1st & 2nd Year, M. Tech.,

COURSE STRUCTURE AND SYLLABUS
FOR

COMPUTER INTEGRATED MANUFACTURING
(AR 22)

(Applicable for the batches admitted from 2024-25)

DEPARTMENT OF MECHANICAL ENGINEERING

ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(AN AUTONOMOUS INSTITUTION, PERMANENTLY AFFILIATED TO JNTUGV, VIZIANAGARAM)

Approved by AICTE, New Delhi, Accredited By NBA, AICTE & NAAC, UGC, New Delhi, Listed Under 2(f) & 12(B), UGC, New Delhi.

K. Kotturu, Tekkali- 532 201, Srikakulam Dist., AP

ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT (AUTONOMOUS)

Approved by AICTE, Accredited by NBA & NAAC, Recognised under 2(f)12(b) of UGC, Permanently Affiliated to JNTUGV, Vizianagaram.
K. Kotturu, Tekkali, Srikakulam-532201, Andhra Pradesh

Academic Regulations for M.Tech

(Effective for the students admitted into first year from academic year 2024-2025)

The M.Tech Degree of the Aditya Institute of Technology andManagement (Autonomous), Tekkali shall be conferred on candidates who are admitted to the program and fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS:

Admission to the above program shall be made subject to the eligibility, qualifications and specialization prescribed by the University from time to time. Admissions shall be made on the basisof merit / rank obtained by the qualifying candidate in GATE /PGCET, subject to reservations prescribed by the Govt. of AP from time to time.

2.0 AWARD OF M. Tech. DEGREE:

2.1 A student shall be declared eligible for award of the M.Tech degree,if he/she pursues a course of study and completes it successfully in not less than two academic years and not more than four academic years.

2.2 A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his/her admission, shall forfeit his/her seat in M.Tech course.

2.3 **The student shall register for all 68 credits and secure all the 68 credits.**

3.0 ATTENDANCE:

3.1 The minimum instruction for each semester 90 clear instruction days.

3.2 A candidate shall be deemed to have eligibility to write End Semester examinations if he/she has put in a minimum of 75% of attendance in aggregate of all the subjects.

3.3 Condonation of shortage of attendance up to 10% (65% and above, and below 75%) may be given by the College academic committee.

3.4 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representations by the candidate with supporting evidence.

3.5 Shortage of attendance below 65% shall in NO case be condoned.

3.6 A candidate shall not be promoted to the next semester unless he/she fulfills the attendance requirements of the present semester.

3.7 A stipulated fee shall be payable towards condonation of shortage of attendance.

4.0 COURSE OF STUDY:

The following specializations are offered at present for the M.Tech course of study

1	VLSI System Design
2	Power Electronics and Drives
3	Computer Science and Engineering
4	Structural Engineering
5	Computer Integrated Manufacturing

4.1 A standard academic format common for all PG programmes describing numbers of credits, weightage for lecture, laboratories work and projects have been fixed considering the scope of study. The position and sequence of study of core courses and elective courses are made to ensure sequential and integral learning. The focus on advance study in core courses through theory and laboratories work supported by study on relevant programme specific electives are incorporated. The selection of unique courses in the basket of elective is a special feature of curriculum ensuring flexibility and diversity. The emphasis on understanding advanced Concepts of PG course is ensured through elaborate practical work conducted through actual/virtual laboratory experiments. The concept of designing experiments and developing concept application is made part of learning process. The PG course is spread over two years in four semesters and inclusion of Minor project, Audit course, Open elective, Technical Seminar and Dissertation are the special features of this curriculum. The contents of course are unitized to facilitate its execution. The list of suggested reading is also made part of the curriculum.

4.2 The students are asked to learn IPR/ research methodology to understand the importance and process of creation of patents through research. The introduction of One Audit course covering subjects of developing desired attitude among the Learners is on the line of initiatives such as English for research paper writing, Disaster management, and Constitution of India and Personality development through life enlightenment skills. The courses included under open electives are of importance in the context of special skill development and they are on Industrial safety, Operation research, Composite materials and Waste to Energy. These courses shall make students capable to work in industrial environment.

4.3 The introduction of Minor project ensures preparedness of students to undertake major projects/ dissertation. Students are encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break. The dissertation/major project work of PG programme of one-year duration is given strong weightage in the curriculum. It is expected to undertake industrially relevant problem to develop an optimal solution through extensive research work. The students and faculty can design the research project in consultation with industry preferably in the region.

5.0 EVALUATION:

The performance of the candidate in each semester shall be evaluated subject-wise with a maximum of **100** marks for theory and **100** marks for laboratory, on the basis of continuous Internal Evaluation and Semester End Examination.

5.1 For Theory Courses, **40** marks shall be for internal evaluation and **60** marks for end semester examination. Out of **40** internal marks **30** marks are assigned for subjective exam, **5** marks for assignments and **5** marks for seminars. The internal evaluation for **30** marks shallbe made based on the average of the marks secured in the two Mid Term-Examinations conducted, one in the middle of the Semester and the other immediately after the completion of instruction. Each midterm examination shall be conducted for duration of **120** minutes and question paper shall contain 4 questions. The student should answer all **4 questions**.

5.2 For courses like **Research Methodology & IPR** and **Open Elective,** the pattern of midterm and end examinations is similar to regular theory courses and the valuation is purely internal. Evaluation is based on continuous assessment.

5.3 Audit course is one among the compulsory courses and does not carry any Credits and no semester end examination.

5.4 For laboratory courses, **40** marks shall be for internal evaluation and **60** marks for end semester examination. Out of **40** internal marks **20** marks are assigned based on day-to-day evaluation and **20** are assigned based on the internal test. The end examination shall be conducted by the teacher concerned and an external examiner.

5.5 For Minor Project, **40** marks shall be for internal evaluation and **60** marks for end semester examination. The end semester examination (Viva-Voce) shall be conducted by a committee. The committee consists of an External examiner, Head of the department and Supervisor of the minor project. The internal evaluation shall be made on the basis of seminar given by each student on the topic of his/her minor project, which was evaluated by Departmental committee. The Departmental Committee consists of Head of the Department, supervisor and one other senior faculty member from the Department. Out of **40** internal marks **10** marks allotted for literature survey, **15** marks for results and analysis and **15** marks for seminar.

5.6 For Technical Seminar there will be only internal evaluation for **100** marks. A candidate has to secure a minimum of **50%** marks to be declared successful. For evaluation the candidate has to collect literature on a topic, prepare the document, submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee. The Departmental Committee consists of Head of the Department and two other senior faculty members from the department.

5.7 A candidate shall be deemed to have secured the academic requirement in a subject if he/she secures a minimum of **40%** of marks in the end semester examination and a minimum aggregate of **50%** of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.8 In case the candidate does not secure the minimum academic requirement in any subject (**as specified in 5.7**) he has to reappear for the supplementary examination in that subject in the next academic year.

6.0 EVALUATION OF DISSERTATION Phase-1/DISSERTATION Phase-2 WORK:

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Dissertation Review Committee.

6.1 A DISSERTATION Review Committee **(DRC)** shall be constituted with Principal as chair Person, Head of the department, Supervisor and one senior faculty member of the concerned department.

6.2 **Registration of DISSERTATION:** A candidate is permitted to register for the Dissertation after satisfying the attendance requirement of all the subjects (theory and practical subjects) in Second semester.

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his supervisor, the title, objective and plan of action of his dissertation work to the Dissertation Review Committee for its approval. After obtaining the approval of the Committee the student can initiate the dissertation work after the second semester end examinations.

6.4 Every candidate shall work on dissertation approved by the DRC of the Department.

6.5 If a candidate wishes to change his supervisor or topic of the dissertation he can do so with approval of the DRC. However, the Dissertation Review Committee (DRC) shall examine whether the change of topic/supervisor leads to a major change of his initial plans of project proposal. If so, his date of registration for the dissertation work starts from the date of change of Supervisor or topic as the case may be.

6.6 A candidate shall submit status report in two stages at least with a gap of 3 months between them.

6.7 The work on the dissertation shall be initiated in the beginning of the III semester and the duration of the dissertation is for two semesters. The candidate shall identify the problem, Literature survey, design/modeling part of the problem i.e. almost 35% of his dissertation work should be completed in the III semester itself and it will be evaluated by DRC as Dissertation Phase – 1. If the candidate fails to get the satisfactory report, he has to re-register for the dissertation work.

6.8 A candidate shall be allowed to submit the dissertation report only after fulfilling the attendance requirements of all the semesters with approval of DRC and not earlier than 40 weeks from the date of registration of the dissertation work. For the approval of DRC the candidate shall submit the draft copy of dissertation to the Principal (through Head of the Department) and shall make an oral presentation before the DRC.

6.9 The Candidate may be permitted to submit the Dissertation Report,if only the student pass in all subjects and work is Published/Accepted to be published in a Journal / International conference of repute and relevance.

6.10 Three copies of the Dissertation Report certified by the Supervisor shall be submitted to the College.

6.11 The Dissertation shall be adjudicated by external examiner from outside the college.

6.12 The viva-voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner outside the college.

The Board shall jointly report candidates work as:

A. Excellent
B. Good
C. Satisfactory
D. Unsatisfactory

Head of the Department shall coordinate and make arrangements for the conduct of viva-voce examination. If the report of the viva-voce is unsatisfactory, the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination, the candidate may be asked to submit a new Dissertation proposal to DRC starting with 6.4

7. Method of Awarding Letter Grades and Grade Points for a Course:

A letter grade and grade points will be awarded to a student in each course based on his/her performance as per the grading system given below.

