JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

SEMESTER – I

	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21DBS101	Computational Methods	PC	3	0	0	3
2.	21D04101	Advanced Finite Element Methods	PC	3	0	0	3
3.	21D04102a 21D04102b 21D04102c	**Program Elective Course - I** Computer Integrated Manufacturing Design for Cellular Manufacturing System Design of Hydraulic & Pneumatic System	PE	3	0	0	3
4	21D04103a 21D04103b 21D04103c	**Program Elective Course – II** Advances in Manufacturing Technology Quality Engineering and Manufacturing Computer Aided Process Planning	PE	3	0	0	3
5.	21D04104	Geometric Modeling Laboratory	PC	0	0	4	2
6.	21D04105	Finite Element Analysis Laboratory	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

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SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D04201	Advanced Optimization Techniques	PC	3	0	0	3
2.	21D04202	Industrial Robotics and Expert Systems	PC	3	0	0	3
3.	21D04203a 21D04203b 21D04203c	**Program Elective Course – III** CNC Technology & Programming Computer Graphics Global Integrated Manufacturing	PE	3	0	0	3
4.	21D04204a 21D04204b 21D04204c	**Program Elective Course – IV** Mechatronics Applications in Manufacturing Rapid Prototyping Artificial Intelligence & Expert Systems	PE	3	0	0	3
5.	21D04205	Process Automation Laboratory	PC	0	0	4	2
6.	21D04206	CAM Laboratory	PC	0	0	4	2
7.	21D04207	Technical seminar	PR	0	0	4	2
8.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
		Total					**18**

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SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D04301a 21D04301b 21D04301c	**Program Elective Course – V** Advanced Tool Design Design for Manufacturing Computer Aided Tools for Manufacturing	PE	3	0	0	3
2.	21DOE301c 21DOE301g 21DOE301h	**Open Elective** Business Analytics Internet Of Things Mechatronics	OE	3	0	0	3
3.	21D04302	Dissertation Phase – I	PR	0	0	20	10
4.	21D04303	Co-curricular Activities					2
Total							18

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D04401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

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Course Code	COMPUTATIONAL METHODS	L	T	P	C
21DBS101		3	0	0	3
	Semester	I			

Course Objectives: Student will be able to

- Demonstrate aptitude in standard numerical techniques for solvingvarious classes of problems.
- Learn the theory underlying the derivation of standard numerical techniques and the development of algorithms.
- Modeling of engineering problems drawn from different disciplines of mechanicalengineering.

Course Outcomes (CO): Student will be able

- To enable students to formulate and solve engineering problems that are not amenable to analytical methods.
- To demonstrate the application of numerical methods to data analysis and optimal design.

UNIT – I		Lecture Hrs:09

Introduction to numerical methods applied to engineering problems: Examples, solving sets of equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs

Numerical integration: Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration

UNIT – II		Lecture Hrs: 09

Optimization: One dimensional unconstrained optimization, multidimensional unconstrained optimization –direct methods and gradient search methods, constrainedoptimization
Boundary value problems and characteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

UNIT – III		Lecture Hrs: 09

Numerical solutions of partial differential equations: Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

UNIT – IV		Lecture Hrs: 09

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Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

Hyperbolic partial differential equations: Solving wave equation by finite differences- stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs.

UNIT - V		Lecture Hrs: 09

Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares –regression analysis- multiple linear regression, non linear regression - computer programs.

Textbooks:

1. "Numerical Methods for Engineers", Steven C.Chapra, Raymond P.Canale Tata Mc-Graw hill
2. "Applied numerical analysis", Curtis F.Gerald, partick.O.WheatlyAddison-wesley,1989
3. "Numerical methods", Douglas J..Faires,Riched BurdenBrooks/cole publishing company,1998.Second edition.

Reference Books:

1. "Numerical mathematics and computing", Ward cheney &David Kincaid Brooks/Cole publishing company1999,fourth edition.
2. "Mathematical methods for physics and engineering"Riley K.F.M.P.Hobson.&.Bence S.J.Cambridge university press,1999.

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Course Code	ADVANCED FINITE ELEMENT METHODS	L	T	P	C
21D04101		3	0	0	3
	Semester	I			

Course Objectives:

- You learn modern analysis techniques used widely in engineering practice and the sciences, and you use these techniques in a general finite element program.
- You learn how to establish computational models of problems of solids and fluids, solve them on your laptop, and assess the accuracy of the results.
- You capitalize on your knowledge of mechanics, reinforce your knowledge, and solve problems that can only be tackled numerically on the computer. Great knowledge in your tool box whatever your goals.

Course Outcomes (CO): Student will be able to

- Students will learn the mathematical formulation of the finite element method and how to apply it to basic (linear) ordinary and partial differential equations.
- Solve 1- D problems. & 2- D Structural & Heat Transfer Problems using FEA
- Solve Trusses & Beams Problems using FEA
- Formulate & solve structural & dynamics problems

UNIT - I		Lecture Hrs: 09

Formulation Techniques: Methodology, Engineering problems and governing differential equations, finite elements., Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

UNIT - II		Lecture Hrs: 09

One-dimensional finite element methods: Bar elements, temperature effects. Element matrices, assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element, Heat transfer problems: One-dimensional, conduction and convection problems. Examples: - one dimensional fin,

UNIT - III		Lecture Hrs: 09

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects.

Beams and Frames: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

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UNIT - IV		Lecture Hrs: 09

Two dimensional problems: CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.

Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration.

UNIT - V		Lecture Hrs: 09

Finite elements in Structural Dynamics: Dynamic equations, eigen value problems, and their solution methods, simple problems.

Convergence: Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle.

Textbooks:

1. Introduction to Finite element methods by Chandraputla & Ashok D.Belagondu by Pearson 2012A
2. Concepts and Applications of Finite Element Analysis By Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt

Reference Books:

1. Finite element method in Heat transfer and fluid dynamics, J.N.Reddy, CRC press,1994
2. Finite Element Method, Zienckiwicz O.C. & R. L. Taylor,McGraw-Hill,1983.
3. Finite Element of Nonlinear continua, . J. N. Oden, McGraw-Hill, New York, 1971.
4. Finite element procedures, K. J. Bathe, Prentice-Hall, 1996.

Online Learning Resources:

- https://nptel.ac.in/courses/112/104/112104193/
- https://nptel.ac.in/courses/112/104/112104205/
- https://nptel.ac.in/courses/105/105/105105041/
- https://nptel.ac.in/courses/112/106/112106130/
- https://nptel.ac.in/courses/112/103/112103295/

Course Code	**COMPUTER INTEGRATED MANUFACTURING**	**L**	**T**	**P**	**C**
21D04102a	**Program Elective Course - I**	**3**	**0**	**0**	**3**

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	Semester	**I**
Course Objectives: Student will be able		
• To gain knowledge about the basic fundamental of CAD. • To gain knowledge on how computers are integrated at various levels of planning and manufacturing understand computer aided planning and control and computer monitoring.		
Course Outcomes (CO): Student will be able to		
• Understand the importance of product development through CIM. Get knowledge of shop floor control , Computer Integrated Manufacturing and Automation. • Adopt appropriate material handling and storage in an automated manufacturing environment. • Incorporate methods of utilization of appropriate features in CAD application enhancing productivity in design		
UNIT - I	**Unit – I Introduction:**	Lecture Hrs:09
Fundamental concepts in Manufacturing and Automation, Automation Strategies, Economic analysis in production, fundamentals of CAD / CAM, product cycle and CAD/CAM, Automation and CAD/CAM, Scope of CIM, Automated flow lines, Transfer mechanisms, methods of Line balancing. **Numerical control machines:** Introduction- basic components of an NC system-the NC procedure- NC coordinate system, NC motion control system- application of numerical control- Economics of Numerical control.		
UNIT - II	**Unit – II NC part programming:**	Lecture Hrs: 09
Introduction - The Bunch tape in NC - Tape code format - manual part programming. NC programming with manual data input.		
UNIT - III	**Unit – III Computer controls in NC:**	Lecture Hrs: 09
NC controllers' technology - Computer Numerical Control (CNC), Direct Numerical control (DNC). **Group Technology**: Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT		
UNIT - IV	**Unit – IV Flexible Manufacturing Systems**	Lecture Hrs: 09
Components of FMS, FMS Work stations, Material Handling Systems, and Computer Control system, FMS layout configurations and benefits of FMS. **Computer aided planning systems:** Approaches to Computer aided Process Planning (CAPP) - Generative and Retrieval CAPP systems, benefits of CAPP, Material Requirement Planning (MRP), mechanism of MRP, benefits, and Capacity Planning.		
UNIT - V	Computer integrated manufacturing	Lecture Hrs: 09
Adaptive control machining systems. adaptive control optimization system, adaptive control constraint system, applications to machining processes, computer process monitoring, hierarchical structure of computers in manufacturing, and computer process control.		

