ORDINANCE

FOR

M. TECH. CAD/CAM

GNA UNIVERSITY

Inspiring Innovation.....

(THIS ORDINANCE HAS BEEN APPROVED IN THE MEETING OF
BOARD OF STUDIES HELD ON DATED 27 May, 2022)

APPLICABLE W.E.F. ACADEMIC SESSION 2022-2023

GNA UNIVERSITY
SRI HARGOBINDGARH, PHAGWARA – HOSHIARPUR ROAD,
PHAGWARA 144401, PUNJAB

SRI HARGOBINDGARH, PHAGWARA – HOSHIARPUR
ROAD,PHAGWARA 144401, PUNJAB

ORDINANCE FOR M. TECH. CAD/CAM

SHORT TITLE AND COMMENCEMENT

I. This Ordinance shall be called the Ordinance for the M. Tech. CAD/CAM of GNA University, Phagwara.

II. This ordinance shall come into force with effect from academic session 2022-23.

1. Name of Program: M.Tech. CAD/CAM

2. Name of Faculty: Faculty of Engineering, Design and Automation.

3. Program Outcomes:

I) Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering, specialization to the solution of complex engineering problems.

II) Problem analysis: Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

III) Design/development of solutions: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.

IV) Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

V) Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

VI) The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

VII) Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

VIII) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

IX) Individual and team work: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

X) Communication: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

XI) Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

XII) Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

4. Program Specific Outcomes: After the completion of M. Tech. CAD/CAM, the student will be able to

I. Apply the CAD/CAM technology effectively and develop the solutions in the manufacturing and production industry.

II. To apply the simulations for the problems related to the analysis in the mechanical industries and related research fields.

III. Formulate the research problem out of the research gap established from the literature review of the research fields and analyses it rationally by applying the data analytics techniques.

5. Program Duration: Total duration of the Program shall be of 2 years and each year will comprise of two semesters. In addition, each semester shall normally have 90 working days. If the student is unable to complete its program in prescribed period then he/she will be given 2 more years to complete the program by paying the tution fees for each semester.

6. Eligibility for Admission: B. Tech. / B.E. in Mechanical Engineering / Mechanical and Automation Engineering / Production Engineering / Manufacturing Engineering / Mechatronics Engineering / Robotics and Automation Engineering / Industrial Engineering / Aerospace Engineering or Equivalent with 55% marks (45 % for SC/ST/OBC) from recognized university/institute.

7. Admission Process: Admission to all the M. Tech. programs shall be made on the basis of valid GATE Score in respective discipline. First preference will be given to GATE qualified candidates and who have obtained at least 55% (45% for SC/ST/Industry sponsored) marks in the aggregate in the qualifying examination from a recognised University. After offering seats to the GATE qualified candidates, for seats remaining vacant (if any), the admission will be made on the basis of following method:

The centralized admission cell shall make selection for admission to the program. The selection of the candidate shall be strictly on merit basis, subject to fulfillment of eligibility criteria. Candidates are required to fill the prescribed application form and submit the same to the admission cell. The admission cell after verifying the eligibility will forward the form to the Office of Registrar for further processing. If the candidate is selected, he/she is required to deposit the prescribed fee along with the application form and the required documents to the Office of Registrar.

8. Curriculum: The 2 years curriculum has been divided into four semesters and shall include lectures/ tutorials/ laboratory work/ field work/ outreach activity/ project work/ viva/ seminars/ presentations/ term papers/assignments etc. or a combination of some of these. The curriculum will also include other curricular, co-curricular and extra-curricular activities as may be prescribed by the university from time to time.

9. Choice Based Credit System: The University has adopted Choice Based Credit System (CBCS), which provides an opportunity to the students to choose courses from the offered courses comprising of Core, Elective, Ability Enhancement and Audit Courses. The choice based credit system provides a “flexible” approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Following are the types of courses and structure for the program:

Course Categories:

I.	BSC:	Basic Science Courses
II.	ESC:	Engineering Science Courses

III.	HSMC:	Humanities and Social Sciences including Management courses
IV.	PCC:	Professional core courses
V.	PEC:	Professional Elective courses
VI.	OEC:	Open Elective courses
VII.	LC:	Laboratory course
VIII.	MC:	Mandatory courses (Audit Course)
IX.	PROJ:	Project work/Dissertation

Audit Course

The introduction of two Audit courses covering subjects of developing desired attitude among the learners is on the line of initiatives such as Unnat Bharat Abhiyan, Yoga, Value education, Disaster management, Sanskrit, Pedagogy, Constitution of India, Personality development through Indian culture etc.

Introducing Research Component:

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analysing /exploring a real life situation / difficult problem.

Before going for Thesis submission, it shall be mandatory to publish or receiving acceptance of publication of at least one research paper from the carried out research in either International conference or Journal of repute such as UGC-care/GNA Journal etc.