Table: Grading System for M.Tech. Programme

Percentage	Level	Letter Grade	Grade Points
>= 90%	Outstanding	A+	10
80 to <90%	Excellent	A	9
70 to <80%	Very Good	B	8
60 to <70%	Good	C	7
50 to <60%	Fair	D	6
< 50%	Fail	F	0
-	Absent	AB	0

7.1 Calculation of Semester Grade Points Average (SGPA)* for semester

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as below:

$$SGPA = \frac{\sum(CR \times GP)}{\sum CR}$$ (for all courses passed in semester)

Where **CR** = Credits of a Course
GP = Grade points awarded for a course

SGPA is calculated for the candidates who passed all the courses inthat semester.

7.2 Calculation of Cumulative Grade Points Average (CGPA) andAward of Division for Entire Programme.

The CGPA is calculated as below:

$$CGPA = \frac{\sum(CR \times GP)}{\sum CR}$$ (for entire programme)

Where **CR** = Credits of a Course
GP = Grade points awarded for a course

CGPA is calculated for the candidates who passed all the courses till that semester.

As per the AICTE regulations, conversion of CGPA into equivalent percentage as follows:
Equivalent Percentage = (CGPA – 0.75) x 10

After a student has satisfied the requirement prescribed for the completion of the programme and is eligible for receiving the award of M.Tech. Degree, he shall be placed in one of the below divisions:

Table: Award of Divisions

Class Awarded	CGPA Secured	Remarks
First Class with distinction	≥ 7.75 (Without any supplementary appearance)	From the CGPA secured from 68 Credits
First Class	≥ 6.75	
Second Class	≥ 6.0 and < 6.75	

8.0 WITH-HOLDING OF RESULTS:

If the candidate has not paid any dues to the college or if any caseof indiscipline is pending against him / her, the result of the candidate will be withheld and he/she will not be allowed into the next higher semester. The issue of the degree is liable to be withheld in such cases.

9.0 TRANSITORY REGULATIONS:

Candidate who have discontinued or have been detained for want of attendance or who have failed after having undergone the course are eligible for admission to the same or equivalent subjects as and when subjects are offered, subject to 5.8 and 2.0.

10.0 GENERAL:

10.1 The academic regulations should be read as a whole for purpose of any Interpretation.

10.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

10.3 The Institute may change or amend the academic regulations and syllabus at any time and the changes and amendments made shall be applicable to all the students with effect from the date notified by the college.

10.4 Wherever the word he, him or his occur, it will also include she, her and hers.

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ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, TEKKALI

(An Autonomous Institution)

M.Tech Course Structure (AR-22)

COMPUTER INTEGRATED MANUFACTURING

M. Tech., (CIM) - I SEMESTER						
Semester	**Course Code**	**Subject**	**L**	**T**	**P**	**C**
I	22MCM1001	Advanced Computer Aided Design	3	0	0	3
	22MCM1002	Direct Metal Deposition & 3D Printing	3	0	0	3
	Program Elective – I					
	22MCM1003	Tool Design	3	0	0	3
	22MCM1004	Machine Learning				
	Program Elective – II					
	22MCM1005	Metrology and Computer Aided Inspection	3	0	0	3
	22MCM1006	Design for Manufacturing & Assembly				
	22MCM1101	Additive Manufacturing Lab	0	0	4	2
	22MCM1102	Computer Aided Design & Manufacturing lab	0	0	4	2
	22MCC1001	Research Methodology and IPR	2	0	0	2
	Audit Course - 1					
	22MAC1001	English for Research Paper Writing	2	0	0	0
	22MAC1002	Disaster Management				
	22MAC1003	Constitution of India				
	22MAC1004	Personality Development Through Life Enlightenment Skills				
Total			**16**	**0**	**8**	**18**

M. Tech. (CIM) - II SEMESTER						
Semester	**Course Code**	**Course**	**L**	**T**	**P**	**C**
II	22MCM1007	Product Design and Development	3	0	0	3
	22MCM1008	Computer Integrated Manufacturing	3	0	0	3
	Program Elective – III					
	22MCM1009	Finite Element Analysis	3	0	0	3
	22MCM1010	Industrial Automation				
	Program Elective – IV					
	22MCM1011	Design of Robotic Systems	3	0	0	3
	22MCM1012	Logistics & Supply Chain Management				
	Program Elective – V					
	22MCM1013	Intelligent Manufacturing	3	0	0	3
	22MCM1014	Industrial Internet of Things				
	Open Elective					
	22MOE1001	Industrial Safety	3	0	0	3
	22MOE1002	Operations Research				
	22MOE1003	Composite Materials				
	22MOE1004	Waste to Energy				
	22MCM1103	Simulation Lab	0	0	4	2
	22MCM1201	Minor Project	0	0	4	2
	Total		**18**	**0**	**8**	**22**

M. Tech. (CIM) - III SEMESTER						
Semester	**Subject Code**	**Subjects**	**L**	**T**	**P**	**C**
III	22MCM2202	Technical Seminar	0	0	4	2
	22MCM2203	Dissertation Phase – I	0	0	20	10
Total			**0**	**0**	**24**	**12**
M. Tech (CIM) - IV SEMESTER						
Semester	**Subject Code**	**Subjects**	**L**	**T**	**P**	**C**
IV	22MCM2204	Dissertation Phase – II	0	0	32	16
Total			**0**	**0**	**32**	**16**

L – Lecture hours/Week; T – Tutorial hours/Week;

P – Practical hours/ Week; C – Credits;

ADVANCED COMPUTER AIDED DESIGN

Subject Code: 22MCM1001	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- To gain knowledge on computer aided graphics for designing 2D and 3D models.
- To explain 2D curves, 3D models, modeling methods and CAD file formats.
- To comprehend knowledge on reverse engineering concepts.

COURSE OUTCOMES

CO 1	Familiarize with graphics operations and various standards
CO 2	Develop proficiency in curve generation and interpolation techniques
CO 3	Create accurate using CAD tools and construct and visualize 3D models from 2D drawings.
CO 4	Apply advanced geometric modeling techniques
CO 5	Prepare and manipulate CAD models
CO 6	Understand and apply reverse engineering concepts

SYLLABUS

UNIT-I

Graphics primitives: Primitive operations, The display-file interpreter, Display-file structure, Display-file algorithms.

Graphics Standards: Graphics and computing standards, data exchange standards, design database, interfacing design and drafting, mechanical assembly.

UNIT-II

Curves: Curve generation, Interpolation, B splines, Curved surface patches, Bezier curves, mathematical representation of space curves such as cubic splines, Bezier curves, B-spline and NURBS.

UNIT-III

Three dimension models: 3D geometry, 3D primitives, 3D transformations, Parallel projection, Perspective projection, Isometric projections, Viewing parameters, Special projections. Hidden surfaces and lines: Back-face removal, Back-face algorithms, The Painter's algorithm, Warnock's algorithm, Franklin algorithm, Hidden-line methods.

UNIT-IV

Geometric Modeling: Presentation of dimensioning / tolerances / symbols & annotation, Associatively, Parent child relationship, Parametric design, Programming techniques in drafting / modeling / analysis, Concept of computer animation, Properties calculation, Surface design, Surface theory, Surface analysis, Fundamentals of solid modeling, Different approaches of creating an assembly.

UNIT-V

CAD models: Model preparation, Data interfacing formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures; Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing.

UNIT-VI

Reverse Engineering: History of Reverse Engineering, Concept of reverse engineering, Importance and various methods of RE, Scope and tasks of RE, Preserving and preparation for the four stage process, Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation, Equipment Involved in the Reverse Engineering technique, Integrating formal and structured methods in reverse engineering, Integrating reverse engineering, reuse and specification tool environments to Rapid Prototyping.

TEXT BOOKS

1. Zhigang Xiang, Roy A. Plastock, ‘Computer Graphics’, 2nd Edition , McGraw Hill Education (India) Private Limited
2. Computer Graphics - A Programming Approach by Steven Harrington, McGraw-Hill International Edition, 1987.
3. David Rogers and J. Alan Adams, ‘Mathematical elements for computer graphics’, 2nd Edition , McGraw Hill Education (India) Private Limited
4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
5. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996

REFERENCE BOOKS

- Schaum's Outline of Theory and Problems of Computer Graphics by Roy A. Plastock and Gordon Kalley, McGraw-Hill Companies, Inc., 1986.
- Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
- Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991

DIRECT METAL DEPOSITION AND 3D PRINTING

Subject Code: 22MCM1002	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Explore and analyze the evolution and fundamentals of rapid prototyping
- Develop expertise in various rapid prototyping techniques
- Assess and manage post-processing and data format challenges

COURSE OUTCOMES

CO 1	Understand the fundamentals and historical development of rapid prototyping
CO 2	Gain knowledge of liquid-based rapid prototyping systems
CO 3	Gain proficiency in wire additive manufacturing techniques
CO 4	Analyze case studies involving powder-based rapid prototyping
CO 5	Evaluate the impact of post-processing on product costing
CO 6	Understand and address issues related to rapid prototyping data formats

SYLLABUS

UNIT-I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, RP Applications.