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Textbooks:
1. Automation, Production systems and Computer Integrated Manufacturing Systems – Mikel P.Groover, PHI Publishers
Reference Books:
1. CAD/CAM - Mikell P.Groover, and Emory W. Zimmers.Jr. PHI Publishers 2. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, PHI Publishers 3. CAD/CAM/CIM, Radhakrishnan and Subramanian, New Age Publishers
Online Learning Resources:
1.https://en.wikipedia.org/wiki/Computer-integrated_manufacturing 2. https://www.techopedia.com/definition/30965/computer-integrated-manufacturing-cim 3. https://www.youtube.com/watch?v=_OaBMsUgqgQ 4. https://www.youtube.com/watch?v=edplvB_Xvso 5. https://nptel.ac.in/courses/112/104/112104289/ 6. https://www.youtube.com/watch?v=9fqygvj-O2s.

Course Code	**DESIGN FOR CELLULAR MANUFACTURING SYSTEM (PE-I)**	**L**	**T**	**P**	**C**
21D04102b		**3**	**0**	**0**	**3**
	Semester	**I**			

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Course Objectives: Student will be able to

- To impart knowledge on group technology, optimization algorithms, implementation of GT/CMS, Performance measurements and economical aspects of CMS.

Course Outcomes (CO):

At the end of this course the student should be able to understand

- Concepts and applications of Cellular manufacturing systems
- Traditional and non-traditional approaches of Problem solving
- Performance measurement
- Human and economical aspects of CMS.

UNIT - I	**INTRODUCTION**	Lecture Hrs:09

Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT.

UNIT - II	**CMS PLANNING AND DESIGN**	Lecture Hrs:09

Problems in GT/CMS - Design of CMS - Models, traditional approaches and non-traditional approaches - Genetic Algorithms, Simulated Annealing, Neural networks

UNIT - III	IMPLEMENTATION OF GT/CMS	Lecture Hrs:09

Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS

UNIT - IV	**PERFORMANCE MEASUREMENT AND CONTROL**	Lecture Hrs:09

Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework.

UNIT - V	**ECONOMICS OF GT/CMS**	Lecture Hrs:09

Conventional Vs group use of computer modelss in GT/CMS, Human aspects of GT/CMS - cases.

Text Books:

1. Askin, R.G. and Vakharia, A.J., G.T " Planning and Operation, in The automated factory-Hand Book: Technology and Management ", Cleland.D.I. and Bidananda, B (Eds), TAB Books , NY, 1991.
2. Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), " Planning, design and analysis of cellular manufacturing systems ", Elsevier, 1995.

Reference Books:

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1. Burbidge, J.L. Group " Technology in Engineering Industry ", Mechanical Engineering pub.London, 1979. 2. Irani, S.A. " Cellular Manufacturing Systems ", Hand Book.

Online Learning Resources:

- https://nptel.ac.in/courses/110/106/110106044/
- https://www.youtube.com/watch?v=toTYb7Sirm0
- https://www.youtube.com/watch?v=Ynhp8Wi2qwM
- https://nptel.ac.in/courses/112/104/112104188/
- https://nptel.ac.in/courses/110/107/110107141/
- https://www.youtube.com/watch?v=voN_297SXD8

Course Code	**DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS (PE-I)**	**L**	**T**	**P**	**C**
21D04102c		**3**	**0**	**0**	**3**
	Semester	**I**			

Course Objectives:

- Power in Industry. Also to impart knowledge on the methodology of basic and advanced design of pneumatics and hydraulics systems.

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- It helps students to get knowledge on the need, use and application of fluid power.

Course Outcomes (CO): Student will be able to

- Familiar to industrial design that lead to automation.
- To impartstudents on the science, use and application of hydraulics and pneumatics as fluid.

UNIT – I		Lecture Hrs:09

OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

UNIT – II		Lecture Hrs: 09

CONTROL AND REGULATION ELEMENTS

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

UNIT – III		Lecture Hrs: 09

HYDRAULIC CIRCUITS

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety andemergency mandrels.

UNIT – IV		Lecture Hrs: 09

PNEUMATIC SYSTEMS AND CIRCUITS

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

UNIT – V		Lecture Hrs: 09

INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS

Pneumatic equipments- selection of components - design calculations – application -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Textbooks:

1. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.
2. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.

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Reference Books:
1. Antony Espossito, "Fluid Power with Applications", Prentice Hall, 1980. 2. Dudleyt, A. Pease and John J. Pippenger, "Basic fluid power", Prentice Hall, 1987. 3. K.Shanmuga Sundaram, "Hydraulic and Pneumatic Controls: Understanding made Easy" S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009).
Online Learning Resources:
• https://nptel.ac.in/courses/112/103/112103249/ • https://nptel.ac.in/courses/112/106/112106175/ • https://nptel.ac.in/content/storage2/courses/112106175/Module%201/Lecture%201.pdf • https://www.vidyarthiplus.com/vp/attachment.php?aid=18972 • https://snscourseware.org/snscenew/notes.php?cw=CW_5e27ec3b0457a

Course Code	**ADVANCES IN MANUFACTURING TECHNOLOGY**	**L**	**T**	**P**	**C**
21D04103a	**Program Elective Course - II**	**3**	**0**	**0**	**3**
	Semester	**I**			

Course Objectives: Students able to

- Understand the "Technology Generation and Practical Deployment for enabling industries to face global competition" as opposed to "Technology Acquisition and Adoption".
- Provide an integrated, effective and practical platform for
- Create facilities for teaching, training and research & development work for post-graduate studies in various fields of manufacturing technology
- Link up with national and international colleges/ universities of excellence to impart the education,

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maintain quality & content of curriculum and award degree certificates in post-Graduation / Doctorates

- Provide facilities for international and national subject experts to stay, teach and conduct research projects / programmes on mutual exchange and recognition basis

Course Outcomes (CO): Students able to

- Analyze technical problems, propose solutions and document with written and oral reports.
- Employ technology for communications, data collection, analysis, simulation and control.
- Use Basic Project management skills, project team work and ethical behavior.
- Machine variety materials using a conversational and CNC lathe, milling machine and grinder.
- Use the basic manufacturing methods, measurements, automation and quality control.
- Code PLCs and micro controllers for networking and system control applications.
- Apply engineering design and project management principles.
- Use CAD/CAM and apply it to engineering graphics and mechanical design.
- Apply the basics of engineering materials, structures and to mechanical design.
- Read blueprints, perform component measurements and utilize the Machinery's Handbook.

UNIT - I	**Surface Processing Operations**	Lecture Hrs: 09

Plating and Related Processes, Conversion Coatings, Physical Vapor Deposition, Chemical Vapor Deposition, Organic Coatings, Porcelain Enameling and other Ceramic coatings, Thermal and Mechanical Coating Processes.

UNIT - II	**Un-conventional Machining Methods**	Lecture Hrs: 09

Abrasive jet machining - Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments. Ultrasonic machining: Elements of the process, machining parameters, effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters, economic considerations, applications and limitations.

UNIT - III	**Electro-Chemical Processes**	Lecture Hrs: 09

Electro-Chemical Processes: Fundamentals of electro chemical machining, metal removal rate in ECM, Tool design, Surface finish and accuracy economics aspects of ECM.
Wire EDM Process: General Principle and applications of Wire EDM, Mechanics of metal removal, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy.