10. Medium of Instructions:

10.1 The medium of instructions and examination will be English.

10.2 Practical work/Project Work / Project Report / Dissertation / Field Work Report / Training

11. Mode: The program is offered in 'Full Time' mode of study only.

12. Attendance Requirement to be Eligible to Appear in End Semester Examination:

12.1 Every student is required to attend at least 75% of the lectures delivered squaring tutorials, practical and other prescribed curricular and co-curricular activities.

12.2 Dean of Faculty may give a further relaxation of attendance up to 5% to a student provided that he/she has been absent with prior permission of the Dean of the Faculty for the reasons acceptable to him/her.

12.3 Further, relaxation up to 10% may be given by The Vice Chancellor to make a student eligible under special circumstances only.

12.4 No student will be allowed to appear in the end semester examination if he/she does not satisfy the attendance requirements. Further, the attendance shall be counted from the date of admission in the University or commencement of academic session whichever is later.

13. Credit: A unit by which the course is measured. It determines the number of hours of instruction required per week.

Contact Hours per Week	Credit Assigned
1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
2 Hours Practical (Lab) per week	1 credit

14. Specific Regulation for M. Tech Programs

14.1 On recommendation of the concerned Head/Dean of faculty, Dean of Academic Affairs may allow any of the students to do 2nd year (3rd and 4th semester) in any industry/organization provided this will enhance the student profile and is important for his practical exposure in the industry. The respective Dean/HOD must ensure that the student will complete his two elective courses either in the industry or through MOOC platform.

If the student opted to complete his course in the industry then the evaluation will be done at the university level in collaboration of the industry. One person from industry will act as co-supervisor.

14.2 Student will submit the synopsis in phase I of the dissertation and the synopsis presentation will be evaluated by Department Research Committee (DRC).

14.3 Allotment of Thesis Supervisor(s)

- Master's Project/Thesis supervisor(s) for a student will be appointed from amongst the faculty members of the GNA University.
- Departments will evolve modalities for appointing of supervisors keeping in view of the student's aspirations and faculty interest. The Department Research Committee will co-ordinate this activity.
- No student will have more than two supervisors.
- No student once registered for thesis/project units will be allowed to continue the program without a thesis supervisor having been appointed by the committee.

- No change in thesis supervisor(s) will be allowed without the consent of the committee.
- No change/ addition of supervisor(s) is/are allowed after the thesis has been submitted to the concerned faculty.
- In case there has been change/addition in the supervisor (s) the thesis will be submitted not earlier than three months from the date of such change/addition.
- With prior approval of the chairman of Department Research Committee (DRC), a student may be allowed to have a co-supervisor from outside the university, in exceptional cases.

15. Program Structure:

Semester I (First Year)

S. No.	Pre-Requisites	Course Code	Course Title	Hours per week			Marks Distribution			Credits
				L	T	P	Internal	External	Total	
1.	PCC	MCC1101	Computer Aided Design	3	0	0	40	60	100	3
2.	PCC	MCA1101	Python Programming	3	0	0	40	60	100	3
3.	PCC	MCC1106	Industrial Automation & Robotics	3	0	0	40	60	100	3
4.	MC	RES1101	Research Methodology	3	1	0	40	60	100	4
5.	PEC		Elective – I	3	0	0	40	60	100	3
6.	LC	MCC1121	Computer Aided Design Lab	0	0	4	60	40	100	2
7.	LC	MCA1121	Python Programming Lab	0	0	2	30	20	50	1
8.	LC	MCC1126	Industrial Automation & Robotics Lab	0	0	2	30	20	50	1
9.	Audit	DIS1101	Disaster Management	3	0	0	40	0	40	S/US (Non -Credit)
Total										**20**

Semester II (First Year)

S. No.	Pre-Requisites	Course Code	Course Title	Hours per week			Marks Distribution			Credits
				L	T	P	Internal	External	Total	
1.	PCC	MCC1201	Computer Aided Manufacturing	3	0	0	40	60	100	3
2.	PCC	MCC1206	Finite Element Modeling & Analysis	3	1	0	40	60	100	4
3.	PCC	MCC1204	Computer Integrated Manufacturing Systems	3	0	0	40	60	100	3
4.	PCC	MCC1205	Rapid Prototyping and Tooling	3	0	0	40	60	100	3
5.	PEC		Elective – II	3	0	0	40	60	100	3
6.	LC	MCC1221	Computer Aided Manufacturing Lab	0	0	4	60	40	100	2
7.	LC	MCC1222	Computer Aided Engineering Lab	0	0	4	60	40	100	2
8.	LC	MCC1225	Rapid Prototyping and Tooling Lab	0	0	2	30	20	50	1
Total										**21**