UNIT-II

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT-III

Sheet Additive Manufacturing: Classification, Cubic Technologies' LOM, Kira's Paper Lamination Technology, CAM-LEM's CL: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Ultrasonic Consolidation: Fundamentals, Process Parameters, Process Modeling.

Wire Additive Manufacturing: Classification, Fused Deposition Modeling (FDM): Models and specifications, Machine Architecture, feeding & pitch mechanism, critical forces, melt properties, Liquefier dynamics, Die swelling and bead cooling, Bead deposition, spreading and bonding, Surface Roughness, Process, working principle, Applications, Advantages and

Disadvantages.

UNIT-IV

Powder Based Rapid Prototyping Systems: Classification, Working Principle, Laser cladding: Principle, Powder–Handling System, and Powder –Delivery System: Design Consideration, Powder–Feed AM Process Modeling, and Applications.

Binder based AM: Classification, Working Principle: Sub-systems, 3D Printing: Z Corp's 3D Printer, Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT-V

Post-processing concerns: Post-processing needs, defects in RM parts, issue in metal RM parts, Support materials removal, Surface texture improvements, Accuracy improvement, Asthetic improvement and property enhancement, product costing for rapid manufacturing.

UNIT-VI

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

TEXT BOOKS

1. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2015.

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

REFERENCE BOOKS

- Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.

- Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

- Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC Press, 2000

TOOL DESIGN

Subject Code: 22MCM1003	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- To classify and understand various types of cutting tools, including their materials
- To gain knowledge on designing of various cutting tools
- To gain knowledge on designing of jigs and fixtures
- To gain knowledge in designing tools for super-finishing processes

COURSE OUTCOMES

CO 1	Explain the classification of cutting tools and tool parameters like tool material, tool life etc.
CO 2	Design single and multi-point cutting tools.
CO 3	Design of broaches and super-finishing processes.
CO 4	Design of drills and reamers.
CO 5	Design press tools including die-sets and plastic tools.
CO 6	Design jigs and fixtures for various machine tool operations.

SYLLABUS

UNIT-I

Introduction to cutting tool features: Classification and coding of cutting tools, carbide tools, and coated tools. Cutting tool life, tool failure, types of tool failures, cutting tool fluids, and tool materials.

UNIT-II

Design of Single-Point Cutting Tools: Form Tools, Design of flat and circular form tools, Tool holding methods.

Design of Multi-Point Cutting Tools: Milling Cutters: Major types, design and manufacturing of peripheral, end and face milling cutters, forces and power estimation, grinding of milling cutters.

UNIT-III

Broaches: Pull and Push types. Internal and External broaches, geometry and design and manufacturing of pull type and push type broaches.

Super-finishing Processes: Honing, Lapping Burnishing, Ballizing, Polishing.

UNIT-IV

Drills: Twist drill geometry, Design and manufacturing of twist drill – Effect of variation of different angles on torque and thrust forces – Types and design of shanks – Sharpening of twist drill, Design and manufacture of twist drills.

Reamers: Types, Geometry, Reaming allowance, Tolerance disposition.

UNIT-V

Design of Press Tools: Die set elements – Design of die set for simple components in Blanking, Piercing, Bending, Drawing, Forging and Spinning.

Plastic Tools: Plastic dies for simple components.

UNIT-VI

Jigs & Fixtures: Design principles and constructional features – Locating methods associated with flat, cylindrical, internal and external surfaces, Types of locating pins, Requirements and choice of locating systems, Redundant location, Fool proofing – Setting blocks, Types of clamping devices and their basic elements, Quick action clamps and nuts.

TEXT BOOKS

1. Tool Design, Cyril Donaldson, V. C. Goold, 4th edition, Tata McGraw Hill Pub, 2012.

2. Surender Keshav & Umesh Chandra, *Production Engineering* Design (Tool Design), Satya Prakashan, New Delhi-1994.

REFERENCE BOOKS

- Metal Cutting Theory and practice, Amitabha Bhattacharya, Inyong Ham, ASTME Pub
- Design of Cutting Tools, Rodin, Mir Publications, Moscow.
- Fundamentals of Tool Design, Sixth Edition, Society of Manufacturing Engineers Dearborn, Michigan

MACHINE LEARNING

Subject Code: 22MCM1004	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES.

- To understand and articulate the fundamental concepts of machine learning
- Develop a comprehensive understanding of machine learning techniques and their applications
- Gain proficiency in implementing and evaluating machine learning models and theoretical concepts
- To explore and implement advanced learning methods, including inductive logic programming and unsupervised learning,

COURSE OUTCOMES

CO 1	Understand and explain fundamental machine learning concepts
CO 2	Analyze and implement boolean functions and logical representations
CO 3	Design and evaluate neural networks and linear models
CO 4	Apply statistical learning techniques and decision trees
CO 5	Explore and implement inductive logic programming
CO 6	Evaluate computational learning theory and unsupervised learning methods

SYLLABUS

UNIT-I

Introduction: Preliminaries, what is machine learning; varieties of machine learning, learning input/output functions, sample application.

UNIT-II

Boolean functions and their classes, CNF, DNF, decision lists. Version spaces for learning, version graphs, learning search of a version space, candidate elimination methods

UNIT-III

Neural Networks, threshold logic units, linear machines, networks of threshold , networks vs. knowledge-based systems

UNIT-IV

Statistical Learning, background and general method, learning belief networks, nearest neighbor. Decision-trees, supervised learning of uni-variance decision trees, network equivalent of decision trees, over-fitting and evaluation

UNIT-V

Inductive Logic Programming, notation and definitions, introducing recursive programs, inductive logic programming vs decision tree induction.

UNIT-VI

Computational learning theory, fundamental theorem, Vapnik-Chernonenkis dimension, linear dichotomies and capacity. Unsupervised learning, clustering methods based on ecludian distance and probabilities, hierarchical clustering methods. Introduction to reinforcement and explanation-based learning.

TEXT BOOKS

1. Introduction to Machine learning, Nils J. Nilsson, 1998
2. Machine learning for dummies, IBM Limited ed, by Judith Hurwitz and Daniel Kirsch

REFERENCE BOOKS

- Introduction to Machine Learning with Python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O' Reilly

METROLOGY AND COMPUTER AIDED INSPECTION

Subject Code: 22MCM1005	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

- Master fundamental measurement concepts and surface texture analysis
- Comprehend and utilize advanced measurement techniques and instruments
- Apply Nano-metrology principles to cutting-edge measurement challenges

COURSE OUTCOMES

CO 1	Understand fundamental measurement concepts
CO 2	Understand surface texture definitions and types
CO 3	Comprehend the principles of light interference and interferometry
CO 4	Utilize advanced measuring instruments
CO 5	Apply ray-based scanning and advanced imaging techniques
CO 6	Understand and apply the principles of nano-metrology

SYLLABUS

UNIT-I

Definition, Standards of measurement, Errors in measurement, Interchangeability and Selective assembly, Dimensional and Form tolerances – Accuracy and Precision, Calibration of instruments, Linear measurement, Angular measurement

UNIT-II

Definitions and Types of Surface Texture, Surface Roughness Measurement Methods, Comparison, Profilometer, 3D Surface Roughness Measurement, Instruments

UNIT-III

Interferometry: Introduction, Principles of light interference, Interferometers, Measurement and Calibration, Laser Interferometry, Tool Makers Microscope

UNIT-IV

CMM, Constructional features – Types – Applications of CMM – & CNC CMM, Laser Micrometer, Laser Scanning gauge, Non contact and in-process inspection,

UNIT-V

Vision system, Overview of Computer imaging systems, Image Analysis, Preprocessing, Human vision system, Ray based scanning techniques, X-ray technique, CT technique.

UNIT-VI

Nanometrology – Introduction – Principles – Nanometer metrology systems – Methods of measuring length and surfaces to nano scale result with interferometers and other devices.

TEXT BOOKS

1. Metrology for engineers By GNGalyer FW and CRSHOTBOLT, ELBS, 1990.
2. Industrial Metrology By Graham TSmith, Springer, 2002.
3. White house, D. J, “Handbook of Surface & Nanometrology”, The institute of Physics,London, 1994.

REFERENCE BOOKS

- ASTE Handbook of Industries Metrology, Prentice Hall of India Ltd., 1992.
- Image Processing, Analysis, and Machine Vision By Milan Sonka, Vaclav Hlavac and Roger Boyle, Cengage-Engineering; 3 Ed., 2007

DESIGN FOR MANUFACTURING AND ASSEMBLY

Subject Code: 22MCM1006	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

- Integrate material and process selection for component design
- Apply design considerations for manufacturing processes
- Develop and implement assembly systems and methodologies

COURSE OUTCOMES

CO 1	Understand material selection and relate it to process selection for a component
CO 2	Explain design considerations for machining and casting processes
CO 3	Understand effects of thermal stresses in pre and post treatments of weld joints
CO 4	Implement design guidelines for extruded sections and plastic components
CO 5	Understand automatic assembly transfer systems
CO 6	Design systematic DFA methodology for manual assembly

SYLLABUS

UNIT-I

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

Machining Process: 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.

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

UNIT-III

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 dies forging design - parting lines of dies drop forging die design-general design recommendations.

UNIT-IV

Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing - Keeler Goodman Forming Line Diagram - Component Design for Blanking.

Plastics: Viscoelastic and Creep behavior in plastics – Design guidelines for Plastic components – Design considerations for Injection Moulding.