UNIT - IV	**Electron Beam Machining**	Lecture Hrs: 09

Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages, limitations, comparison of thermal and non-thermal processes.
Plasma Arc Machining: Principle, machining parameters, effect of machining parameters on surface finish and metal removal rate, applications, limitations

UNIT - V	**Laser Beam Machining**	Lecture Hrs: 09

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Principle, effect of machining parameters on surface finish, applications, and limitations. **Rapid Prototyping:** Working principle, methods-Steriolithography, Laser sintering, Fused deposition method, applications and limitations.
Text Books:
1. Manufacturing Technology - P. N. Rao, TMH Publishers 2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons Publishers
Reference Books:
1.Production Technology - HMT 2.Manufacturing Science - Cambel 3.Welding Technology - R.S, Parmar, 4. Introduction to Nanotechnology - Poole and Owens, Wiley (2003). Outcomes
Online Learning Resources:
• https://nptel.ac.in/courses/112/107/112107078/ • https://youtu.be/t3y_Ys3LgGM • https://www.youtube.com/watch?v=E4VZ_rFqpG4&t=1s • https://youtu.be/-tcaR7oSx_w • https://youtu.be/Uybg6VDLoRQ • https://youtu.be/Uybg6VDLoRQ • https://youtu.be/aWQsEX1TrSI

Course Code	**QUALITY ENGINEERING AND MANUFACTURING**	**L**	**T**	**P**	**C**
21D04103b	**Program Elective Course - II**	**3**	**0**	**0**	**3**
	Semester	**I**			

Course Objectives: Student will be able to

- To impart through knowledge in various latest measurement systems such as laser metrology, coordinate measuring machines and electro-optical devices. To train them in the area of precision and quality manufacturing

Course Outcomes (CO): Student will be able to

- Know the importance of the quality in their life and can make it as their habbit in all their activities.

UNIT - I	**Quality value and Engineering**	Lecture Hrs:09

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An overall quality system, quality engineering in production design, quality engineering in design production processes		
UNIT - II	**Loss function and quality level**	Lecture Hrs: 09
Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances (N-type-, S-type and L-type)		
UNIT - III	**Tolerance Design and Tolerancing**	Lecture Hrs: 09
Functional limits, tolerance design for N-type, L-type and S-type characteristics, tolerance allocation for multiple components. **Parameter and tolerance design:** Introduction to parameter design, signal to noise ratios, parameter design strategy, Introduction to tolerance design, tolerance design using the loss function, identification of tolerance design factors.		
UNIT - IV	**Design of Experiments**	Lecture Hrs: 09
Introduction, Task aids and Responsibilities for DOE process steps, DOE process steps description. **Analysis of variance (ANOVA):** no-WAY ANOVA, One-way ANOVA, two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.		
UNIT - V	**Orthogonal Arrays**	Lecture Hrs: 09
Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment. **Interpolation of experimental results:** Interpretation methods, percent contribution, estimating the mean **ISO-9000** Quality system, BDRE, 6-sigma, bench marking, quality circles-brain storming-fishbone diagram-problem analysis.		
Text Books:		
1. Taguchi techniques for quality engineering/Philip J.Ross / McGraw Hill Intl. 2nd Edition, 1995.		
Reference Books:		
1. Quality Engineering in Production systems/G.Taguchi, A.Elasayed et al/Mc.Graw Hill Intl. Edition, 1989. 2. Taguchi methods explained: Practical steps to Robust Design/Papan P.Bagchi/Prentice Hall Ind. Pvt. Ltd. New Delhi.		
Online Learning Resources:		
• https://quality-one.com/quality-engineering/ • https://en.wikipedia.org/wiki/Quality_engineering • https://youtu.be/5_hng9rgVHE • https://www.youtube.com/watch?v=oIG_NDb2g3U		

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- https://nptel.ac.in/courses/110/104/110104080/
- https://nptel.ac.in/courses/110/105/110105088/

Course Code	**COMPUTER AIDED PROCESS PLANNING**	**L**	**T**	**P**	**C**
21D04103c	**Program Elective Course - II**	**3**	**0**	**0**	**3**
	Semester	**I**			

Course Objectives: Student will be able

- To know the various steps involved in CAPP
- To classify the various methods of CAPP
- To understand the feature recognition in CAP
- Notable requirements for process planning systems are consistency, accuracy, and ease of application and completeness.

Course Outcomes (CO):

- Generate the structure of automated process planning system and uses the principle of generative and retrieval CAPP systems for automation
- Select the manufacturing sequence and explains the reduction of total set up cost for a particular sequence
- Predict the effect of machining parameters on production rate, cost and surface quality and determines

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the manufacturing tolerances

- Explain the generation of tool path and solve optimization models of machining processes
- Create awareness about the implementation techniques for CAPP

UNIT - I	**Introduction to CAPP**	Lecture Hrs: 09

Information requirement for process planning system, Role of process planning, advantages of conventional process planning over CAPP, Structure of Automated process planning system, feature recognition, methods.

Generative CAPP system: Importance, principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.

UNIT - II	**Retrieval CAPP system**	Lecture Hrs: 09

Significance, group technology, structure, relative advantages, implementation, and applications **Selection of manufacturing sequence:** Significance, alternative manufacturing processes, reduction of total set-up cost for a particular sequence, quantitative methods for optimal selection, examples.

UNIT - III	**Determination of machining parameters**	Lecture Hrs: 09

Reasons for optimal selection of machining parameters, effect of parameters on production rate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

Determination of manufacturing tolerances: design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach**,** integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach

UNIT - IV	**Generation of tool path**	Lecture Hrs: 09

Simulation of machining processes, NC tool path generation, graphical implementation, determination of optimal index positions for executing fixed sequence, quantitative methods.

UNIT - V	**Implementation techniques for CAPP**	Lecture Hrs: 09

MIPLAN system, Computer programming languages for CAPP, criteria for selecting a CAPP system and benefits of CAPP. Computer integrated planning systems, and Capacity planning system.

Text Books:

1Automation , Production systems and Computer Integrated Manufacturing System –Mikell P.Groover
2..Computer Aided Design and Manufacturing – Dr.Sadhu Singh.

Reference Books:

1. Computer Aided Engineering – David Bedworth

Online Learning Resources:

- https://nptel.ac.in/courses/112/104/112104188/

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- https://www.youtube.com/watch?v=20_K7c65Swg
- https://www.youtube.com/watch?v=y24meNZbUoU
- https://youtu.be/PRjExZxWsNc
- https://nptel.ac.in/courses/103/103/103103164/

Course Code	**GEOMETRIC MODELLING LABORATORY**	**L**	**T**	**P**	**C**
21D04104		**0**	**0**	**4**	**2**
	Semester	**I**			

Course Objectives: Student will be able

- To train the students with CAD packages
- To impart the 2D and 3D modeling skills to the students.
- To import and export different IGES files from one software to another

Course Outcomes (CO):

- Students will be able to design different parts of mechanical equipments
- Students will be able to apply their skills in various designing and Manufacturing Industries.

List of Experiments:

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A – MODELLING

1.Generation of the following curves using "C" language

i. Bezier curves
ii. Splines
iii. B-Splines

2.Generation of the following surfaces using "C" language

i. Bezier surfaces
ii. B-Splines surfaces

3. Generation of solids using "C"

i. Constructive solid geometry
ii. Boundary representation

4. Typical tasks of Modeling using PRO/E,IDEAS, CATIA solid modeling packages

Surface modeling
Solid Modeling
Drafting and
Assembly Module

Course Code	**FINITE ELEMENT ANALYSIS LABORATORY**	**L**	**T**	**P**	**C**
21D04105		**0**	**0**	**4**	**2**
	Semester	**I**			

Course Objectives:

- Students should use the commercial software or programmes form 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.