Semester III (Second Year)

S. No.	Pre-Requisites	Course Code	Course Title	Hours per week			Marks Distribution			Credits
				L	T	P	Internal	External	Total	
1.	PEC		Elective – III	3	0	0	40	60	100	3
2.	PEC		Elective – IV	3	0	0	40	60	100	3
3.	PEC		Elective – III Laboratory	0	0	2	30	20	50	1
4.	PEC		Elective – IV Laboratory	0	0	2	30	20	50	1
5.	Dissertation	MCC1300	Dissertation Phase – I	0	0	20	40	0	40	10
6.	Audit	MCC1301	Technical Writing	0	2	0	40	00	40	S/US (Non-Credit)
Total										**18**

Semester IV (Second Year)

S. No.	Pre-Requisites	Course Code	Course Title	Hours per week			Marks Distribution			Credits
				L	T	P	Internal	External	Total	
1.	Dissertation	MCC 1400	Dissertation Phase – II	0	0	3	60	40	100	16
Total										**16**

List of Professional Elective Courses

S. No.	Course Code	Course Title	L	T	P	Credits
Elective – I						
1	MCC1142	Artificial Intelligence	3	0	0	3
2	MCC1143	Management Information System	3	0	0	3
3	MCC1145	Non Destructive Testing	3	0	0	3
Elective – II						
1	MCC1244	Vehicle Dynamics	3	0	0	3
2	MCC1245	Product Design and Development	3	0	0	3
3	MCC1246	Mechanics of Composite Materials	3	0	0	3
Elective – III						
1	MCC1244	Vehicle Dynamics	3	0	0	3
2	MCC1245	Product Design and Development	3	0	0	3
3	MCC1246	Mechanics of Composite Materials	3	0	0	3
Elective – III Laboratory						
1	MCC1324	Product Life-cycle Management Lab	3	0	0	3
2	MCC1325	Computer Graphics Lab	3	0	0	3
3	MCC1326	Heat Transfer Lab	3	0	0	3
Elective – IV						
1	MCC1347	Computational Fluid Dynamics	3	0	0	3
2	MCC1348	Mechatronics	3	0	0	3
3	MCC1349	Machine Tool Design	3	0	0	3

Elective – IV Laboratory						
1	MCC1327	Computational Fluid Dynamics Laboratory	0	0	2	1
2	MCC1328	Management Information System	0	0	2	1
3	MCC1329	Non Destructive Testing	0	0	2	1

16. Examination/Continuous Assessment System (CAS):

For CAS two assessment components are adopted to evaluate student's performance.

16.1 Internal Assessment, which includes attendance, mid semester examination and other components (Assignment, Snap Test, Project, Research Based Assignments, Practical Lab Continuous Assessment, Quiz, Multiple Choice Questions, Case Study, Field Survey/Field Report etc.) carrying a weightage of 40%.

16.2 External Assessment i.e. End Semester Examination, carrying a weightage of 60%.

16.3 Internal assessment of practicals i.e. Practical Lab Continuous Assessment carrying a weightage of 60%.

16.4 External assessment of practicals i.e. Practical Lab External, carrying a weightage of 40%.

16.5 Every student has to score at least 25% marks each in Continuous Assessment and End Semester examination. The minimum pass percentage is 40% in aggregate. In case a student scores more than 25% each in Continuous Assessment and End Semester examination, but overall percentage in the concerned subject remains less than 40% , then student has to repeat End Semester Examination in that subject.

16.6 Internal Assessment of practicals i.e., Practical Lab Continuous Assessment, carrying a weightage of 60%

16.7 External Assessment of practicals i.e., Practical Lab External, carrying a weightage of 40%

17. Grading System: University follows eight letter grading system (A+, A, B+, B, C+, C, D, and F) that have grade points with values distributed on a 10 point scale for evaluating the performance of student. The letter grades and the corresponding grade points on the 10-point scale are as given in the table below. If number of passing students in any subject is less than or equal to 30 then Absolute Grading System will be followed otherwise Relative Grading System will be followed for evaluation.

NB: The CGPA can be converted to percentage by using the given formula:

CGPA x 10 = %

e.g. 7.8 x 10 = 78%

Note: Cumulative Grade Point Average (CGPA), it is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Academic Performance	Range of Marks	Grades	Grades Points	Remarks
Outstanding	≥90	A+	10	
Excellent	≥80 & <90	A	9	
Very Good	≥70 & <80	B+	8	
Good	≥60 & <70	B	7	
Fair	≥50 & <60	C+	6	
Average	≥40 & <50	C	5	
Minimally Acceptable	40	D	4	
Fail	<40	F	0	
Incomplete		I	-	
Withdrawal		W		
Grade Awaited		GA	-	
Minor Project		**S/US**		S-Satisfactory US- Unsatisfactory

17.1 Acceptance of MOOC courses

Faculty of Faculty of Engineering, Design and Automation accepts the MOOC course available on SWAYAM platform for credit transfer. 40% of the courses can be taken from the available list of MOOCs on SWAYAM.