UNIT-V

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

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

UNIT-VI

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

TEXT BOOKS

1. Product Design for Manufacturing and Assembly by Geoffrey Boothroyd, Peter Dewhurst & Winston A. Knight. CRC Press/2010

2. Product-Design-and-Development-Karl-T.-Ulrich-Steven-D.-Eppinger-Edisi-6-2015

REFERENCE BOOKS

- Engineering Design - Material &Processing Approach/ George E. Deiter/McGraw Hill Intl. 2nd Ed. 2000.

- Hand Book of Product Design /GeoffreyBoothroyd/MarcelandDekken,N.Y.1990.

ADDITIVE MANUFACTURING LAB

Subject Code: 22MCM1101	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES

- master data translation and additive manufacturing technologies
- Design, manufacture, and optimize additive manufacturing parts and assemblies
- Develop and test advanced additive manufacturing materials and techniques

COURSE OUTCOMES

CO 1	Understand and utilize data translation and export design functionalities
CO 2	Demonstrate and explain the use of various additive manufacturing machines
CO 3	Design and manufacture simple parts and assemblies for additive manufacturing
CO 4	Apply slicing software for part development and process optimization
CO 5	Develop and test composite solid filaments for extrusion additive manufacturing
CO 6	Perform 3D scanning, mesh file creation, and post-processing techniques

LIST OF EXPERIMENTS

1. Learn Data Translation – Built in translation facility to export design
2. Demonstrate various machines used in AM (Physical &/or video explaining processes and functions.
3. Design a simple part for AM to understand product design.
4. Design and make a simple assembly/ sub assemble model to create simple 3D utility item by assembling different sub-assembly.
5. Checkout the various orientation, various settings of the part development using slicing software
6. Analyze and apply different process of algorithm for slicing/ supports/ layers/ orientation etc.
7. Develop a composite solid filament and to determine optimal condition of internal mixture
8. Develop a composite solid filament and to determine optimal condition of wire extruder
9. Test the developed filament fluidic properties via Melt Flow Index test rig
10. Print polymer composite parts with cloud based slicing software

11. Manufacture simple item viz., Bracket/ Lever, Clamp, Spur Gear, threaded components etc. by extrusion additive manufacturing (FFF Technology).
12. Design for Additive manufacturing (DFAM).
13. Scan a job at various angles; club/ combine scanned data or images; process the scanned data to develop mesh file (.STL) to create a parametric model
14. Finish job by different post processing techniques and Quality Checks

TEXT BOOKS

1. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.

COMPUTER AIDED DESIGN AND MANUFACTURING LAB

Subject Code: 22MCM1102	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES

- To provide knowledge of modeling tools for creating solid and surface models.
- To provide knowledge on different CAD software.
- To simulate the tool path of cutting tool on the work piece in computer aided manufacturing.
- To generate NC program on verification of tool path for simple components in turning and milling

COURSE OUTCOMES

CO 1	Proficiency in 3D part modeling techniques
CO 2	Ability to edit and modify 3D models
CO 3	Conversion of 3D models to 2D drawings
CO 4	Modeling and assembling machine elements
CO 5	Development of assembly drawings and bills of materials
CO 6	Tool path simulation and NC code generation

LIST OF EXPERIMENTS

A) MODELING:

1. 3D Part modelling– Extrusion, Cut/hole, Sweep, Draft, Loft, Blend and Rib.

2. Editing– Move, Pattern, Mirror, Round and Chamfer

3. Conversion of 3D solid model to 2D drawing- Different views, Sections, Isometric view and Dimensioning

4. 3D modelling of machine elements like Flanged coupling and Screw jack.

6. Assembly Drawing (Using Application Packages) Parts drawing and preparation of assembled views given part details for components followed by practicing the same using CAD packages.

7. Suggested Assemblies: (any 3) Shaft couplings– Plummer block– Screw jack– Lathe Tailstock– Universal Joint– Machine Vice– Stuffing box– Safety Valves- Non-return valves– Connecting rod– Piston and crank shaft– Multi plate clutch– Preparation of Bill of materials and tolerance data sheet

B) TOOL PATH SIMULATION AND NC CODE GENERATION:

1. NC Code (G-codes & M-codes) generation using CAD / CAM software - Post processing for standard CNC Controls for any of FANUC, Siemens etc.

Note: Use any of following software: CATIA, UNIGRAPHICS NX, SOLIDWORKS, SOLIDEDGE

RESEARCH METHODOLOGY AND IPR

Subject Code: 22MCC1001	L	T	P	C
	2	0	0	2

COURSE OBJECTIVES

- Develop research problem formulation and analytical skills
- Apply research methodology and ethics for literature review and data interpretation
- Gain knowledge of patents, intellectual property rights, and their scope

COURSE OUTCOMES

CO 1	Understand research problem formulation.
CO 2	Analyze research related information
CO 3	Follow research ethics and the methodology to review the literature
CO 4	Interpret the data with various techniques and to write a technical report
CO 5	Get prior knowledge on patents procedures and Intellectual Property
CO 6	Understand the scope of patent rights

SYLLABUS

UNIT-I

Research Methodology: Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, importance of knowing how research is done, research process

UNIT-II

Criteria of Good Research: Problems encountered by researchers in India. Defining the research problem: Research problem, Selecting the problem, Necessity of defining the problem, Technique involved in defining a problem, an Illustration

UNIT-III

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, Searching the existing literature, Reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed, Analysis plagiarism, and Research ethics.

UNIT-IV

Interpretation and Report Writing: Meaning of interpretation, Technique of interpretation, Precaution in interpretation, Significance of report writing, Different steps in writing report, Layout of the research report, Types of reports, Oral presentation, Mechanics of writing a research report, Precautions for writing research reports.

UNIT-V

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 Patent Cooperation Treaty (PCT).

UNIT-VI

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

TEXT BOOKS

1. Research methodology by C.R. KOTHARI, 2nd edition, New Age International Publishers, 1990.

2. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

REFERENCE BOOKS

- Research Methodology, Paneersevam, PHI

- Research Methodology, Chawla and Sondhi, Vikas

- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007

- Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

ENGLISH FOR RESEARCH PAPER WRITING

Subject Code: 22MAC1001	L	T	P	C
	2	0	0	0

COURSE OBJECTIVES

- Develop Clear and Concise Research Writing Skills
- Cultivate Independent Interpretation and Accurate Results
- Enhance Logical Structure and Effective Use of Language in Research Papers

COURSE OUTCOMES

CO 1	Students will be able to write paper with clarity and brevity
CO 2	Students will be able to interpret their findings in their own way unaffected by external factors
CO 3	Students will be able to get accurate results with an astute understanding of the subject
CO 4	Students will be able to begin paper writing more aptly
CO 5	Students will be able to write methods, results, discussions and conclusion in their paper more logically
CO 6	Students will be able to use phrases competently to express their ideas

SYLLABUS

UNIT-I

Planning and preparation, Word order, Breaking up long sentences, Structuring paragraphs and sentences, Being concise and removing redundancy, Avoiding ambiguity and vagueness

UNIT-II

Clarifying who did what, Highlighting findings, Hedging and criticizing, Paraphrasing and plagiarism, Sections of a paper, Abstracts, Introduction

UNIT-III

Review of the Literature, Methods, Results, Discussion, Conclusions, Final check.

UNIT-IV

Key skills needed when writing a title, An abstract, An introduction and a review of the literature.

UNIT-V

Skills needed when writing methods, Results, Discussions and Conclusion.

UNIT-VI

Useful phrases, how to ensure paper is as good as it could possibly be the first- time Submission.

TEXT BOOKS

1. Goldbort R (2006). Writing for Science. Yale University Press.
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's book.

AR-22 / M.TECH. / CIM	I Year I Semester

DISASTER MANAGEMENT

Subject Code: 22MCM1002	L	T	P	C
	2	0	0	0

COURSE OBJECTIVES

- Understand and manage disaster concepts and preparedness
- Evaluate Seismic vulnerabilities and monitoring systems
- Apply statistical methods to analyze landslide risks

COURSE OUTCOMES

CO 1	Know the disaster concepts to management
CO 2	Ability to categorize disasters & preparedness plans for disaster response
CO 3	Ability to analyze seismic vulnerable location in various parts of India
CO 4	Monitoring and evaluation plan for disaster response, setting up of early warning systems for risk reductions
CO 5	Ability to analyze seismic vulnerable location in various parts of India
CO 6	Analyze the statistical approach on land slides

SYLLABUS

UNIT-I

Concept of Disaster Management: Types of Disasters. Disaster mitigating agencies and their organizational structure at different levels

UNIT-II

Overview of Disaster situations in India: Vulnerability profile of India and vulnerability mapping including disaster – prone areas, communities, places.

UNIT-III

Disaster preparedness – ways and means; skills and strategies; rescue, relief, reconstruction and rehabilitation.

UNIT-IV

Case studies: Lessons and experiences from various important disasters in India.

UNIT-V

Seismic vulnerability of urban areas.: Seismic response of R.C. frame buildings with soft first storey. Preparedness for natural disasters in urban areas. Sulabh technology for sanitation improvement in urban habitat. Landslide hazards zonation mapping and geo-environmental problems associated with the occurrence of landslides.

UNIT-VI

Statistical approach to study landslides: Landslide casual factors in urban areas. Roads and landslide hazards in Himalayas. Lateral strength of masonry walls. A numerical model for post earthquake fire response of structures. Cyclone resistant house for coastal areas. Disaster resistant construction role of insurance sector. Response of buried steel pipelines carrying water subjected to earthquake ground motion. Preparedness and planning for an urban earthquake disaster. Urban settlements and natural hazards. Role of knowledge based expert systems in hazard scenario.