Course Outcomes (CO): Student will be able to

- Select appropriate element for given problem
- Select suitable meshing and perform convergence test
- Select appropriate solver for given problem
- Interpret the result
- Apply basic aspects of FEA to solve engineering problems

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- Validate FEA solution

List of Experiments:

Finite Element Analysis using ANSYS 14.5 Package for different structures the discretization can be done with 1-D, 2-D & 3-D elements to perform the following analysis:

1. Static Analysis

a. Stress analysis of 2D truss.

b. Stress analysis of a plate with a circular hole and L-Bracket – 2D and 3D
c. Stress analysis of beams (cantilever, simply supported & fixed ends)

d. Stress analysis of an axi-symmetric component

2. Thermal and Fluid flow Analysis

a. Conductive heat transfer analysis of a 2D and 3D components
b. Convective heat transfer analysis of a 2D component

c. Coupled field analysis of a component

d. Determination of velocity of a fluid and volumetric flow rates for 1-D Fluid flow \

e. Determination of velocity of a fluid and volumetric flow rates for 2-D Fluid flow

3. Modal Analysis

a. mode frequency analysis of a 2D component

b. mode frequency analysis of beams (cantilever, simply supported, fixed ends)

4. Transient analysis

a. Transient analysis of a cantilever beam

5. FEM through MAT LAB

a. Introduction to MAT LAB

b. Analysis of 1-dimesional & 2D dimensional truss.

c. Analysis of 1-dimesional & 2D dimensional beam. d. Analysis of 1-dimesional & 2D dimensional heat conduction.

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Lab Manual

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Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
21DRM101		2	0	0	2
	Semester	I			

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I		Lecture Hrs:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT - II		Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III		Lecture Hrs:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - IV		Lecture Hrs:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V		

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

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2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

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Course Code	ADVANCED OPTIMIZATION TECHNIQUES	L	T	P	C
21D04201		3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

- To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems
- To develop and promote research interest in applying optimization techniques in problems of Engineering and Technology
- To apply the mathematical results and numerical techniques of optimization theory to concrete engineering problems.

Course Outcomes (CO): Student will be able to

- Understand importance of optimization of industrial process management
- Apply basic concepts of mathematics to formulate an optimization problem
- Analyse and appreciate variety of performance measures for various optimization problems

UNIT - I	INTRODUCTION AND ROBOT KINEMATICS	Lecture Hrs:09

Linear programming: Two-phase simplex method, Big-M method, duality, interpretation, applications.
Assignment problem: Hungarian's algorithm, Degeneracy, applications, unbalanced problems, traveling salesman problem.

UNIT - II	ROBOT DRIVES AND CONTROL	Lecture Hrs: 09

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

UNIT - III	ROBOT SENSORS	Lecture Hrs: 09

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT - IV	ROBOT CELL DESIGN AND APPLICATION	Lecture Hrs: 09

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,
Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT - V	ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	Lecture Hrs: 09

Dominated sorted GA, convergence criterion, applications of multi-objective problems .

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Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence
Text Books:
1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers 2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers 3. Engineering Optimization – S.S.Rao, New Age Publishers
Reference Books:
1.Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers 2. Genetic Programming- Koza 3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

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Course Code	INDUSTRIAL ROBOTICS & EXPERT SYSTEMS	L	T	P	C
21D04202		3	0	0	3
	Semester	II			

Course Objectives:

- To teach students the basics of robotics, construction features, sensor applications, robot cell design, robot programming and application of artificial intelligence and expert systems in robotics.

Course Outcomes (CO): Student will be able to

- Students are to the basics kinematics of robotics, and are able to understand the robot programming and also artificial intelligence and expert systems in robotics

UNIT - I	INTRODUCTION AND ROBOT KINEMATICS	Lecture Hrs:09

Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT - II	ROBOT DRIVES AND CONTROL	Lecture Hrs: 09

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT - III	ROBOT SENSORS	Lecture Hrs: 09

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

UNIT - IV	ROBOT CELL DESIGN AND APPLICATION	Lecture Hrs: 09

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

UNIT - V	ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	Lecture Hrs: 09

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

Text Books:

1. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987

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2. Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987

Reference Books:

1. Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, 1985.
2. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
3. Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
4. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.
5. Timothy Jordanides et al ,"Expert Systems and Robotics ", Springer –Verlag, New York, May 1991.

Online Learning Resources:

- https://freevideolectures.com/course/4560/nptel-mechanism-robot-kinematics
- https://see.stanford.edu/course/cs223a
- https://cosmolearning.org/courses/introduction-to-robotics/video-lectures/
- https://www.youtube.com/watch?v=0yD3uBshJB0
- https://nptel.ac.in/courses/112/105/112105236/
- https://www.youtube.com/watch?v=xrwz9IxpMJg
- https://www.coursehero.com/file/59785981/Lecture-9-Robot-cell-designppt/
- https://www.plantautomation-technology.com/articles/different-types-of-robot-programming-languages

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Course Code	CNC TECHNOLOGY & PROGRAMMING	L	T	P	C
21D04203a	Program Elective Course - III	3	0	0	3
	Semester	II			

Course Objectives: Student will be able to study

- Safety in the CNC environment
- CNC Machine Tools compared to Manual Machine tools
- Repeatability and Speed is the Key to CNC C. Programming
- Manual Programming
- CAD/CAM Programming CNC Lathe 1. Uses 2. Setups 3. Tooling 4. CNC Lathe Project
- CNC Mill a. Uses b. Setups c. Tooling d. CNC Mill Project Course Topic

Course Outcomes (CO): Student will be able to

Upon completion of this course, the student will be able to:

- Understand the basic procedures and concepts of programming, set up and operation of a
- CNC Machining Centre.
- Identify and understand the basic programming codes.
- Create geometry and tool paths from the specifications on a blueprint for simple parts using
- Master cam programming software.
- Identify and define the functions of the CNC machine control.
- Set up the CNC machining center for manufacturing simple parts
- Manufacture simple parts on the CNC machining center.

UNIT - I	Introduction to CNC Machine tools	Lecture Hrs: 09

Evolution of Computerized control in manufacturing, Components, Working principle of CNC, DNC and Machining centers.
Constructional features of CNC machine tools: Introduction, Spindle drives, Transmission belting, axes feed drives, Slide ways, Ball screws.
Accessories: Work tables, Spindles, Spindle heads, Beds and Columns, Tooling – Automatic Tool changer (ATC).

UNIT - II	Feedback devices	Lecture Hrs: 09

Introduction, Digital incremental displacement measuring systems, Incremental rotary encoders, Moire fringes, Digital absolute measuring system.
Electro-magnetic analogue position transducers: Principle, advantages, characterstics, Synchros, Synchro-Resolvers, Inductos, Laser interferometer.

UNIT - III	Control Systems and interface	Lecture Hrs: 09

Open and closed loop systems, Micro processor based CNC systems, block diagram of typical CNC system, description of hard ware and soft interpolation systems, Standard and optional features of CNC control systems.

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UNIT - IV	**APT programming**	Lecture Hrs: 09
APT language structure, APT geometry, Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to point motion commands, continuous path motion commands, post processor commands, control commands, Macro subroutines, Part programming preparation for typical examples.		
UNIT - V	**Economics and Maintenance of CNC machine tools**	Lecture Hrs: 09
Introduction, factors influencing selection of CNC machines, Cost of operation of CNC machines, Maintenance features of CNC machines, Preventive maintenance, Documentation, Spare parts, Training in Maintenance.		

Text Books:

1.Computer Numerical Control Machines – Dr. Radha Krishnanan, New Central Book Agency

2. Computer Numerical Control Machines – Hans B. Keif and T. Frederick Waters Macmillan/McGraw Hill.

Reference Books:

1.CNC Machines – B.S. Aditahn and Pabla

2. CNC Machining technology – Springer – Verlag

3. Computer Numerical Machine tools - G.E. Thyer, NEWNES

Online Learning Resources:

- https://nptel.ac.in/courses/112/105/112105211/
- https://academy.titansofcnc.com/files/Fundamentals_of_CNC_Machining.pdf http://home.iitk.ac.in/~nsinha/CNC.pdf
- https://www.thomasnet.com/articles/custom-manufacturing-fabricating/understanding-cnc-machining/
- https://www.hubs.com/knowledge-base/cnc-machining-manufacturing-technology-explained/
- https://www.youtube.com/watch?v=P0BvBbQoiok
- https://www.youtube.com/watch?v=bfTQVixviAo
- https://en.wikipedia.org/wiki/APT_(programming_language)

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Course Code	COMPUTER GRAPHICS	L	T	P	C
21D04203b	Program Elective Course - III	3	0	0	3
	Semester	II			

Course Objectives:

- The students can understand the Basics of computer Graphics like drawing line, arc etc., Drawing of spline curves, Creation of surfaces, Algorithms for 3D viewing, Available drawing standards.

