbook of Expert Systems in Manufacturing", McGraw Hill, 1991
- Robert Levine, "A comprehensive guide to artificial intelligence and expert systems",Elain Rich ,"Artificial Intelligence",
- Sasikumar, Ramani, et al ,"Rule based expert systems".
- Graham Winstanley, "Program Design for Knowledge Based Systems", Galgotia Publications.
- Artificial Neural Networks", Zurada
- V.B. Rao and H.V. Rao, "C++ : Neural Networks and Fuzzy Logic", BPB Publications.

II Semester

ME3920	**PE II: Product Data Management**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

This engineering course focuses on understanding the structure of database, design of database, different types of database and query languages and constraints and pitfalls in database design .Also provides the learning of Expert Database Architectures; Semantic Data Models,Decision-Support Systems and databases for product design and other CAD/CAM applications.

Unit 1 Purpose of Database Systems; View of Data; Data Models; Database Languages; Database Users; Overall System Structure **[7hrs]**

UNIT 2 Design Issues; Mapping Constraints; Keys; Entity-Relationship Diagram; Weak Entity Sets; Extended E-R Features; Design of an E-R Database Schema; **[8 hrs]**

UNIT 3 Structure of Relational Databases; The Relational Algebra; The Tupple Relational Calculus; The Domain Relational Calculus; Extended Relational Algebra Operations; Modifications of the Database; Views
Basic Structure; Set Operations; Aggregate Functions; Null Values; Nested Sub queries; Derived Relations; Views; Modification of the Database; Joined Relations; Data-Definition Language; Other Relational Languages - Query-by-Example; Quel; Datalog; Views **[8 hrs]**

UNIT 4 Domain Constraints; Referential Integrity; Assertions; Triggers; Functional Dependencies Views **[7 hrs]**
Pitfalls in Relational-Database Design; Decomposition; Normalization Using Functional Dependencies; Views

UNIT 5 New Database Applications; The Object-Oriented Data Model; Object-Oriented Languages; Persistent Programming Languages; Persistent C++ Systems; Object-Relational Databases Views: Indexing and Hashing Ordered Indices **[7 hrs]**
Centralized Systems; Client-Server Systems; Parallel Systems; Distributed Systems; Network Types; Parallel Databases; Distributed Databases; Security and Integrity; Standardization Views

UNIT 6 Expert Database Architectures; Semantic Data Models; Views **[7 hrs]**
Decision-Support Systems; Data Analysis; Data Warehousing; Spatial and Geographic Databases; Multimedia Databases; Mobility and Personal Databases; Information-
Product Design Databases; CAD-CAM Data Management Requirements; Databases for Shop floor control and Factory information system; Enterprise Resource Planning; Database requirements of Computer Integrated Manufacturing Views:
Assignment for hands on experience on computer using any commercial database for different applications to be given. The assignment to be given in the groups.

Books for Reference:

1. Abraham Silberschatz, Henry F. Korth, S.Sudarshan, "Database System Concepts", McGraw Hill International Editions, Third Edition
2. P. Beynon-Davies, "Expert Database Systems – A Gentle Introduction", McGraw Hill International; 1991
3. James Martin ,"Database Management Systems",
4. Mark Swank and Drew Kittel , "Worldwide Web - Database Developer's Guide"
5. Fredrick H.Jones and Lloyd Martin "The AutoCAD Database Book - Accessing and Managing CAD Drawing Information"; Galgotia Publications, Third Edition.

II Semester

ME3921	**PE II: Mechatronics**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

Develop the ability to understand the working of various electronically and computer control devices. This will help to bridge the existing gap between machines, Automation and Computer control system

Unit 1 Introduction to Mechatronics. Components of mechatronics system. Signal Conditioning Process, Operational Amplifier, Data Acquisition Systems.