TEXT BOOKS

1. Natural Hazards in the Urban Habitat" by Iyengar, C.B.R.I., Tata McGraw Hill.
2. Natural Disaster management", Jon Ingleton(Ed), Tulor Rose
3. Disaster Management", R.B. Singh (Ed), Rawat Publications,2006
4. Anthropology of Disaster management", Sachindra Narayan, Gyan Publishing House,2000

CONSTITUTION OF INDIA

Subject Code: 22MCC1003	L	T	P	C
	2	0	0	0

COURSE OBJECTIVES

- Understand the Complexity of Indian Federalism
- Evaluate Risks in Public Administration
- Develop Strategies for National Development

COURSE OUTCOMES

CO 1	Realize the rigidness of our Indian Politics and Administrative aspects.
CO 2	A Student can understand our nation federalism.
CO 3	Can assess different types of risks involved in misadministration.
CO 4	Can create competitive advantage.
CO 5	Summarizes the legal, Administrative, Political and Financial aspects for betterment of the National building.
CO 6	To assess the growth of Indian opinion regarding modern Indian intellectuals' Constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism

SYLLABUS

UNIT-I

Introduction: Historical perspective of the constitution of India - Salient features of The Indian Constitution –Features: Fundamental Rights (Article 12 to 35), Duties (51 A – 1976 emergency) and Directive principles (Article 36 to 51) of State Policy - Articles 14 to 18- Articles 19 - Article 21

UNIT-II

Amendment Procedure of The Indian Constitution: 42nd amendment (Mini Constitution) - 44th amendment (1978 – Janatha Govt.)

UNIT-III

Local Administration: District's administration head: Role and Importance, Municipalities: Introduction, Mayor and role of elected representative, CEO of municipal corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials andtheir roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments),Village level: Role of elected and appointed officials, Importance of grass root democracy.

UNIT-IV

Parliamentary form of Govt. In India: President of India - Emergency provisions - National Emergency – Article 352 President Rules – Article 356 - Financial Emergency –

Article 360Prime Minister and Cabinet - Supreme Court of India (Indian Judiciary)

UNIT-V

Indian Federalism: Union – State relations; - Legislative, Administrative and Financial relations. LokSabha, RajyaSabha, VidhanSabha & VidhanParishad - Composition; Speaker, Chairman, Privileges, Legislative procedure.

UNIT-VI

Parliamentary Committees: Public Accounts Committee - Estimates Committee - Committee on Public Undertakings. - Election commission of India (Article -324) - Comptrollar and Auditor General (CAG) of India (Article – 148 to 150) - Finance Commission (Article – 280) - NeethiAayog (Planning Commission) and - Political Parties.

TEXT BOOKS

1. D.D Basu – Indian Constitution.
2. Dr. D. Surannaidu – Indian Politica lSystem.
3. Madhav Khosla – The Indian Constitution.

REFERENCES BOOKS

- The Constitution of India, 1950 (Bare Act), Government Publication.
- M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Subject Code: 22MAC1004	L	T	P	C
	2	0	0	0

COURSE OBJECTIVES

- Internalize Virtues and Ethical Conduct
- Explore Spiritual and Philosophical Concepts from Bhagavad Gita and Vedantic Perspectives

COURSE OUTCOMES

CO 1	Realize that everyone is responsible for creating his/her own personality.
CO 2	Gain knowledge of the importance of developing virtues like wisdom and courage and knowing what are good acts (do's) and bad acts (don'ts).
CO 3	Understand the key message of Bhagavad Gita which is experiencing spiritual oneness by practicing any or all of the karma, bhakti, dhyana or raja, and jnana yogas.
CO 4	Know the vedantic perspective of life with regards to understanding human nature, art of living and technique of self-unfoldment.
CO 5	Realize the goal and means to attain self-realization which is the only way to attain liberation.
CO 6	Become aware that sub-conscious mind which is full of desires is the main obstacle for self-realization and spiritual practices help in eliminating these desires

SYLLABUS

UNIT-I

Personality Development: It is personality that matters – Laws of personality development – Different layers of personality – Pleasure is not the goal – How to change our character – Control your negative emotions – Change yourself first – Take whole responsibility of yourself.

UNIT-II

Holistic Personality Development: (from Bhartruhari Neeti Satakam)

Wisdom (Verses 19, 20, 21, 22) – Pride & Heroism (Verses 29, 31, 32) – Virtues (Verses 26, 28, 63, 65) – Don'ts (Verses 52, 53, 59) – Do's (Verses 71, 73, 75, 78)

UNIT-III

Bhagavad Gita:

Chapter 2 – Verses 17, 56, 62, 68

Chapter 3 – Verses 13, 21, 27, 35, 36, 37, 42

Chapter 4 – Verses 18, 38, 39

Chapter 6 – Verses 5, 13, 17, 23, 35

Chapter 12 – Verses 13, 14, 15, 16, 17, 18

Chapter 18 – Verses 37, 38, 45, 46, 48, 63

UNIT-IV

Vedantic Perspective of Life: Brief discussion of major topics in

Understanding human nature – Art of Living – Technique of self unfoldment

UNIT-V

Vivekachudamani: Self-realization is the means of liberation – Means to self-realization – Qualifications of a spiritual aspirant – 4-fold spiritual discipline

UNIT-VI

Mind and Its Mysteries: What is Mind? Mind and body, Mind and food – Mental faculties – Theory of perception, Memory, Imagination, Thought-Culture, Desires – Cultivation of virtues, Control of senses and mind – Concentration, Meditation and Enlightenment.

TEXT BOOKS

1. Personality Development, Swami Vivekananda, Advaita Ashrama Publication,
2. ISBN 978817552246
3. Three Satakam of Bharatrhari (Niti, Srngara, Vairagya), P. Gopinath, Rashtriya Sanskrit
4. SansthanPubllication.
5. Bhagavad Gita, Swami Swarupananda, Advaita Ashram Publication.
6. Vedanta – Science of Life, 3 Vols, Swami Chinmayananda, Chinmaya Mission Pub
7. (Vol1 – Understanding Human Nature, Vol2 – Art of Living, Vol3 – Technique of Self-Unfoldment)
8. Message of Vivekachudamani, Swami Ranganadhananda, Advaita Ashrama Publication,
9. ISBN 817553089
10. Mind, Its Mysteries and Control, Swami Sivananda, Divine Life Society Publication.

REFERENCES BOOKS

- https://archive.org/download/satakasofbhartri00bharuoft/satakasofbhartri00bharuoft.pdf
- Bhagavad Gita – Sadhaka Sanjivani, Swami Ramsukhdas, Gita Press Publication (1080, 1081)

- The Goal and The Way, Swami Satprakashananda, Ramakrishna Math Publication
- Spiritual Quest, Swami Tapasyananda, Ramakrishna Math Publications, ISBN 8171204562
- Mind According to Vedanta, Swami Satprakashanada, Ramakrishna Math Publication,
- ISBN 8171206506

PRODUCT DESIGN AND DEVELOPMENT

Subject Code: 22MCM1007	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Comprehend the fundamentals of product design and development
- Develop and evaluate conceptual designs for manufacturability, assembly, and sustainability
- Apply value engineering, economic analysis, and incorporate ergonomics and aesthetics

COURSE OUTCOMES

CO 1	Understand the fundamentals of product design and development
CO 2	Develop and evaluate conceptual designs
CO 3	Design for manufacturability, assembly, and sustainability
CO 4	Apply value engineering and economic analysis
CO 5	Incorporate ergonomics and aesthetics into design
CO 6	Utilize concurrent engineering and rapid prototyping tools

SYLLABUS

UNIT-I

Introduction: Classification, Specifications of Products, Product life cycle, Product mix, Introduction to product design, Modern product development process, Innovative thinking, Morphology of design.

UNIT-II

Conceptual Design:

Generation, selection & embodiment of concept, Product architecture.

Industrial design: process, need.

Robust Design: Taguchi Designs & DOE, Design Optimization

Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design.

UNIT-III

Design for Mfg. & Assembly: Basic Methods of designing for Mfg. & Assembly, Designs for Maintainability, Designs for Environment, Product costing, Legal factors and social issues,Engg ethics and issues of society related to design of products.

UNIT-IV

Value Engineering / Value Analysis:

Definition. Methodology, Case studies, Economic analysis: Qualitative & Quantitative.

UNIT-V

Ergonomics / Aesthetics:

Gross human autonomy, Anthropometry, Man-Machine interaction, Concepts of size and texture, colour, Comfort criteria, Psychological & Physiological considerations,

UNIT-VI

Concurrent Engg.: Rapid prototyping fundamentals, Tools for product design – Drafting / Modeling software, CAM Interface.

Patents & IP Acts- Overview, Disclosure preparation

TEXT BOOKS

1. Karl T Ulrich, Steven D Eppinger , " Product Design & Development." Tata McGrawhill New Delhi 2003
2. David G Ullman, "The Mechanical Design Process." McGrawhill Inc Singapore 1992
3. N J M Roozenberg , J Ekels , N F M Roozenberg " Product Design Fundamentals and Methods ." John Willey & Sons 1995
4. Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1 / e 2004 , Pearson Education New Delhi

REFERENCE BOOKS

- L D Miles "Value Engineering."
- Hollins B & Pugh S "Successful Product Design." Butter worths London
- Bralla J G "Handbook of Product Design for Manufacture, McGrawhillNewYork.