Course Outcomes (CO): Student will be able to understand

- Basics of computer Graphics like drawing line, arc etc.
- Drawing of spline curves
- Creation of surfaces
- Algorithms for 3D viewing
- Available drawing standards
- Basics of computer Graphics like drawing line, arc etc.

UNIT - I	Introduction to computer graphics	Lecture Hrs: 09

Color CRT raster scan monitors, plasma display & liquid crystal display monitors, computer input devices, hard copy devices.
Raster scan graphics: Line drawing algorithms – DDA & Bresenham algorithms, circle generation, general function rasterization, displaying lines, characters and polygons.

UNIT - II	Filling algorithms	Lecture Hrs: 09

polygon filling, edge fill algorithm, seed fill algorithm, fundamentals of antialiasing and half toning.

UNIT - III	Line CLIPPING	Lecture Hrs: 09

Simple visibility algorithm, Cohen-Sutherland subdivision line clipping algorithm, mid point sub division algorithm.
Polygon clipping: polygon clipping, reentrant polygon clipping – Sutherland – Hodgeman algorithm, character clipping, 3D- clipping.

UNIT - IV	Transformations	Lecture Hrs: 09

Cartesian and homogeneous coordinate systems two dimensional and three dimensional transformations – scaling, rotation, Shearing, Zooming, viewing transformation, reflection, rotation about an axis, concatenation.

UNIT - V	Rendering	Lecture Hrs: 09

Hidden line removal algorithms, surface removal algorithms, painters, Warnock, Z-buffer algorithm.
Shading algorithms: Constant intensity algorithm, Phong's shading algorithm, gourand shading algorithm, Comparison of shading algorithms.

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Text Books:

1. Procedural elements for computer graphics-D.F.Rogers, Tata McGraw-Hill.
2. Computer Graphics-Donald Hearn & M.P. Bakers.

Reference Books:

1. Computer graphics-Harrington.

Online Learning Resources:

- https://lecturenotes.in/subject/59/computer-graphics-cg
- https://www.dgp.toronto.edu/~hertzman/418notes.pdf
- http://www2.cs.uidaho.edu/~jeffery/courses/324/lecture.html
- http://personal.ee.surrey.ac.uk/Personal/J.Collomosse/pubs/cm20219.pdf
- http://www.svecw.edu.in/Docs%5CCSECGLNotes2013.pdf
- https://www.youtube.com/watch?v=fwzYuhduME4
- https://nptel.ac.in/courses/106/103/106103224/
- https://nptel.ac.in/courses/106/102/106102065/

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	GLOBAL INTEGRATED MANUFACTURING	L	T	P	C
21D04203c	Program Elective Course - III	3	0	0	3
	Semester	II			

Course Objectives: Student will be able to understand

- Globaly Emphasizes the integration of manufacturing enterprise using computer-
- integrated manufacturing (CIM) technologies.
- It employs CAD/CAM interface and
- other CIMsubsystems, database management, facility layout, Grouptechnology, teamwork, and manufacturing operations.

Course Outcomes (CO): Student will be able to

- Develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.
- Obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc, as they apply to factory management and factory floor operations.
- Describe the integration of manufacturing activities into a complete system.

UNIT - I	INTRODUCTION	Lecture Hrs: 09

Evolution of manufacturing, CAD/CAM and CIM – Globalization - Scope of CIM - Segments of generic CIM, computers and workstations, an overview of CIM software. World class manufacturing and its importance.

UNIT - II	GLOBAL MANUFACTURING ENTERPRISE	Lecture Hrs: 09

Global manufacturing revolution – Reconfigurable machine – Reconfigurable manufacturing system - Production design for globalization – Location of manufacturing plants – Global business strategies – Global strategic alliance – IT-based enterprise – Information transfer in manufacturing systems - PRIDE – Competitive advantage: Logistics – Strategic sourcing - Supply chain - The dilemma of globalization – Where manufacturing enterprises heading?

UNIT - III	INTERNATIONAL LOGISTICS	Lecture Hrs: 09

Introduction – supply chain background - outbound logistics functions – inbound logistics functions – overall logistics activities – logistics intermediates. Economic importance. Logistics media: ocean ships (cargo types), air transportation, surface transportation. Terms of sale and payment. Documentation and insurance: cargo, hull, air, land transport – settlement of insurance – claims. Famine relief logistics – demand forecasting – sourcing models – packaging – managing inventories - site/route selection – warehousing and storage.

INTERNAL SOURCING: Introduction – why sourcing is global? – design of global sourcing system – global sourcing and procurement – issues in import and export.

FUTURE ISSUES IN INTERMEDIATE LOGISTICS: Overview – increase use of world-class logistics practices – multi-country trade alliances – one stop shopping concept – amodalism – environmental concerns – space transportation and exploration – The internet.

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UNIT - IV	**CNC TECHNOLOGY AND ROBOTIC SYSTEMS**	Lecture Hrs: 09

Principles of numerical control, types of CNC machines, features of CNC systems, programming techniques, capabilities of a typical NC, CAM software, integration of CNC machines in CIM environment, DNC – FMS – objectives – components – FMS layout configurations – FMS classification – ERP. Material handling systems – basics and advanced: conveyor analysis, AGV analysis. Warehousing – storage and retrieval systems: AS/RS analysis. Overview of JIT. Robotic systems-types of robots and their performance capabilities, programming of robots, hardware of robots, kinematics of robots, product design for robotized manufacturing, applications of robots in manufacturing and assembly. Process planning, variant and generative process planning methods – manual vs CAPP - AI in process planning.

UNIT - V	**MANUFACTURING SYSTEM SOFTWARE**	Lecture Hrs: 09

CIM architecture - Production management system (PMS) - forecasting, master production schedule, MRP, capacity planning, shop floor control (SFC), factory data collection system (FDS) – Automatic data capture (ADC) method and its techniques – Bar code – types of bar codes – Data acquisition system - inventory management, product routing, job costing, marketing applications – Applications of ADC - Basics of networking concepts, networking devices.
VIRTUAL ORGANISATION: Paperless factory – Mobile office - Introduction of virtual reality and application - Virtual prototyping – Virtual manufacturing - Virtual instrumentation and measurement - Virtual enterprises.

Text Books:

1. Donal F Wood, Anthony P Barone, Paul R Murthy and Daniel L Wardlow, “International logistics”, AMACOM, 2007.
2. Voram Koren, “The Global Manufacturing Revolution: Product – Process – Business Integration and Reconfigurable Systems”, Kindle Edition, 2011.
3. Mikell P Groover, “Automation of Production Systems and Computer Integrated Manufacturing”, Pearson Education, New Delhi, 2001.

Reference Books:

1. Lee Kunwoo, “CAD/CAM/CAE Systems”, Addition, Wesley, USA, 1999.
2. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall, India, New Jersey, 2003.
3. Radha krishnan P, Subramanyan S and Raju V, “CAD/CAM/CIM”, New Age International Pvt. Ltd, New Delhi,

Online Learning Resources:

- https://nptel.ac.in/courses/112/104/112104289/
- https://nptel.ac.in/courses/112/105/112105249/
- https://www.youtube.com/watch?v=lRm9GiGoZKg
- https://osme.co.in/wp-content/uploads/2020/05/6TH-SEM-MECHANICAL-ENGG-Advance-manufacturing-and-CAD-CAM.pdf
- https://www.cet.edu.in/noticefiles/259_Lecturer%20Note%20on%20Mechatronics-ilovepdf-compressed.pdf

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Course Code	MECHATRONICS APPLICATIONS IN MANUFACTURING (PE-IV)	L	T	P	C
21D04204a		3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

- Understand architecture of the mechatronics system design and characteristics of sensors and actuators and their selection for mechatronic systems.
- Learn the basic concepts of microprocessor, microcontroller and PLC used in mechatronics system.
- Learn underlying concepts of MEMS and its applications in micro-manufacturing.