Instructions for MOOC courses

a) MOOC courses taken for credit transfer must be approved and recommended by Dean Academics and Dean of the Faculty before the start of the semester.

b) The copy of the list of courses taken by the students for any course has to be submitted to the Controller of the Examination.

c) MOOC course should be done from SWAYAM platform as per the guidelines of UGC.

d) To obtain the credit the student needs to complete the assessment of the course and provide the certificate of the course issued by the SWAYAM/NPTEL. After completing the certificate, the student must submit the certificate within a week to the department.

e) The fees (if any) for the registration and / or assessment of the MOOC course must be borne by the student only.

f) The student can opt for a particular online MOOC course if and only if the credit of that course is equivalently mapped with the program structure.

g) If the student obtains the same course credit which mapped with the course, then credit shall be considered for this course and the grade/marks provided by the accessing authority shall be transfer to the student. The result of the MOOC shall be taken on record by the university examination cell and a result declared for these papers.

h) For any particular semester, all results for the MOOC course must be submitted along with the marks of other papers of the same semester by the course coordinator.

I) MOOC course coordinators shall be appointed for each of the course taken by the student.

18. Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (Course title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

19. Re-appear: Student with backlog of one semester will be carried forward to next semester. Re-appear examinations will be conducted twice in a year after ESE of every semester.

20. Improvement of overall Score: A candidate having CGPA < 5.5 and wishes to improve his/her overall score may do so within two academic years immediately after passing the degree program by reappearing into maximum four course(s)/subject(s). The improvement would be considered if and only if the CGPA becomes > 5.5.

21. Program qualifying criteria: For qualifying the Program every student is required to earn prescribed credits (75). If any student fails to earn prescribed credits (75) for the program then he/she will get a chance to complete his/her Program in two more years than the actual duration of degree.

21.1 Specific regulation for Post Graduate Diploma

- A student who attains the minimum CGPA of 6.0 after completing the course work and leaves studies thereafter will be awarded a post-graduate (P.G.) diploma in engineering in the

appropriate branch.

- Further, if a student is unable to complete his dissertation within the maximum prescribed period of the M. Tech course, he may on request be awarded P.G. diploma in the appropriate branch provided he fulfills the requirements for the P.G. diploma.
- Revision of Regulations, Curriculum and Syllabi: The University may revise, amend, change or update the Regulations, Curriculum, Syllabus and Scheme of examinations through the Board of Studies and the Academic Council as and when required.

GNA UNIVERSITY
Inspiring Innovation.....

M.TECH (CAD/CAM)

FACULTY OF ENGINEERING, DESIGN & AUTOMATION

(Applicable for 2022-2023 onwards)

MCC1101: Computer Aided Design
Credits: 3
LTP 300

Course Description: The course aims to equip the students with knowledge of basic theory behind various CAD packages. The course includes geometric modeling techniques viz. wireframe, solid, surface, 2D and 3D transformations.

Course Outcomes (CO):

After completion of this course, students will be able to:

CO1: Fit the curve and surface through a given set of data points.

CO2: Understand and differentiate the different solid modeling techniques and their representations.

CO3: Apply geometric transformations (2D or 3D) on any geometric model in theory and correlate it with the different tools of any CAD application.

CO4: Apply the data transfer formats for CAD/CAM data transfer from one CAD software to another.

Unit I

Introduction: Geometric Modeling, Mathematical Representation – Non-parametric (Explicit and Implicit), Parametric, Advantages of Parametric Representation.

Curve Design: Fundamental of Curve Design, Analytic and synthetic entities, Parametric Representation of a Analytic and Synthetic Curve – Point, line, circle, ellipse, hyperbola,

parabola, Hermite cubic spline, Bezier Curves, B-Spline Curve, NURBS.

Unit II

Surface Design: Fundamental of Surface Design, Parametric Representation of the Surfaces, Sixteen Point form, Plane surface, Cylindrical and Ruled Surfaces, Surface of Revolution, Hermite Bi-cubic surface, Bezier Surface, B-Spline Surface.

Solid Design and Modeling: Topology and geometry, Fundamental of Solid Design, Solid Modeling Techniques – Constructive Solid Geometry - Set Theory, Boolean Operators, Boundary Representation – Eular operators, Sweep Representation, other techniques like - Cell Decomposition and Spatial Occupancy Enumeration.

Unit III

Transformations: Translation, Rotation, Scaling, Symmetry and Reflection, Homogeneous Transformations, Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformation.