[7 hrs]

Unit 2 Introduction, sensors, actuators, modeling of systems. Recent trend of designing machine units along with electronic circuits for operation and supervision of mechanisms. Actuators, Sensors and Transducers: Hydraulic, pneumatic and electrical actuators and their system modeling, performance terminology, system modeling of sensors; displacement, position and proximity sensors, velocity and acceleration sensors, flow sensors, force sensors, temperature sensors, ultrasonic and fiber-optic sensors, selection of sensor, piezo-electric sensors Techniques of interfacing mechanical devices with computer hardware

[7 hrs]

Unit 3 Basic principles ,working and specific applications of armature and field controlled D.C. Motors, Variable voltage and variable frequency control of 3 phase and single phase Induction motors, speed control of synchronous motors, Different types of stepper motors-Constriction ,working and application. Position control of stepper motors.

[8 hrs]

Unit 4 Comparison between microprocessor and microcontroller, organization of microcontroller system, architecture of controller, pin diagram of 8051, addressing modes, programming of 8051, interfacing input and output devices, interfacing D/A converters and A/D converters, Various applications for automation and control purpose.

[7 hrs]

Unit 5 Programmable Logic Controller: Review of logic gates, basic structure, features, input/output processing, programming, functional block diagram (FBD), ladder diagram, logic functions, latching, sequencing, jumps, internal relays, counters, shift registers, master and jump control, data handling, data movement, data comparison, arithmetic operations, code conversion, analog input and output, applications for automation, diagnostics and condition monitoring.

[8 hrs]

Unit 6 General philosophy of Artificial Neural Network simulations, Fuzzy logic for operation and control of mechatronic systems. Study of systems used in Ink Jet Printers, Photo copying, Washing Machines, IC Engine fuel injection system etc

[7 hrs]

Text books:

S.N.	Title of the book	Edition (Year of publication)	Author(s)	Publisher
1	Introduction to Mechatronics and Measurement Systems	2007	Michael B.Histand and David G. Alciatore	Tata McGraw-Hill Education
2	Mechatronics	2007	Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ.,	Chapman and Hall, 1991
3	Microprocessor Architecture, Programming and Applications	2002	Ramesh.S, Gaonkar	Prentice Hall
4	Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics	1996	Lawrence J.Kamm	John Wiley and Sons
5	Introduction to Microprocessors for Engineers and Scientists	2004,	Ghosh, P.K. and Sridhar	PHI Learning Pvt. Ltd.

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II Semester

ME3922	**PE II: Machine Tool Design**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

To develop in the engineering students the ability to analyze any engineering problem in a simple and logical manner and to apply to its solution a few, well understood basic principles. This subject deals with the basic structure of machine tools , its design and design of gear box, guides , and other machine tool elements.

Unit 1: Machine Tools **(8 Hrs.)**

Introduction, classification, general requirements, characteristics, technical and economical prerequisites for machine tool design, machine tool design process, machine tool layout, motion in machine tool, machine tool drives, hydraulic and mechanical drives, types and elements, individual and group drives, devices for intermittent motion, reversing and differential mechanism, selection of electric motor.

Unit 2: Regulation of Speed and Feed Rates: **(8 hrs.)**

Aim of speed and feed regulations, stepped regulations of speed-Various laws of step regulation, Selection of range ratio, Standard value of Geometric progression ratio and guidelines for selection proper values, Breakup of speed steps, Structure diagrams and its analysis, Classification of speed and feed boxes, design of feed box, machine tool drives using multiple speed motors, Special cases of gear box Design speed box with Overlapping speed steps, Speed box with combine structure, Speed box with Broken geometric progression, electromechanical system of regulation, Friction, Pressure and Ball Variations, Epicyclic Drive.

Unit 3: Design of machine Tool Structure: **(8 Hrs.)**

Function and requirement of machine tool structure, design criteria from strength and stiffness consideration, concept of unit rigidity, unit strength under bending for material of machine tool structures, compare steel and cast iron on the basis of material properties, manufacturing problems and economy, role of static and dynamic stiffness in design of elements of machine tools, profiles of machine tool structures, factors affecting stiffness of machine tool structures.

Unit 4: **Design of Guideway and Power Screws**: **(8 hrs.)**

Function and types of Guideways, types of slideways and antifriction ways, functional features of slides ways, its shapes and materials, methods of adjusting clearance, design criteria (wear resistance and stiffness) and calculations for slideways operating under semi liquid friction condition, stick slip phenomenon affects accuracy of setting and working motions, comparision of design and stiffness of hydrodynamic, hydrostatic and aerostatics slide ways, design of antifriction Guideways, concept of combination of Guideways, Design of sliding friction power screw for wear resistance, strength, stiffness and buckling stability, design of rolling friction power screw for strength under static loading.