Course Outcomes (CO): At the end of the course the students shall be able to

- Interface sensor and actuator for a mechatronic system.
- Indigenously design and develop a mechatronic system.
- Design and develop MEMS for various industrial applications.

UNIT - I	INTRODUCTION	Lecture Hrs: 09

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design.

UNIT - II	SENSORS AND TRANSDUCERS	Lecture Hrs:09

Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion - Fluid pressure - Temperature sensors - Light sensors - Selection of sensors – Signal processing - Servo systems.

UNIT - III	MICROPROCESSORS IN MECHATRONICS	Lecture Hrs: 09

Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters – Applications - Temperature control - Stepper motor control - Traffic light controller.

UNIT - IV	PROGRAMMABLE LOGIC CONTROLLERS	Lecture Hrs: 09

Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC.

UNIT - V	DESIGN AND MECHATRONICS	Lecture Hrs: 09

Designing - Possible design solutions - Case studies of Mechatronics systems.

Text Books:

1. Michael B.Histand and David G. Alciatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.

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2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ, "Mechatronics ", Chapman and Hall, 1993.
3. Ramesh.S, Gaonkar, "Microprocessor Architecture, Programming and Applications" Wiley Eastern, 1998.

Reference Books:

1.Lawrence J.Kamm, " Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", Prentice-Hall, 2000.
2. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, "Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall, 1995.

Online Learning Resources:

- https://www.cet.edu.in/noticefiles/259_Lecturer%20Note%20on%20Mechatronics-ilovepdf-compressed.pdf
- https://lecturenotes.in/subject/137/mechatronics-mech
- http://engineering.nyu.edu/mechatronics/Control_Lab/Criag/Craig_RPI/2001/Mechatronics%20Lecture%20Notes.htm
- https://jcboseust.ac.in/mechanical/images/mtech1stsem/mechatronics_product_design.pdf
- https://www.youtube.com/watch?v=tAkkUNEknGk
- https://nptel.ac.in/courses/112/107/112107298/
- https://www.youtube.com/watch?v=ncSnIkBO-X0

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Course Code	RAPID PROTOTYPING	L	T	P	C
21D04204b	Program Elective Course - IV	3	0	0	3
	Semester	II			

Course Objectives:

- At the end of this course the students would have developed a thorough understanding of the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping Technologies.

Course Outcomes (CO): Student will be able to

- It helps the students to get familiarized with the various methods of rapid prototyping technologies and rapid tooling.

UNIT - I	Introduction	Lecture Hrs:09

Need for the compression in product development, History of RP system, Survey of applications, Growth of RP industry and classification of RP system.
Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

UNIT - II	Fusion Decomposition Modeling	Lecture Hrs:09

Principle, process parameter, Path generation, Applications.
Solid ground curing: Principle of operation, Machine details, Applications,

UNIT - III	Laminated Object Manufacturing	Lecture Hrs:09

Principle of Operation, LOM materials, Process details, Applications.
Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genisys Xs printer HP system 5, Object Quadra system.

UNIT - IV	LASER ENGINEERING NET SHAPING (LENS)	Lecture Hrs:09

Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling, Cast kriksite, 3Q keltool, etc, Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft, Tooling vs. hard tooling.

Software for RP: STL files, Overview of Solid view, magics, imics, magic communication, etc. Internet based software, Collaboration tools.

UNIT - V	Rapid Manufacturing Process Optimization	Lecture Hrs:

Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of

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build orientation.

Text Books:

1.“ stereo lithography and other RP & M Technologies**”**, Paul F.Jacobs, SME, NY 1996

2. “ Rapid Manufacturing **”,** Flham D.T & Dinjoy S.S, Verlog London 2001

Reference Books:

1. Rapid automated**”**, Lament wood, Indus Press New York.

Online Learning Resources:

- https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/
- https://slideplayer.com/slide/6927137/
- https://www.mdpi.com/2073-4360/12/6/1334
- https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-%20FDM.pdf
- https://lecturenotes.in/subject/197
- https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
- https://www.youtube.com/watch?v=NkC8TNts4B4

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Course Code	ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS (PE-IV)	L	T	P	C
21D04204c		3	0	0	3
	Semester	II			

Course Objectives:

- The student should be made to study the concepts of Artificial Intelligence. 1.Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.

Course Outcomes (CO): Student will be able to

- Identify problems that are amenable to solution by AI methods.
- Identify appropriate AI methods to solve a given problem.
- Formalise a given problem in the language/framework of different AI methods.
- Implement basic AI algorithms.
- Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

UNIT - I	Artificial Intelligence	Lecture Hrs:09

Introduction, definition, underlying assumption, Important of Al, Al & related fields State space representation, defining a problem, production systems and its characteristic, search and control strategies –Introduction, preliminary concepts, examples of Search , problems.
Uniformed or preliminary Concept: Examples of search problems, Uniformed or Blind Search, Informed Search, Or Graphs, Heuristic Search techniques- Generate and Test, Hill climbing, Best first search, Problem reduction, Constraint satisfaction, Means- Ends Analysis.

UNIT - II	Knowledge Representation Issues	Lecture Hrs: 09

Representations and Mapping, Approaches, Issues in Kr, Types of knowledge procedural Vs Declarative, Logic programming, Forward Vs Backward reasoning, Matching, Non monotonic reasoning and it logic.
Use of Predicate Logic: Representing simple facts, Instance and is a relationships, Syntax and Semantics for Propositional logic, FOPL, and properties of Wffs, conversion to casual form, Resolution, Natural deduction.

UNIT - III	Statistical and Probabilistic Reasoning	Lecture Hrs: 09

Symbolic reasoning under uncertainly, Probability and Bayes theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster- Shafer Theory, Fuzzy Logic.

UNIT - IV	Expert Systems	Lecture Hrs: 09

Introduction, Structure and uses, Representing and using domain knowledge, Expert System Shells. Pattern recognition, introduction, Recognition and classification process, learning classification patterns, recognizing and understanding speech.
Introduction to Knowledge Acquisition: Types of learning, General learning model, and

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performance measures.		
UNIT - V	**Typical Expert Systems**	Lecture Hrs: 09
MYCIN, Variants of MYCIN, PROSPECTOR DENDRAL, PRUFF etc. **Introduction to Machine Learning:** Perceptons, Checker Playing examples, Learning, Automata, Genetic Algorithms, Intelligent Editors.		

Text Books:

1. " Artificial Intelligence**"** , Elaine Rich & Kevin Knight**,**M/H 1983
2. **"**Artificial Intelligence in Business**"**, Wendry B.Ranch**,** Science & Industry –Vol -II application, Ph 1985.
3. **"** A Guide to Expert System**"** Waterman, D.A., Addison,– Wesley inc. 1986.

Reference Books:

1. **"**Building expert sys**tem"** Hayes, Roth, Waterman, D.A (ed), AW 1983.
2. **"**Designing Expert System**"**, S.M. and Kulliknowske Weis, London Champion Hull 1984.

Online Learning Resources:

- https://www.youtube.com/watch?v=11nzrNkn9D8
- https://www.youtube.com/watch?v=BXHcPESoaPY
- https://silo.tips/download/module-9-lecture-notes-5-expert-systems
- https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm
- https://epub.uni-regensburg.de/13629/1/ubr06078_ocr.pdf
- https://lecturenotes.in/subject/879/artificial-intelligence-and-expert-system
- https://www.vssut.ac.in/lecture_notes/lecture1530018613.pdf
- https://www.cet.edu.in/noticefiles/271_AI%20Lect%20Notes.pdf

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Course Code	PROCESS AUTOMATION LABORATORY	L	T	P	C
21D04205		3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

To review and train in CAD modeling.
To train on various areas of finite element analysis of mechanical components.
CAM lab
To train on part programming and program generation from a CAD model.
To train on machining in various CNC machines.
To train on various modern measuring instruments.

Course Outcomes (CO): Student will be able to

Students will be able to review and train in CAD modeling.
Students will be get trained on various areas of finite element analysis of mechanical components.
Students would get trained on part programming and program generation from a CAD model•
Students would get trained on machining in various CNC machines, Students would get trained on various modern measuring instruments.