Unit IV

Data Exchange Formats for CAD/CAM: Neutral file format, Types of file formats & their exchange (IGES, STEP), Graphics standards – Graphics Kernal System (GKS)

Recommended Books / Suggested Readings:

1. Zeid, I., CAD/CAM, McGraw Hill
2. Rogers, D. F. and Adams, J. A., Mathematical Elements for Computer Graphics, McGraw Hill
3. Rooney, J. and Steadman, P., Principles of Computer Aided Design, prentice Hall
4. Mallineuse, G., Computational Concepts and Methods, Kogan Page Ltd.
5. Radhakrishnan, P. and Kothandaraman, C. P., Computer Graphics & Design, Dhanpat Rai Publication
6. Krishnamoorathy, C. S. and Rajeev, J. S., Computer Aided Design (Software and Analysis Tools), Narosa

MCA1101: Python Programming

Credits : 3

LTP 300

Course Description: The course aims to equip the students to learn computer programming via python programming language. In this course student will be able to:

1. Develop the programming skills in core Python.
2. Understand the basic and advanced programming concepts of Python.
3. Understand python-based web application framework like Django.
4. Build database applications in Python.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Describe the Python environment, data types, operators used in Python.

CO2: Design and implement basic applications with database connectivity.

CO3: Use of control structures and numerous native data types with their methods.

CO4: Identify and handle the exceptions in programs through appropriate exceptions handling methods.

CO5: Develop python-based web application framework like Django.

Course Content

Unit I

Introduction: Programming Language, History and Origin of Python Language, Features of Python, Limitations, Major Applications of Python, First Python Program, Python Interactive Help Feature, Python differences from other languages, Installing and setting Python environment in Windows and Linux, basics of Python interpreter, Execution of python program, Editor for Python code, syntax, variable, Data types. Flow control: if, if else, for, while, functions, continue, pass, break. Strings: Sequence operations, String Methods, Pattern Matching.

Unit II

Lists: Basic Operations, Iteration, Indexing, Slicing and Matrixes; Dictionaries: Basic dictionary operations; Tuples and Files; Functions: Definition, Call, Arguments, Scope rules and Name resolution; Modules: Module Coding Basics, Importing Programs as Modules,

Executing Modules as Scripts, Compiled Python files(.pyc), Standard Modules: OS and SYS, The dir() Function, Packages, Different ways to import Packages.

Unit III

Classes and Objects: The concept of OOPS in Python, designing classes, creating objects, accessing attributes, editing class attributes, Built-in class attributes, Garbage collection, Destroying objects.

Exception Handling and Classes: Exception Handling-Introduction, Exceptions, and its types, how to handle exceptions.

File Management in Python: Operations on files (opening, modes, attributes, encoding, closing), read () & write () methods, tell () & seek () methods, renaming & deleting files in Python, directories in Python.

Python SQL Database Access: Introduction, Installation, DB connection, Creating DB table, INSERT, READ, UPDATE, DELETE operations.

Unit IV

Python Django Framework: Introduction to Django Web Framework, features of Django, Installing Django, MVC model, HTTP concepts, Views, URL Mapping, Creating Template Objects, Form validation and Error Messages, Form Display, Django Models, Model Fields, Model Inheritance, CRUD on DB, Session and Caching, Dynamic Webpages, Toggle Hidden Content.

Suggested Readings:

1. Swaroop, “A Byte of Python”, Lulu.com (October 1, 2008)
2. Mark Lutz, “Programming Python, Tata McGraw Hill Publication, 2005
3. David Ascher, “Core Python Cookbook, Springer Publication.
4. Learning Python, O'Reilly Publications by Mark Lutz.
5. Python Essential Reference, David Beazley, Third Edition.
6. Fluent Python, O'Reilly Publications
7. “Python crash course - A hands-on, project-based introduction to programming”, by Eric Matthes.
8. Justin Seitz,2009, “Gray Hat Python: Python Programming with Hackers and Reverse Engineers”, No Starch Press, Inc.
9. Paul Berry,2011, “Headfirst Python”. O'REILLY Media, Inc.
10. Jeeva Jose & P. Sojan Lal. 2016. Introduction to Computing & Problem Solving with Python.
11. Wesley J Chun, Core Python Applications Programming, 3 rd Edition, Pearson.
12. Python online documentation: www. python.org/doc.

MCC1106: Industrial Automation and Robotics

Credits : 3

LTP 300

Course Description: This course include theoretical knowledge with applied skills in the control of robotic and automated equipment using electronics, programmable automation controllers, computers, hydraulics and pneumatics. This program offers key practical courses similar to those found in our highly successful Mechanical Engineering Technology Robotics and Automation Technology program including advanced programming, automation and process controls, and robotics and culminates in a final term industrial automation project.