Unit 5 : Design of Spindle: **(7hrs.)**

Function and requirements of spindle units, their materials, effect of machine tool compliance on machining accuracy, design of spindles for bending stiffness: deflection of spindle axis due to a) bending b) compliance of spindle supports c) compliance of tapered joints, optimum spacing between spindle supports permissible deflection and design for stiffness: additional check for strength like additional supports, location of bearings and drive elements, balancing.

Unit 6 : **Design of spindle supports:** **(7hrs.)**

Requirements of spindle supports, features of antifriction bearings, load bearing abilities of ball and roller bearing. Parameters which access the violability of combinations of roller and ball and roller bearings in spindle units. Preloading of antifriction bearing and its method design of sliding bearing: sleeve, hydrodynamic journal, hydrostatic journal, air lubricated (aerodynamic, aerostatic)

Text Books:

I) Machine Tool Design -N. K. Mehata TMH
2) Principles of Machine Tools –Gopal Chandra Sen , Amitabh Bhattacharya New central book agency
3) Machine Tool Design -Basu, Pal Oxford IBH
4) Technology of Machine Tool by Steve F. Krar Indian Edition 2013 (Mc-Graw Hill)

Reference Books:

All about Machine Tool – by Henrich Gerling (New Edge Publication)

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II Semester

ME3923	**PE II: Plant Design**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

To learn the design consideration and methodology of various equipment used in plants like pressure vessels and its foundation, storage tanks, heat exchangers etc. To learn about the components and design of piping systems.

Unit 1 Pressure Vessel Design [7 Hrs]

Introduction to Pressure Vessels: Fired & Un-fired vessels. Vessel Mechanics & Design considerations: Thick/Thin shells -cylindrical, spherical & different types of end-covers. Design of a typical pressure vessel using industrial Software.

UNIT 2 Shell and Mounting Design [8 Hrs]

Design of spherical/ cylindrical shells and heads/ closures for cylindrical shells under internal and external pressure;
Design of a self- supporting tall vertical cylindrical vessel under wind/ seismic loading; Design of RCC foundation for a tall vessel; Compensation for openings in cylindrical shells; Design of special flanges;

UNIT 3 Design of Storage Tank and Heat Exchangers [7 Hrs]

Design of storage tanks for liquids.
Design of heat exchanger and heat exchanger network

UNIT 4 Valves [7 Hrs]

Selection of valves, Pressure reducing valves and fittings; Water treatment, Storage; Steam: Steam handling ,Steam Trap, Ejectors etc.;

UNIT 5 Piping Design [7 Hrs]

Pipe Size and pressure drop calculation for single and two phase flow, multiple pipe line networking ..

UNIT 6 Piping Analysis [7 Hrs]

Introduction to Piping Engineering – their design. Method of stress analysis of piping system – Thermal & other static modes of loading. Design of a typical piping problem using industrial software

Text Books:

- Bedworth, Wolfe & Henderson -Computer Aided Design & Manufacturing - McGraw Hill

Reference Books:

- Ibrahim Zeid – CAD/CAM –Theory & Practice –TMH
- Couper, Penny, Roy-Chemical Process Equipment (Selection and Design)
- Shashi Menon- Piping Calculation

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II Semester

ME3924	PE III: Computational Fluid Dynamics	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

OBJECTIVES

The aim of this course is to provide basic knowledge on modern computational methods which are commonly used for laminar and turbulent flows. Furthermore, the intention is to provide skills in the analysis and evaluation of results from numerical flow simulations. This knowledge should be sufficient to be able to chose an appropriate solution strategy and estimate the accuracy of the results for a given flow case.Knowledge and understanding : For a passing grade the student must be able to:

- discuss the potential and limitations of computational fluid dynamics
- describe different methods for numerical solution of flow problems and their applicability for different types of flow
- describe the sources of errors in the process from mathematical description to numerical solution of a fluid mechanical problem and how these errors affect the solution