List of Experiments:

1. Aristo XT Six axis Robot
   a. Introduction to Robot programming
   b. Robot programming exercises (Point-to-Point and continuous path task)

2. Either Online / Offline mode.
   a. Simulation of a manufacturing system for increasing production rate.
   b. Simulation of a simple automation system.

3. Either Online / Offline mode.
   I. Hydraulic Circuits
      a. Introduction to Automation studio & its control
      b. Draw & Simulate the Hydraulic circuit for series & parallel cylinders connection
      c. Draw & Simulate Meter-in, Meter-out and hydraulic press and clamping.
      d. Sequencing circuits in hydraulics.
      e. Synchronizing circuits in hydraulics.
   II. Pneumatic circuits
      a. Sequencing circuits in Pneumatics.
      b. Synchronizing circuits in Pneumatics.
      c. Design and Simulation of simple pneumatic circuit by using Cascade Method.
      d. Design and Simulation of simple pneumatic circuit by using step counter method
4. Additive manufacturing machine
   a. Introduction to Additive manufacturing Machine.
   b. Design and fabrication of simple symmetrical and unsymmetrical components

Text Books: Lab Manual

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M.TECH. IN CAD/CAM
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Course Code	CAM LAB	L	T	P	C
21D04206		3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

- To get practical knowledge on manual part programming of CNC lathe machine by using G codes and M codes.
- To get practical knowledge on manual part programming of CNC milling and drilling machine by using G• codes and M codes.
- To get the practical knowledge on APT language.•

Course Outcomes (CO):

- Upon successful completion students should be able to:
- Use an understanding of General and Machine (G& M) code to generate or edit a program which will operate a CNC Lathe.
- Apply mathematical methods to calculate Cartesian coordinates

List of Experiments:

1. Manual part programming (using G and M codes) in CNC Lathe Machine
   (a) Part programming for linear interpolation, circular interpolation, chamfering and grooving.
   (b) Part programming by using standard canned cycles for facing, turning, taper turning and thread cutting.
2. Manual part programming (using G and M codes) in CNC Milling Machine
   (a) Part programming for linear interpolation, circular interpolation and contour motions.
   (b) Part programming involving canned cycles for drilling peak drilling and boring.
3. APT (Automatically Programmed Tools) language in CNC Milling and Lathe machine.
4. Cutting tool path generation using any one simulation package for different machining operation

Text Books: Lab Manual

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Course Code	ADVANCED TOOL DESIGN	L	T	P	C
21D04301a	Program Elective Course - V	3	0	0	3
	Semester	III			

Course Objectives:

The purpose of this course is to make the students to get familiarized with the design of various tools that can be implemented for different mechanical operations.

Course Outcomes (CO):

It helps the students to get familiarized with advanced tool design for various mechanical operations which includes cutting, jigs and fixtures, press tool dies and modern CNC machine tools.

UNIT - I	INTRODUCTION TO TOOL DESIGN	Lecture Hrs: 09

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment.

UNIT - II	DESIGN OF CUTTING TOOLS	Lecture Hrs: 09

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

UNIT - III	DESIGN OF JIGS AND FIXTURES	Lecture Hrs: 09

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Thrust and Turning Moments in drilling - Drill jigs and modern manufacturing- Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Modular Fixtures – Cutting Force Calculations.

UNIT - IV	DESIGN OF PRESS TOOL DIES	Lecture Hrs: 09

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing dies-Design and drafting.

UNIT - V	TOOL DESIGN FOR CNC MACHINE TOOLS	Lecture Hrs: 09

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

Text Books:

1. Cyrll Donaldson, George H.LeCain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2000.
2. E.G.Hoffman,” Jig and Fixture Design”, Thomson Asia Pvt Ltd, Singapore, 2004.

Reference Books:

1. Prakash Hiralal Joshi, “Tooling data”, Wheeler Publishing, 2000
2. Venkataraman K., “Design of Jigs, Fixtures and Presstools”, TMH, 2005

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3. Haslehurst M., "Manufacturing Technology", The ELBS, 1978.
Online Learning Resources:
https://www.iare.ac.in/sites/default/files/lecture_notes/TOOL%20DESIGN_Lecture_Notes.pdf https://www.cet.edu.in/noticefiles/261_MMP%20Lecture%20Notes-ilovepdf-compressed.pdf https://www.vssut.ac.in/lecture-notes.php?url=production-engineering https://nptel.ac.in/courses/112/105/112105233/ https://www.youtube.com/watch?v=7MkX-sW97rI https://nptel.ac.in/courses/112/105/112105126/# https://youtu.be/7yzvno4AvKw

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Course Code	DESIGN FOR MANUFACTURING	L	T	P	C
21D04301b	Program Elective Course - V	3	0	0	3
	Semester	III			

Course Objectives: Student will be able to

- Internalize the attributes along which the success or failure of a manufacturing process, machine, or system will be measured: quality, cost, rate and flexibility.
- Provide exposure to a range of current industrial processes and practices used to manufacture products in high and low volumes. Focus in depth on a few selectedprocesses.
- Understand the factors that control the rate of production and influence the quality, cost and flexibility of processes.
- Understand the impact of manufacturing constraints on product design and processplanning.
- Apply an understanding of variation to the factors that control the production rate and influence the quality, cost and flexibility of processes and systems.

Course Outcomes (CO): Student will be able to

- Manufacturing is how we satisfy human need and create wealth. The challenge is to create a product that is responsive to the customer with high quality and low cost. A graduate should have the tools and confidence to go into a manufacturing enterprise that is using an unfamiliar process to make a product he/she has not seen, and yet be able to make intelligent decisions.

UNIT - I		Lecture Hrs:09

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing 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		Lecture Hrs: 09

Machining processes: 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 - III		Lecture Hrs: 09

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design- product design rules for sand casting.

UNIT - IV		Lecture Hrs: 09

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Metal joining: Appraisal of various welding processes, factors in design of weldments – 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 dies – drop forging die design – general design recommendations.

UNIT - V		Lecture Hrs: 09

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components- design considerations for injection moulding

Textbooks:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,

Reference Books

1. ASM Hand book Vol.20

Online Learning Resources:

- https://nptel.ac.in/courses/112/101/112101005/
- https://www.iare.ac.in/sites/default/files/lecture_notes/DFMA_LECTURE_NOTES.pdf
- https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/lecture-notes/
- https://dokumen.tips/documents/design-for-manufacturing-and-assembly-1-lecture-notes-on-design-for-manufacturing.html
- https://www.youtube.com/watch?v=ofmbhbVCUqI
- https://onlinecourses.nptel.ac.in/noc21_me66/preview

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Course Code	COMPUTER AIDED TOOLS FOR MANUFACTURING	L	T	P	C
21D04301c	Program Elective Course - V	3	0	0	3
	Semester	III			

Course Objectives:

- The purpose of this course is to make the students to get familiarized with various computer aided tools that can be implemented in various industrial applications.

Course Outcomes (CO): Student will be able to

- It helps the students to get familiarized with computer aided tools for various industrial applications which includes manufacturing, process planning, inspection, data management and reverse engineering.

UNIT - I	COMPUTER AIDED MANUFACTURING	Lecture Hrs:09

Manufacturing Processes – Removing, Forming, Deforming and joining – Integration Requirements. Integrating CAD, NC and CAM – Machine tools – Point to point and continuous path machining, NC, CNC and DNC – NC Programming – Basics, Languages, G Code, M Code, APT – Tool path generation and verification – CAD/CAM NC Programming – Production Control – Cellular Manufacturing.

UNIT - II	COMPUTER AIDED PROCESS PLANNING	Lecture Hrs:09

Role of process planning in CAD/CAM Integration – Computer Aided Process Planning – Development, Benefits, Model and Architecture – CAPP Approaches – Variant, Generative and Hybrid – Process and Planning systems – CAM-I, D-CLASS and CMPP – Criteria in selecting a CAPP System.

UNIT - III	COMPUTER AIDED INSPECTION	Lecture Hrs:09

Engineering Tolerances – Need for Tolerances – Conventional Tolerances – FITS and LIMITS – Tolerance Accumulation and Surface quality – Geometric Tolerances – Tolerances Practices in design, Drafting and manufacturing – Tolerance Analysis – Tolerance synthesis – Computer Aided Quality control – Contact Inspection Methods – Non Contact Inspection Methods – Non optical.