Course Outcomes (CO):

1. To recognize standard schematic symbols for common fluid power components.
2. To understand and troubleshoot basic fluid power, electro-hydraulic, and electro-pneumatic circuits using schematic diagrams.
3. To get the basic knowledge about the various transfer devices and feeders.
4. To know various different basic types of robots and how to program them.
5. To know the basic structure of PLC and its programming
6. To have the knowledge of machine vision applications in the field of automation.

Course Content

Unit I

Introduction: Concept and scope of automation, Socio economic consideration, Low cost automation.

Fluid Power Control: Fluid power control elements and standard graphical symbols, Construction and performance of fluid power generators, Hydraulic and pneumatic cylinders – construction, design and mounting; Hydraulic and pneumatic valves for pressure, flow and direction control: Servo valves and simple servo systems with mechanical feedback, governing differential equation and its solution for step position input, Basic hydraulic and pneumatic circuits.

Unit II

Pneumatic Logic Circuits: Design of pneumatic logic circuits for a given time displacement diagram or sequence of operations

Fluidics: Boolean algebra, Truth tables, Coanda effect, Fluidic elements – their construction working and performance characteristics: Elementary fluidic circuits

Unit III

Electrical and Electronic Controls: Introduction to electrical and electronic controls such as electromagnetic controllers – transducers and sensors, microprocessors, programmable logic controllers (PLC), Integration of mechanical systems with electrical, electronic and computer systems.

Advance Automation Process: Introduction to SCADA, Components of SCADA, Introduction to HMI and Application of SCADA and HMI in modern Industries.

Unit IV

Robotics: Introduction, classification based on geometry, devices, control and path movement, End effectors – types and applications, Sensors – types and applications, Concept of Robotic/Machine vision, Teach pendent.

Industrial Applications of Robots for material transfer, machine loading / unloading, welding, assembly and spray painting operations.

Text Books:

1. A.K Gupta, S.K. Arora, **Industrial Automation and Robotics,** LaxmiPubilaction (P) Ltd.
2. S.R. Majumdar, **Pneumatic Control,** Tata McGraw Hill.

Suggested Readings:

1. Anthony Esposito, Fluid Power with applications, Pearson.
2. S.R. Deb, Robotics and Flexible Automation, Tata mc Graw Hill

Web Links:

1.https://www.scribd.com/doc/237309451/Robotics-and-Industrial-Automation
2.http://nptel.ac.in/courses/108105063/pdf/L-01(SM)(IA&C)%20((EE)NPTEL).pdf
3.http://nptel.ac.in/downloads/112101098/
4.https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/lecture-notes/

RES 1101: RESEARCH METHODOLOGY

Credits : 4

LTP 310

Course Description: The course aims to equip the students with the knowledge to understand the role of research development, research aptitude and comprehend pre-requisites of research. It also aim to formulate experimentation for productive research using appropriate methodology, techniques including Taguchi methods

The course includes the description of research methodology.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to

CO1: Plan a research activity following all elements of a research process

CO2: Systematically collect data and perform a required analysis (statistical or otherwise) for a research/ experiment.

CO3: Identify and formulate the linear relationship between process variables and output

CO4: Select and analyze the appropriate experimental design for a research problem

Course Content

Unit I

Basic Principles: Research & its significance, Research Vs. Research Methodology, Nature and objective of research, Types of Research objectives, Research Classification, Errors in research, Criteria of Good research, Research Process: Research topic, Literature review, Formulation of problem, Research design, collect and analyze data, Sampling techniques, Sampling errors.

Unit II

Data collection & Analysis: Data types, Data Collection Types: Observation, Interview, Questionnaire, Schedules, Collection of Secondary Data. Analysis and Processing of Data: Types of Analysis, statistics in Research, Measures of central tendency and dispersion: Mean median, mode, range, mean deviation and standard deviation. Measures of Relationship: Linear regression, least square principle and fitted models, Karl Pearson's correlation coefficient.

Unit III

Hypothesis testing: Hypothesis, Characteristics of hypothesis, Hypothesis Vs Problem Statement, Basic ideas of Hypothesis Testing: Null hypothesis, Alternative Hypothesis, Level of significance, Type I and Type II Errors, One tailed and two tailed hypothesis, Tests of significance based on normal, t and Chi-square distributions (z-test, t-test, chi-square test, F-test), Analysis of variance technique. Computer assisted statistical analysis.

Unit IV

Design of Experiments: Classification of experimental designs, Design and analysis of one factor experiments -Completely randomized and randomized complete block designs, One–way ANOVA, Latin Square Design, Analysis of data from a Latin square, Introduction to Main effects and interactions, Two-way ANOVA. Design of Experiments with the help of orthogonal arrays, Introduction to Taguchi's robust parameter design, Analysis, Signal /Noise ratio.