Unit 1 **Introduction** **[7 hrs]**

Introduction –Theoretical, Computational and Experimental Techniques and their comparison. Scope of CFD. Different CFD Approaches. Modeling, Discretization and Basic Solution Module. Convergence, Stability and Consistency

UNIT 2 **Modelling** **[7 hrs]**

Modeling in CFD – Navier-Stokes Equation for Laminar Flow in Cartesian Coordinate System. Potential, Boundary-Layer and Fully Viscous Modeling. Streamfunction-Vorticity Formulation

UNIT 3 Boundary Conditions in Different Formulations and Case Studies like Potential and Viscous Modeling of Flow in a Cavity, Boundary-Layer Modeling of Flow over a Flat Plate and Viscous Modeling of Flow in Entrance-Region for Flow between Parallel Plates. **[8 hrs]**

UNIT 4 **Discretization** **[8 hrs]**

Finite-Difference Discretization of CFD Model – Discretization of First and Second Derivatives by Forward, Backward and Central Differencing. Truncation and Order of Error, and Accuracy.

UNIT 5 Case Studies like Potential and Viscous Modeling of Flow in a Cavity, Boundary-Layer Modeling of Flow over a Flat Plate and Viscous Modeling of Steady Flow in Entrance-Region for Flow between Parallel Plates in Streamfunction-Vorticity Formulation along with Role of Upwinding. Unsteady Flow Modeling and Stability **[8 hrs]**

UNIT 6 Special Topics in CFD – Solution of Simultaneous Linear Algebraic Equations by TDMA and ADI Techniques. Viscous Flow Modeling in Primitive-Variable Formulation: SIMPLE Algorithm **[7 hrs]**

Book for reference:

1. Anderson John; "Computational Fluid Dynamics"
2. Chung T.J;"Computational Fluid Dynamics"
3. Thévenin Dominique, Janiga Gábor; "Optimization and Computational Fluid Dynamics"
4. Date Anil Waman; "Introduction to Computational Fluid Dynamics"

Softwares:

1. PHOENICS
2. Fluent
3. Ansys CFX - 5

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II Semester

ME3925	PE III: Design Optimization Techniques	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

UNIT- I INTRODUCTION: **[6 hrs]**

Design philosophy steps in Design process — General Design rules for manufacturability — basic principles of design Ling for economical production — creativity in design. Materials: Selection of Materials for design Developments in Material technology -- criteria for material selection — Material selection interrelationship with process selection process selection charts.

UNIT II: METAL CASTING: **[7 hrs]**

Appraisal of various casting processes, selection of casting process, - general design considerations for casting — casting tolerances — use of solidification simulation in casting design — product design rules for casting.

UNIT III: MACHINING PROCESS: **[9 hrs]**

Overview of various machining processes -- general design rules for machining - Dimensional tolerance and surface roughness — Design for machining — Ease — Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT IV: METAL JOINING: **[8 hrs]**

Appraisal of various welding processes, Factors in design of weidments — general design guidelines — pre and post treatment of welds — effects of thermal stresses in weld joints — design of brazed joints. Forging — Design factors for Forging — Closed die forging design — parting lines of die5 drop forging die design — general design recommendations. Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, and Deep Drawing— Keeler Goodman Forming Line Diagram — Component Design for Blanking.

UNIT-V ASSEMBLY : **[8 hrs]**

Assemble Advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation.

Automatic Assembly Transfer Systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine.

UNIT-VI: DESIGN OF MANUAL ASSEMBLY **[7 hrs]**

Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

TEXTBOOK:

1. Geoffrey Boothroyd, "Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.
2. Engineering Design – Material & Processing Approach – George E. Deiter, McGraw Hill Intl. 2nd Ed. 2000.

REFERENCE BOOKS:

1. Geoffrey Boothroyd, "Hand Book of Product Design" Marcel and Dekken, N.Y. 1990.
2. A Delbainbre "Computer Aided Assembly London, 1992.