COMPUTER INTEGRATED MANUFACTURING

Subject Code: 22MCM1008	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Comprehend fundamental concepts of Computer-Integrated Manufacturing (CIM)
- Plan and schedule manufacturing processes using CIM principles
- Integrate factory floor functions with computer-assisted applications

COURSE OUTCOMES

CO 1	Understanding basic CIM concepts and selection of suitable concepts.
CO 2	Studying and understanding about planning and scheduling
CO 3	Identify multiple factory floor functions which could be integrated through computer assisted applications.
CO 4	Describe structure and functional areas of CIM system.
CO 5	Apply principles of intelligent manufacturing techniques.
CO 6	Assess the direct control and monitoring of all the manufacturing oriented operations

SYLLABUS

UNIT-I

Introduction: Manufacturing Enterprise: External and Internal Challenges, World-Class Order-Winning Criteria, CIM- Definition, Benefits and Implementation Steps, Manufacturing Systems: Classification, Elements or Sections of a Typical Manufacturing Organization, Structure and Functional Areas of CIM System-CAD, CAPP, CAM, CAQC, ASRS, Advantages of CIM.

UNIT-II

Planning and Scheduling Functions in CIM System: Aggregate Production Planning (APP), Master Production Schedule (MPS), Material Requirement Planning (MRP), Capacity Requirement Panning (CRP), Manufacturing Resource Planning (MRP-II), Just-in-Time Production Systems and Concept of Enterprise Resource Planning (ERP).

UNIT-III

Computer-Aided Process Planning: Approaches–Variant and Generative, Feature Classification and Recognition, Process Classifications and Selections, Machines and Tool Selection, Setting Process Parameters, Process Sheet Documentation.

UNIT-IV

Database and Communication in CIM System: Data Communication Technologies, Database Management Technologies, Automated Data Collection in Shop Floor.

UNIT-V

Flexible Manufacturing Systems: Introduction, Configurations of Workstations, Planning, Applications and Benefits, Adaptive control with constraints and adaptive control with optimization

UNIT-VI

Intelligent Manufacturing Techniques: World Class Manufacturing, Lean Manufacturing, Agent Technology, Reengineering, Material Requirement Planning, Enterprise Resource Planning, JIT Production System, Kanban System, Automation, Automated Material Handling, Storage and Retrieval Systems.

TEXT BOOKS

1. Computer-Integrated Manufacturing by J.A. Rehg and W.K. Henry, Pearson Education, 3rd edition, New Delhi.

2. Automation Production Systems and Computer-Integrated Manufacturing by M.P. Groover, Pearson Education Singapore, 4th edition, 2016.

3. Principles of Computer Integrated Manufacturing by S. K. Vajpayee, PHI Delhi, 1998.

REFERENCE BOOKS

- Systems Approach to Computer Integrated Design and Manufacturing by Nanua Singh, John Wiley & Sons, New Delhi.

- Computer Integrated Manufacturing- An Introduction with Case Studies by Paul G. Ranky, Prentice-Hall International.

FINITE ELEMENT ANALYSIS

Subject Code: 22MCM1009	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Comprehend the fundamental principles of the finite element method (FEM)
- Apply FEM to solve 1D structural and thermal problems
- Extend FEM formulation to 2D and 3D problems

COURSE OUTCOMES

CO 1	Understand the basics principle of FE method
CO 2	Identify mathematical model for solution of common problems
CO 3	Solve structural, thermal problem using FE in 1D Case
CO 4	Derive element stiffness matrix by different methods
CO 5	Understand the formulation for 2D and 3D case
CO 6	Recognize need for and engage in lifelong learning

SYLLABUS

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

2-D Problems: Lagrange and Serendipity shape functions, iso-parametric formulation, numerical integration, modeling with iso-parametric elements, requirements for convergence, patch test, nonconforming elements, and reduced integration.

UNIT-V

3-D Problems: Axisymmetric solids, governing equations, axisymmetric elements and their applications, mixed formulations, bending of flat plates (Kirchhoff Theory), continuity requirements and boundary conditions.

UNIT-VI

3-D Problems: Discrete Kirchhoff's elements, thick plate elements, plate bending applications, shells as assemblage of flat plates, finite element formulation for dynamic problems, mass properties, introduction to elastic stability for frames and plates.

TEXT BOOKS

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

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

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

4. Tirupathi, R., and Chandrupatla, Finite Elements in Engineering; 3rd edition, PHI Publication, New Delhi.

REFERENCE BOOKS

- Bruce Irons and Soharab Ahmed, Techniques of Finite Elements; John Wiley and Sons, New York.

- K.J. Bathe, Finite Element Method; Prentice Hall, 1987. 7. O.P., Goptha, Finite and

- Boundary Element Methods in Engineering; Oxford and IBH.

INDUSTRIAL AUTOMATION

Subject Code: 22MCM1010	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Understand principles and strategies of automation in production systems
- Design and analyze material handling, fluid power, and pneumatic systems
- Analyze and design manufacturing systems, assembly lines, and implement flexible manufacturing systems

COURSE OUTCOMES

CO 1	Understand the principles and strategies of automation in production systems
CO 2	Apply knowledge of material handling systems
CO 3	Design and analyze fluid power and pneumatic systems
CO 4	Analyze and design manufacturing systems and assembly lines
CO 5	Design and implement cellular manufacturing and flexible manufacturing systems (FMS)
CO 6	Apply inspection and quality control techniques in manufacturing

SYLLABUS

UNIT-I

Introduction: Automation In Production System, Manual Labor in production systems ,Principles and Strategies of Automation, Basic Elements of An Automated System, Levels of Automation, production concepts and mathematical models.

Material Handling: Introduction to Material Handling, Material Handling Equipment’s, Principles and Design Consideration in material handling, Material Transport Equipment, Automated Storage systems, Lean Manufacturing .

UNIT-II

Fluid Power and Pneumatic Systems: Introduction to Fluid power, Pascal’s Law, Hydraulic Circuit Design and Analysis-Introduction, Control of A Single-Acting Hydraulic Cylinder Circuit, Control of a Double Acting Hydraulic Cylinder Circuit, Regenerative Cylinder Circuit. Basic Pneumatic systems, Types of Cylinders-Single acting Cylinder- Double acting Cylinder, Direction Control Valves- Valve position, Shuttle Valve, Basic Pneumatic Circuits-Control of Single acting Cylinder Circuit- Control of Double acting circuit, Impulse operation- Pilot operation of single acting and Double acting cylinder.

UNIT-III

Manufacturing Systems: Introduction to Manufacturing systems, Components of Manufacturing systems, Classification scheme for Manufacturing systems ,Simple problems using Mathematic models of production performance, single station manufacturing cells, fundamentals of manual assembly lines, automated production lines, Alternative Assembly lines

UNIT-IV

Automated Production Lines and Assembly systems: Fundamentals of Automated Production Lines, Applications Of Automated production lines, System configurations, Work Part Transfer Mechanisms, Storage Buffers, Power Transmission Systems- Gears, Power Screws(Linear Guide ways), Other Transmissions Systems such as chains and ropes, System Design Considerations.

UNIT-V

Cellular Manufacturing and Flexible Manufacturing Systems: Introduction, Part Families, Manufacturing Cells, Cellular Manufacturing, Part classification and coding, Production Flow Analysis, Group Technology and its applications. Introduction to FMS, FMS Industrial Applications and its benefits, FMS components, Planning and implementation issues.

UNIT-VI

Inspection and Quality control: Introduction, Inspection, Specifying limits of variability, dimensions and tolerances, selection of gauging equipments, gauge control, quality control and quality assurance, statistical quality control, total quality management, six sigma, quality standards, Simple numerical problems, Coordinate Measuring Machines.

TEXT BOOKS

1. Automation, Production Systems and Computer Integrated Manufacturing- M. P. Groover, Pearson Education. Third edition/Fifth edition, 2009.

REFERENCE BOOKS

- Fluid Power with Applications-Anthony Esposito, Peason, Sixth Addition.
- Pneumatic Systems, Principles and Maintenance- SR Majumdar, 2011 Edition.
- Industrial Robotics, Technology, Programming, and applications- MikellP.Groover.
- Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition,2010

DESIGN OF ROBOTIC SYSTEMS

Subject Code: 22MCM1011	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

- Understand the mechanics and kinematics of industrial robots
- Develop mathematical models for trajectory planning and robotic control
- Design and implement robotic work cells and control systems

COURSE OUTCOMES

CO 1	Demonstrate the relationship between mechanical structures of industrial robots and their operational workspace characteristics.
CO 2	Apply the concepts of coordinate transformations for development of arm equation and subsequently the inverse kinematics model for given serial manipulator.
CO 3	Develop and analyze the mathematical model for trajectory planning, resolved motion rate control and dynamics model for a given serial robotic manipulator
CO 4	Develop the algorithms for design of robotic work cell controller and its programming
CO 5	Studying and Understanding Sensing and Vision systems
CO 6	Design and analyze the work-cell environment for given robotic manipulator configuration and work-cell devices for required integrated industrial application.