Recommended Books / Suggested Readings:

1. Probability and Statistics for Engineers and scientists, Walpole, Myers, Myers and Ye, 7th ed, 2002, Pearson Education.

2. Statistics in Research, Bernand Ostle and Richard N.Mensing 3rd ed, 1975, Oxford & IBH Pub Co.

3. Probability and Statistics in Engineering, Hines, Montgomery, Goldsman and Borror, 4th ed, 2003, John Wiley & Sons.

4. Experimental design, Theory & application, Federer, 1955, Oxford & IBH pub Co.

MCC1121: Computer Aided Design Lab

Credits : 2

LTP 004

Course Description: This course aims to equip the students with the practical aspects of the Computer Aided Design (CAD) by making the students to work on any of the CAD application software like Creo/Catia/NX-CAD etc. It involves the practicing on creating sketches, constraining the sketches, generating solid models, assembly of any product.

Course Outcomes (CO):

After the competition of this course:

1. The students will be able to identify and suggest the hardware and software requirements of a CAD application software.
2. Apply sketching constraints on digital 2D drawings.
3. Generate 3D models using solid modeling CAD tools.
4. Indent different materials and calculate mass properties of parts.

Course Content

CAD Introduction. Sketcher, Solid modeling –Extrude, Revolve, Sweep, etc and Variational sweep, Loft ,etc, Surface modeling –Extrude, Sweep, Trim etc. and Mesh of curves, Free form etc, Feature manipulation – Copy, Edit, Pattern, Suppress, History operations etc, Assembly-Constraints, Exploded Views, Interference check, Drafting-Layouts, Standard & Sectional Views, Detailing & Plotting. Exercises in Modeling and drafting of Mechanical Components - Assembly using Parametric and feature based Packages like **CREO / SOLIDWORKS /CATIA / NX/ SOLIDEDGE etc.**

List of Experiments:

1. Practical demonstration of 2D sketch tools and constraints. Create all wireframes as depicted in Project file.
2. To make simple 3D solid structures by using Sketch based tools to improve their imagination power for developing virtual 3D components. (2D drawing file will provide)
3. Practical Application of modification tools for efficient product development.
4. Practical Demonstration of advance solid modeling tools to create products (Plastic, Casting) with variable cross section.
5. Practical Application of use of Boolean operations and new body concept for faster product development. Live project will be given for developing virtual model and its process planning.
6. To make a virtual assembly of single Piston Engine and Rotary Engine using Top-Down Assembly.
7. Practical Demonstration of Bottom-Up Assembly of Plastic mold tool design.
8. To create a new home use product by using Generative Shape design (Surface and integrated surface and solid modeling tools)
9. Practical Demonstration of Mold Die Layout and its various parts.
10. To create core and cavity design for real life industrial product. Practical Application of the use of sliders and inserts for the Mold design
11. To create drafting of products created in 3D Modeling for production processes.
12. Graphics programming in C++/MATLAB for geometric modeling of different Curves, Surfaces and Solid primitives. The generated geometric models will have the capability to be modified as per the user's requirements.

Recommended Books:

1. 3DS online Documentation
2. CATIA V5 R21 by Shyaam Tickoo, Tata McHill Publications

MCC1121: Python Programming Lab

Credits : 1

LTP 002

Course Description: The course aims to equip the students to gain practical experience with basic coding concepts such as conditional statements, iteration, strings, functions etc. In this course student will be able to:

1. Write, test, and debug simple Python programs.
2. Implement Python programs with conditionals and loops.
3. Implement functions for structuring Python programs.
4. Build Programs using Python lists, tuples, dictionaries.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Write, Test and Debug Python Programs.

CO2: Develop applications to real time problems.

CO3: Use functions and represent Compound data using Lists, Tuples and Dictionaries.

CO4: Read and write data from & to files in Python and develop Application using Pygame.

Course Content

Students should be made to practice the various concepts learned in classroom by implementing them in the form of programs. Various programs should be practiced in the lab based on each of the following –

1. Problem solving using computers: Familiarization with programming environment.
2. Branching and logical expressions: Problems involving if-then-else structures.
3. Loops, while and for loops: Iterative problems e.g., sum of series.
4. Searching, sorting.
5. Strings, memory structure: String operations.
6. Functions: All types of functions.
7. Numerical methods: Root finding, numerical differentiation, numerical integration.
8. Recursion, structure of recursive calls: Recursive functions.
9. Demonstrate the use of Lists, Dictionaries.
10. Exception handling.
11. Find the most frequent words in a text read from a file.
12. Simulate elliptical orbits and bouncing ball using Pygame.
13. Create Database Connection and execute INSERT, READ, UPDATE, DELETE operations, COMMIT & ROLLBACK operation on the tuple created in the database.
14. Divide students into batches and suggest them to develop any interested mini project based on Django Web Framework.