UNIT - IV	REVERSE ENGINEERING	Lecture Hrs:09

Scope and tasks of Reverse Engineering – Domain Analysis – Process Duplicating – Tools for RE – Developing Technical data – Digitizing techniques – Construction of surface model – Solid part model – Characteristic evaluation – Software's and its application – CMM and its feature capturing – surface and solid modeling.

UNIT - V	DATA MANAGEMENT	Lecture Hrs:09

Strategies for Reverse Engineering Data management – Software application – Finding renewable software components – Recycling real time embedded software – Design experiments to evaluate a RE tools – Rule based detection for RE user interface – RE of assembly programs.

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Text Books:

1. Ibrahim Zeid and R. Sivasubramanian, "CAD/CAM Theory and Practice", Revised First special Indian Edition, Tata Mc Graw Hill Publication, 2007
2. Catherine A. Ingle, "Reverse Engineering", Tata Mc Graw Hill Publication, 1994
3. Ibrahim Zeid, "Mastering CAD/CAM", special Indian Edition, Tata Mc Graw Hill Publication, 2007.

Reference Books:

1. David D. Bedworth, Mark R. Henderson, Philp M. Wolfe, "Computer Integrated Design and manufacturing", Mc Graw Hill International series, 1991
2. Linda Wills, "Reverse Engineering" Kluwer Academic Press, 1996
3. Donald R. Honra, "Co-ordinate measurement and reverse Engineering, American Gear Manufacturers Association.

Online Learning Resources:

- https://www.autodesk.com/products/fusion-360/blog/computer-aided-manufacturing-beginners/
- https://www.youtube.com/watch?v=EgKc9L7cbKc
- https://nptel.ac.in/courses/112/105/112105211/
- https://lecturenotes.in/subject/409/computer-aided-design-and-manufacturing-cadm
- https://www.youtube.com/watch?v=9dd3M2a4LKI
- https://www.iare.ac.in/sites/default/files/lecture_notes/CAD_CAM_LECTURE%20NOTES.pdf
- https://learnmech.com/computer-aided-inspection-cim-notes/
- https://canvas.instructure.com/courses/838884/pages/unit-3-lesson-6-reverse-engineering

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AUDIT COURSE-I

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COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I	Lecture Hrs:10
1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity	
UNIT - II	Lecture Hrs:10
Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization	
UNIT - III	Lecture Hrs:10
Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.	
UNIT - IV	Lecture Hrs:9
Key skills needed for writing a Title, Abstract, and Introduction	
UNIT - V	Lecture Hrs:9
Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions	

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	**I**			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluatedisasterriskreduction and humanitarian response policy and practice from
- Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.
Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics

UNIT - II

Repercussions of Disasters and Hazards:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'New Royal book

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Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

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Course Code	**SANSKRITFOR TECHNICAL KNOWLEDGE**	**L**	**T**	**P**	**C**
21DAC101c		**2**	**0**	**0**	**0**
	Semester	**I**			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I		
Alphabets in Sanskrit,		
UNIT - II		
Past/Present/Future Tense, Simple Sentences		
UNIT - III		
Order, Introduction of roots		
UNIT - IV		
Technical information about Sanskrit Literature		
UNIT - V		
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics		

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

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AUDIT COURSE-II

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

- Students will be able to understand:
- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what
- conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions. Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head
teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections:Researchdesign,Contexts,Pedagogy,Teachereducation, Curriculum and assessment, Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation

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research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	**II**			
Course Objectives: This course will enable students:					
• To achieve overall health of body and mind • To overcome stres					
Course Outcomes (CO): Student will be able to					
• Develop healthy mind in a healthy body thus improving social health also • Improve efficiency					
UNIT - I					
Definitions of Eight parts of yog.(Ashtanga)					
UNIT - II					
Yam and Niyam.					
UNIT - III					
Do`sand Don't'sin life. i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan					
UNIT - IV					
Asan and Pranayam					
UNIT - V					
i)Variousyogposesand theirbenefitsformind &body ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam					
Suggested Reading					
1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur 2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata					

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Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE	L	T	P	C
21DAC201c	ENLIGHTENMENTSKILLS	2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1."SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

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OPEN ELECTIVE

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COURSE STRUCTURE & SYLLABI

Course Code	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
21DOE301c		**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes (CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on
- data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and
- prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT - I	Lecture Hrs:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II	Lecture Hrs:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III	Lecture Hrs:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents. Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT - IV	Lecture Hrs:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT - V	Lecture Hrs:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.
2. Schniederjans, Christopher M. Starkey, Pearson FT Press.
3. Business Analytics by James Evans, persons Education.

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Course Code	**INTERNET OF THINGS (IOT)**	**L**	**T**	**P**	**C**
21DOE301g		**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives: Student will be able

- To study fundamental concepts of IoT
- To understand roles of sensors in IoT
- To Learn different protocols used for IoT design
- To be familiar with data handling and analytics tools in IoT
- Appreciate the role of big data, cloud computing and data analytics in a typical IoT system

Course Outcomes (CO): Student will be able to

- Understand the various concepts, terminologies and architecture of IoT systems.
- Use sensors and actuators for design of IoT.
- Understand and apply various protocols for design of IoT systems
- Use various techniques of data storage and analytics in IoT
- Understand various applications of IoT
- Understand APIs to connect IoT related technologies

UNIT – I	Lecture Hrs:09
Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M	
UNIT – II	Lecture Hrs: 09
Sensors Networks : Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.	
UNIT – III	Lecture Hrs: 09
Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols	
UNIT – IV	Lecture Hrs: 09
Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications	
UNIT - V	Lecture Hrs: 09
Applications of IoT: Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	
Textbooks:	

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1.Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Wiley Publications
2.Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications
3.Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
4.J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
5.Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.

Reference Books:

1.Daniel Minoli, — "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publication
2.Pethuru Raj and Anupama C. Raman, "The Internet of Things: EnablingTechnologies, Platforms, and Use Cases", CRC Press

Online Learning Resources:

https://onlinecourses.nptel.ac.in/noc17_cs22/course
http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

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Course Code	**MECHATRONICS**	**L**	**T**	**P**	**C**
21DOE301h		**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives: Student will be able

- To study fundamental concepts of Signal condition
- To understand the concepts of precision mechanical systems
- To Learn different electronic interface subsystems
- To be familiar with microcontrollers overview.
- To understand the concepts of programmable logic controllers

Course Outcomes (CO): Student will be able to

- Understand the various concepts, terminologies of Signal condition
- Understand the basics electronic interface subsystems
- Understand and apply various precision mechanical systems
- Understand various applications of microcontrollers overview
- Understand the controlling of programmable logic and programmable motion.

UNIT – I	Lecture Hrs:09

INTRODUCTION : Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.
SIGNAL CONDITIONING : Introduction – Hardware - Digital I/O, Analog input – ADC, resolution , speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps – Software - Digital Signal Processing – Low pass , high pass , notch filtering.

UNIT – II	Lecture Hrs: 09

PRECISION MECHANICAL SYSTEMS : Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Harmonic Transmission - Bearings- Motor / Drive Selection.

UNIT – III	Lecture Hrs: 09

ELECTRONIC INTERFACE SUBSYSTEMS : TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isoation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets
ELECTROMECHANICAL DRIVES : Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation

UNIT – IV	Lecture Hrs: 09

MICROCONTROLLERS OVERVIEW: 8051 Microcontroller , micro processor structure - DigitalInterfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly , C (LED Blinking , Voltage measurement using ADC).

UNIT - V	Lecture Hrs: 09

PROGRAMMABLE LOGIC CONTROLLERS : Basic Structure - Programming : Ladder diagram - Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling -

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Analog input / output - PLC Selection - Application. PROGRAMMABLE MOTION CONTROLLERS : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices :Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive ,
Textbooks:
1. A text book of Mechatronics by Er.R.K. RAJPUT ., S.CHAND publications 2. A text book of Mechatronics by Nitalgour Premchand Mahalik ., McGraw Hill publications
Reference Books:
1. A text book of Mechatronics by W.Bolton ., Pearson Publications