SYLLABUS

UNIT-I

Introduction: Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Subassemblies. Concepts about Basic Control System, Control Loops of Robotic Systems, Different Types of Controllers-Proportional, Integral, Differential, PID controllers

UNIT-II

Kinematics of Robot Manipulator: Introduction, General Mathematical Preliminaries on Vectors& Matrices, Direct Kinematics problem, Geometry Based Direct kinematics problem, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems, Composite Rotation matrix, Homogenous Transformations,, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation. D H Representation & Displacement Matrices for Standard Configurations, Jacobian Transformation in Robotic Manipulation. Introduction, Trajectory Interpolators.

UNIT-III

Dynamics of Robotic Manipulators: Introduction, Preliminary Definitions, Generalized Robotic Coordinates, Jacobian for a two link Manipulator, Euler Equations, and The Lagrangian Equations of motion. Application of Lagrange–Euler (LE) Dynamic Modeling of Robotic Manipulators: - Velocity of Joints, Kinetic Energy T of Arm, Potential Energy V of Robotic Arm, The Lagrange L, Two Link Robotic Dynamics with Distributed Mass.

UNIT-IV

Robot Programming: Introduction, Various Teaching Methods, Task Programming, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation, WAIT, SIGNAL & DELAY Commands, Branching, Robot Language Structure, various Textual Robot Languages Such as VAL II, RAIL and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Etc.

UNIT-V

Robot Sensing & Vision: Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.

UNIT-VI

Industrial Applications: Objectives, Automation in Manufacturing, Robot Applications in Industry, Task Programming, Robot Intelligence and Task Planning, Modern Robots.

Case Study: Robotic pick and place operation in manufacturing industry, Robotic challenges in digital manufacturing

TEXT BOOKS

1. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007
2. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.
3. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985.

REFERENCE BOOKS

- Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.
- Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.

LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Subject Code: 22MCM1012	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Comprehend the fundamentals and scope of logistics and supply chain management
- Implement effective warehousing and inventory management techniques
- Apply strategies and technologies for optimized supply chain operations

COURSE OUTCOMES

CO 1	Understand the fundamentals and scope of logistics
CO 2	Implement warehousing and inventory management techniques
CO 3	Comprehend the components and significance of supply chain management
CO 4	Apply strategies for supply chain operations and planning
CO 5	Design and align supply chain strategy with business objectives
CO 6	Utilize advanced analytics and technologies in supply chain management

SYLLABUS

UNIT-I

Introduction to Logistics: Definition and scope of Logistics- Importance and benefits of Logistics- Types of Logistics (Inbound, Outbound, Reverse)- Transportation modes (Road, Rail, Air, Water)- Transportation management systems-Logistics and supply chain strategy

UNIT-II

Warehousing and Inventory Management: Warehousing and Inventory Management- Warehouse management systems- Inventory management techniques -ABC Analysis, EOQ, JIT- Warehouse layout and design- Inventory control and optimization- Warehouse operations and management.

UNIT-III

Introduction to Supply Chain Management: Definition and scope of Supply Chain Management- Importance and benefits of SCM- Key components of a supply chain- Types of supply chains- Supply chain performance metrics

UNIT-IV

Supply Chain Operations and Planning: Procurement and sourcing strategies- Production planning and control- - Supply chain risk management- agile and lean manufacturing.

UNIT-V

Supply Chain Strategy and Design: Aligning supply chain strategy with business strategy- Supply chain design and optimization - Network design and configuration- Supply Chain

Segmentation

UNIT-VI

Supply Chain Analytics and Technology: Supply chain data analytics and visualization- Predictive analytics and forecasting- Supply chain optimization techniques- Blockchain and IoT applications in SCM

TEXT BOOKS

1. Logistics Management" by Dr. R. S. Kushwaha and Dr. A. K. Singh (Vikas Publishing House)
2. - "Logistics and Supply Chain Management" by Dr. S. S. Gupta and Dr. A. K. Sharma (McGraw Hill Education)
3. - "Supply Chain Management" by Dr. S. K. Goyal and Dr. A. K. Gupta (PHI Learning)
4. Essentials of Supply Chain Management by Michael H. Hugos

REFERENCE BOOKS

- "Logistics Management" by Donald J. Bowersox, David J. Closs, and M. Bixby Cooper
- "Warehousing and Inventory Management" by Dr. S. S. Gupta and Dr. A. K. Sharma
- "Supply Chain Management: Strategy, Planning, and Operation" by Sunil Chopra and Peter Meindl.

INTELLIGENT MANUFACTURING

Subject Code: 22MCM1013	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

- Analyze the structure and functional areas of cim systems
- Implement machine learning and automated process planning in manufacturing
- Design and utilize group technology models and knowledge-based systems

COURSE OUTCOMES

CO 1	Understand the structure and functional areas of CIM systems
CO 2	Comprehend the components and functions of knowledge-based systems
CO 3	Apply machine learning concepts in manufacturing
CO 4	Implement automated process planning and expert systems
CO 5	Utilize group technology models and algorithms in manufacturing
CO 6	Design and analyze knowledge-based systems for group technology

SYLLABUS

UNIT-I

Computer Integrated Manufacturing Systems: Structure and functional areas of CIM system, - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems - MAP/TOP, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

UNIT-II

Components of Knowledge Based Systems: Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

UNIT-III

Artificial Intelligence : Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT-IV

Automated Process Planning : Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

UNIT-V

Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation - Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method.

UNIT-VI

Knowledge Based Group Technology: Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

TEXT BOOKS

1. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall, 1990.
2. Smart Manufacturing: Concepts and Methods, Masoud Soroush, Zhiqiang Ge, Biao Huang, Elsevier Science Publishing Co Inc, 2020.
3. Automation, Production Systems and CIM / Groover M.P./PHI/2007
4. Neural networks: A comprehensive foundation/ Simon Hhaykin/ PHI.

REFERENCE BOOKS

- Intelligent Manufacturing: Methods and Practices, Zude Zhou, Shane (Shengquan) Xie, Dejun Chen
- Neural networks in Computer intelligence/ Li Min Fu/ TMH/2003
- Neural networks/ James A Freeman David M S kapura/ Pearson education/2004

INDUSTRIAL INTERNET OF THINGS

Subject Code: 22MCM1014	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Students will learn the new evolution in hardware, software, and data.
- While the promise of the Industrial Internet of Things (IIoT) brings many new business prospects, it also presents significant challenges ranging from technology architectural choices to security concerns.
- Students acquire upcoming Industrial IoT: Roadmap to the Connected World Course offers important insights on overcoming the challenges and thrive in this exciting space.

COURSE OUTCOMES

CO 1	Able to gain Knowledge of key IIoT concepts including IoT technologies and architectures.
CO 2	Able to explain industrial revolutions and identify sensors, localization, wireless protocols, data storage and security.
CO 3	able to describe cyber physical systems, product life cycle management , virtual and augmented realities.
CO 4	Able to Understand how to develop and implement own IoT technologies, solutions, applications and regulations.
CO 5	Able to explain data extraction from the web and machine to machine interaction.
CO 6	Ability to implement real field problem by gained knowledge of Industrial applications with IoT capability.

SYLLABUS

UNIT-I

Introduction to Industrial IoT (IIoT) Systems: What is IIoT and connected world? the difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT.

Fundamentals of Control System, introductions, components, closed loop & open loop system.

UNIT-II

Industrial Revolutions: Various Industrial Revolutions, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories. Industry 5.0 revolution. Role of Internet of Things (IoT) & Internet of Things (IoT) in Industry,

Introduction to Augmented Reality (AR), and Virtual Reality (VR)

Introduction to Sensors (Description and Working principle): Types of sensors, working principle of basic Sensors -Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11).

UNIT-III

Cyber Physical Systems: Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

UNIT-IV

IIoT Data Monitoring & Control: IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.

UNIT-V

Extraction of data from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

UNIT-VI

Application's of IIOT : Healthcare, Smart irrigation, Robot surveillance, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

TEXT BOOKS

1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) Springer Nature Switzerland AG; 1st ed. 2019 edition.
2. Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Springer series, 1st edition, 2017.
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor).
4. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress.

REFERENCE BOOKS

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

INDUSTRIAL SAFETY

Subject Code: 22MOE1001	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Comprehend mechanical and electrical hazards and their prevention
- Apply maintenance techniques and tools
- Understand wear, corrosion, and fault tracing in machine tools

COURSE OUTCOMES

CO 1	Understand the types, causes and preventive steps of mechanical and electrical hazards.
CO 2	Identify types of maintenance and apply relevant tools of maintenance.
CO 3	Understand the types, causes, applications of wear and types and prevention methods of corrosion
CO 4	Understand the concepts of fault tracing and decision tree for different machine tools
CO 5	List the applications of periodic maintenance.
CO 6	Illustrate the applications of preventive maintenance.

SYLLABUS

UNIT-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

UNIT-II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment

UNIT-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes

UNIT-V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

UNIT-VI

Procedure for periodic and preventive maintenance: Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS

1. Maintenance Engineering, H. P. Garg, S. Chand and Company, 3rd edition, S.Chand
2. Maintenance Engineering Handbook, R Keith Mobley, Lindley R, Higgins and Darrin J, Wikoff, McGraw Hill, 7th edition, 2014.