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II Semester

ME3926	**PE III: Rapid Prototyping**	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

UNIT - I INTRODUCTION

CAD-CAM and its integration, Development of CAD CAM., The importance of being Rapid, The nature of RP/T, The state of RP/T industry. Rapid Prototyping Defined. Time compression Technologies, Product development and its relationship with rapid prototyping.

UNIT - II PROCESS CHAIN FOR RAPID PROTOTYPING

Data Preparation (Pre-processing), Part Building, Post Processing. CAD Model Preparation, Reverse Engineering and CAD model, Digitizing Techniques: Mechanical Contact Digitizing, Optical Non-contact Measurement, CT Scanning Method, Data Processing for Surface Reconstruction.

Data interface for Rapid Prototyping: STL interface Specification, STL data generation, STL data Manipulation, Advantages and limitations of STL file format. Open files. Repair of STL files. Alternative RP interfaces.
Part orientation and support generation: Factors affecting part orientation, various models for part orientation determination, the function of part supports, support structure design, Automatic support structure generation.

UNIT - III MODEL SLICING AND CONTOUR DATA ORGANIZATION

Model slicing and skin contour determination, Identification of external and internal contours, Contour data organization, Direct and adaptive slicing: Identification of peak features, Adaptive layer thickness determination, Skin contour computation. Tool path generation.
Part Building: Recoating, parameters affecting part building time, part quality.
Post Processing: Part removal, finishing, curing.
Other issues: Shrinkage, Swelling, Curl and distortion, Surface Deviation and accuracy, Build Style Decisions,

UNIT – IV RAPID PROTOTYPING MACHINES

Classification, Description of RP Machines: SLA, SLS, FDM, 3D Printing, LOM, SDM, Contour Crafting

UNIT – V RAPID TOOLING AND MANUFACTURING

Classification of RT Routes, RP of Patterns, Indirect RT: Indirect method for Soft and Bridge Tooling, Indirect method for Production Tooling, Direct RT: Direct RT method for Soft and Bridge Tooling, Direct method for Production Tooling, Other RT Approaches. Rapid Manufacturing: Methods, limitations.

UNIT – VI APPLICATION OF RP

Heterogeneous objects, Assemblies, MEMES and other small objects, Medicine, miscellaneous areas including art.

BOOKS RECOMMENDED

1 Bjorke, Layer Manufacturing, Tapir Publisher. 1992.
2 Jacobs, PF (Ed), Rapid Prototyping and Manufacturing, Society of Manuf. Engrs, 1992.
3 Burns, M., Automated Fabrication: Improving Productivity in Manufacturing, 1993.
4 Jacobs, P.F. (Ed.), Stereo lithography and Other RP&M Technologies: From Rapid Prototyping to Rapid Tooling, Society of Manuf. Engrs. NY, 1996.
5 Chua C. k. and L. K. Fai, Rapid Prototyping: Principles and Applications in Manufacturing.
6 Gibson, I. (Ed.), Software Solutions for Rapid Prototyping, Professional Engineering Publications, London., 2002.

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II Semester

ME3927	PE III: Design for Manufacturing and Assembly	L= 3	T = 0	P = 0	Credits = 3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hrs

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UNIT- I INTRODUCTION: **[6 hrs]**

Design philosophy steps in Design process — General Design rules for manufacturability — basic principles of design Ling for economical production — creativity in design. Materials: Selection of Materials for design Developments in Material technology -- criteria for material selection — Material selection interrelationship with process selection process selection charts.

UNIT II: METAL CASTING: **[7 hrs]**

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II Semester

EL3928	**Seminar**	L= 0	T = 0	P = 2	Credits = 1

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	0	100	0	100	---

Objective:

Each student of the concern project shall present and seminars using audio visuals, aids of on their project methodology. Seminar delivery will be followed by question – answer session. The student shall also require to submit minimum 3 page report about the progress. The minimum 3 member seminar committee shall be constituted for the purpose of evaluating seminar

III Semester

EL3939	**Project Phase –I**	L= 0	T = 0	P = 16	Credits = 8

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	0	100	0	100	---

IV Semester

EL3940	**Project Phase –II**	L= 0	T = 0	P = 24	Credits = 12

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	0	40	60	100	---