REFERENCE BOOKS

- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPERATIONS RESEARCH

Subject Code: 22MOE1002	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Develop proficiency in linear programming techniques
- Apply advanced optimization techniques in operations research
- Implement project management and game theory solutions

COURSE OUTCOMES

CO 1	Formulate, solve linear programming problem using graphical and simplex method along with its Big-M and 2-Phase variations.
CO 2	Solve both balanced and unbalanced transportation and assignment problems.
CO 3	Apply the concept of non-linear programming
CO 4	Compute queue performance characteristics for various queuing models.
CO 5	Solve game theory problems by applying standard solution methods.
CO 6	Calculate critical path for a given network using PERT and CPM techniques

SYLLABUS

UNIT-I

Linear Programming: Introduction to linear programming problem formulation, Graphical solution, Simplex method, Artificial variables techniques, Degeneracy.

UNIT-II

Transportation Problem: Formulation, Optimal solution, unbalanced transportation problems, Degeneracy.

Assignment Problem: Formulation, Optimal solution, Traveling salesman problem.

UNIT-III

Nonlinear Programming Problems: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem.

UNIT-IV

Queuing Theory: Characteristics of Queuing models, Classification, (M/M/1):(FCFS/∞/∞), (M/M/1):(FCFS/N/∞), (M/M/C):(FCFS/∞/∞) models.

UNIT-V

Theory of Games: Introduction, Two-person Zero-sum games, Maximum-Minimax principle, Games without saddle points, Mixed Strategies, m × 2 & 2 × n games, Graphical solutions, Dominance property, Algebraic solutions to rectangular games.

UNIT-VI

Network models: Project network, CPM and PERT, Critical path scheduling, Cost considerations in project scheduling.

TEXT BOOKS

1. Introduction to Operations Research by Prem Kumar Gupta, D.S. Hira, S. Chand Publishers, 2014.
2. Operations Research, S.D.Sharma, Kedarnath Ramanadh Pub, 2012.

REFERENCE BOOKS

- Sasieni, M., Yaspan, A., 1959, 1st Ed., "Operations Research ,Methods & Problems", New York: John Wiley & Sons Friedman.
- Operations Research, J.K. Sharma, MacMilan Pub.
- Operations Research by P. Rama Murthy, New Age Pub.
- CPM & PERT, L.S. Srinath, Affiliated East West Press Pu

COMPOSITE MATERIALS

Subject Code: 22MOE1003	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Comprehend and classify composite materials
- Understand fabrication processes and properties of composites
- Design and predict properties of fiber-reinforced composites

COURSE OUTCOMES

CO 1	Illustrate the concept and classification of composites.
CO 2	Understand fundamental fabrication processes for polymer matrix.
CO 3	Analyze and understanding the properties & processing of different metal matrix composites
CO 4	Understand the fundamental concepts of ceramic matrix composites.
CO 5	Understand and Predict elastic properties of long fiber and short fiber composites.
CO 6	Design different types of composite by apply the micromechanics principles.

SYLLABUS

UNIT-I

Introduction: Definition: Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT-II

Reinforcements and the reinforcement matrix interface: Natural fibers; Synthetic organic fibers – aramid, polyethylene; and Synthetic inorganic fibers – glass, alumina, boron, carbon, silicon based fibers; Particulate and whisker reinforcements, Reinforcement-matrix interface – Wettability, Interfacial bonding, and methods for measuring bond strength.

UNIT-III

Metal Matrix Composites: Introduction, Important metallic matrices and properties; Metal matrix composite processing: Solid state processing – Diffusion bonding, Powder metallurgy; liquid state processing – Melt stirring, Compocasting, Squeeze casting, Liquid infiltration under gas pressure; Deposition – spray co-deposition and other deposition techniques like CVD and PVD; in situ processes. Interface reactions.

UNIT-IV

Ceramic Matrix Composites: Introduction; processing and structure of monolithic materials – technical ceramics, glass-ceramics. Processing of ceramics: conventional mixing and pressing – cold pressing and sintering, hot pressing, reaction bonding processes, techniques involving slurries, liquid state processing – matrix transfer moulding, liquid infiltration, sol-gel processing, lanxide process and in situ processes. Processing, properties and applications of alumina matrix composites - SiC whisker reinforced, zirconia toughened alumina; Carbon-carbon composites

UNIT-V

Polymer Matrix Composites: Introduction; polymer matrices – thermosetting, thermoplastic, rubbers. Processing of PMCs , Processing, properties and applications of fibre-reinforced epoxies, PEEK matrix composites, rubber matrix composites. Damping characteristics. Environmental effects in polymer matrix composites. Recycling of PMCs.

UNIT-VI

Micro-mechanics of unidirectional composites: micromechanics models for stiffness – longitudinal stiffness, transverse stiffness, shear modulus, Poisson’s ratio.

TEXT BOOKS

1. Composite Materials: Engineering and Science, by Matthews and Rawlings, CRC Press, 1999.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007

REFERENCE BOOKS

- Composite Materials Science and Engineering, K.K.Chawla, Springer.
- An Introduction to composite material, by D.Hull and T.W. Clyne, Cambridge University press.
- Metal Matrix Composites, Thermomechanical Behaviour by M.Taya, and R.J.Arsenault, Pergamon Press, Oxford.
- Fundamentals of Metal Matrix Composites by S.Suresh, A.Martensen, and A.Needleman, Butterworth, Heinemann
- Engineering Materials and Their Applications – R. A Flinn and P K Trojan / Jaico Books.

WASTE TO ENERGY

Subject Code: 22MOE1004	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES.

- Analyze and diagnose waste conversion technologies
- Evaluate biomass conversion methods
- Design and develop biomass conversion processes

COURSE OUTCOMES

CO 1	Diagnosis the different wastes and their conversion devices.
CO 2	Assess the diverse pyrolysis types of biomass and production methods of different fuel oils.
CO 3	Evaluate the gasification methods of biomass, their design, construction and operation.
CO 4	Suggest the combustion processes of biomass, their design, construction and operation.
CO 5	Analyze the types of biogas plants.
CO 6	Design and develop the biomass conversion processes.

SYLLABUS

UNIT-I

Introduction to Energy from Waste: Classification and Characterization of waste as fuel – Agro based, Forest residue, Industrial waste – Municipal Solid Waste Conversion devices – Incinerators, gasifiers, digesters.

UNIT-II

Biomass Pyrolysis: Pyrolysis: Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications- Oil from waste plastics - Alcohol production from biomass - Bio diesel production.

UNIT-III

Biomass Gasification: Gasifiers: Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV

Biomass Combustion: Biomass stoves: Improved chullahs, types, some exotic designs,fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V

Biogas: Properties of biogas (Calorific value and composition) - Types of biogas Plants – Applications - Technologyand status of Biogas plants - Bio energy system - Design and constructional features - Biomass energy program in India.

UNIT-VI

Biomass: Biomass resources and their classification - Biomass conversion processes – Thermo- chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Urban waste to energy conversion.

TEXT BOOKS

1. Rogoff, M.J. and Screve, F., "Waste-to-Energy: Technologies and Project Implementation", Elsevier Store - Reprint - 2011.
2. Hall, D.O. and Overeed, R.P.," Biomass - Renewable Energy", John Willy and Sons – Reprint - 1987.
3. Harker, J.H. and Backhusrt, J.R., "Fuel and Energy", Academic Press Inc – Reprint - 1981.
4. EL-Halwagi, M.M., "Biogas Technology- Transfer and Diffusion", Elsevier Applied Science – Reprint - 1984.

REFERENCE BOOKS

- Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

SIMULATION LAB

Subject Code: 22MCM1103	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES

- To perform finite element analysis on various components and structural elements and find the deflections and stresses for different loading conditions.
- To calculate the natural frequencies and forced response for 2D and 3D structures using FEA.
- To conduct heat transfer analysis and determine the temperature distribution in a composite slab and fin.

COURSE OUTCOMES

CO 1	Determine deflections and stresses in 1D bars, trusses, and beams
CO 2	Perform static analysis of 2D structures
CO 3	Determine deflections and stresses in 3D bodies
CO 4	Conduct static FE analysis of 3D shell components
CO 5	Estimate natural frequencies and mode shapes of 1D bar and 2D beams
CO 6	Perform Harmonic response analysis of 2D beams

SYLLABUS

EXPERIMENT

1. Determination of nodal displacements, stresses and reactions of given axial loaded bar structure and validating with theoretically calculated FE solution.

2. Determination of nodal displacements, stresses and reactions of given axial loaded bar structure with wall gap and validating with theoretically calculated FE solution.

3. Determination of nodal displacements, stresses and reactions of given axial loaded bar structure with temperature effects and validating with theoretically calculated FE solution.

4. Determination of nodal displacements, stresses and reactions of a given element plane truss arrangement and validating the same with theoretically calculated FE solution.

5. Determination of nodal displacements, stresses and reactions of a given standard bridge plane truss structure and validating the same with theoretically calculated FE solution.

6. Static analysis of 2D cantilever beams and determine deflections, stresses and reactions with point and distributed loads, validating the same with theoretically

calculated FE solution.

7. Static analysis of 2 DoF, determine deflections of simply supported beams, stresses and reactions with point and distributed loads, validating the same with theoretically calculated FE solution.

8. Static analysis of 2DoF, determine deflections of fixed beams, stresses and reactions with point and distributed loads, validating the same with theoretically calculated FE solution.

9. Eigen value modal analysis of 1D stepped bar to determine natural frequencies & dynamic mode shapes, validating the same with theoretically calculated FE solution.

10. Eigen value modal analysis of 2 D beam to determine natural frequencies & dynamic mode shapes, validating the same with theoretically calculated FE solution.

11. Harmonic response analysis of 2D beam components