Software Required: Python IDE.

Recommended Books / Suggested Readings:

1. Swaroop, “A Byte of Python”, Lulu.com (October 1, 2008)
2. Mark Lutz, “Programming Python, Tata McGraw Hill Publication, 2005
3. David Ascher, “Core Python Cookbook, Springer Publication.
4. Learning Python, O'Reilly Publications by Mark Lutz.
5. Python Essential Reference, David Beazley, Third Edition.
6. Fluent Python, O'Reilly Publications
7. “Python crash course - A hands-on, project-based introduction to programming”, by Eric Matthes.
8. Justin Seitz,2009, “Gray Hat Python: Python Programming with Hackers and Reverse Engineers”, No Starch Press, Inc.
9. Paul Berry,2011, “Headfirst Python”. O'REILLY Media, Inc.
10. Jeeva Jose & P. Sojan Lal. 2016. Introduction to Computing & Problem Solving with Python.
11. Wesley J Chun, Core Python Applications Programming, 3 rd Edition, Pearson.
12. Python online documentation: www. python.org/doc

MCC1126: Industrial Automation and Robotics Lab

Credits : 1

LTP 002

Course Description: This course offers key practical courses similar to those found in our highly successful Robotics and Automation Technology program including advanced programming, automation and process controls and robotics.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: The student should be able to design hydraulic and pneumatic circuits.

CO2: The student should be able to design and understand the electro-hydraulic and electro-pneumatic circuits

CO3: Understand various automation tools and methods in manufacturing industry.

CO4: implement various control and automation method in process industries.

CO5: Familiar with various communication technologies in manufacturing and process industries.

Course Content:

1. Design and assembly of hydraulic / pneumatic circuit.
2. Study of power steering mechanism using cut piece model
3. Study of reciprocating movement of double acting cylinder using pneumatic direction control valves
4. Use of direction control valve and pressure control valves clamping devices for jig and fixture
5. Study of robotic arm and its configuration
6. Study the robotic end effectors
7. Study of different types of hydraulic and pneumatic valves
8. Cascading circuits
9. Logic circuits - AND, OR, NOR
10. Circuits using servo valves
11. Circuits using sensors

Recommended Books / Suggested Readings:

1. Anthony Esposito, “Fluid Power with applications”, Pearson Education.
2. Ernst, W., Oil Hydraulic Power and its Industrial Applications, New York: McGraw Hill.
3. Lewis, E. E., and H. Stern, Design of Hydraulic Control Systems, New York: McGraw Hill.
4. Morse, A. C., Electro hydraulic Servo mechanism, New York: McGraw Hill.

DIS1101: Disaster Management

Credits : S/US (Non Credit)

LTP 300

Course Description: The course aims to equip the students with the understanding of a wide variety of disasters and their management.

The course includes a detailed study of different types of disasters

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: To impart knowledge about disasters

Course Content:

Unit I

Environmental Hazards & Disasters: Meaning of Environmental hazards, Environmental Disasters and Environmental stress. Concept of Environmental Hazards, Environmental stress & Environmental Disasters. Different approaches & relation with human Ecology - Landscape Approach - Ecosystem Approach - Perception approach - Human ecology & its application in geographical researches.

Unit II

Types of Environmental hazards & Disasters: Natural hazards and Disasters - Man indeced hazards & Disasters - Natural Hazards - Planetary Hazards / Disasters - Extra Planetary Hazards / disasters - Planetary Hazards - Endogenous Hazards - Exogenous Hazards

Unit III

Endogenous Hazards - Volcanic eruption - Earthquakes - landslides - Volcanic Hazards / Disasters - Causes and distribution of Volcanoes - Hazardous effects of volcanic eruptions - Environmental impacts of volcanic eruptions - Earthquake Hazards / disasters - Causes of Earthquakes - Distribution of earthquakes - Hazardous effects of - earthquakes - Earthquake Hazards in India - Human adjusment, perception & mitigation of earthquake.

Unit IV

Exogenous hazards / disasters - Infrequent events - Cumulative atmospheric hazards / disasters Infrequent events: Cyclones - Lightning – Hailstorms. Cyclones: Tropical cyclones & Local stroms - Destruction by tropical cyclones & local storms (causes, distribution human adjustment, perception & mitigation) Cumulative atmospheric hazards/ disasters :- Floods - Droughts - Cold waves - Heal waves Floods :- Causes of floods - Flood hazards India - Flood control measures (Human adjustment, perception & mitigation) Droughts :- Impacts of droughts - Drought hazards in India - Drought control measures - Extra Planetary Hazards / Disasters - man induced Hazards / Disasters - Physical hazards / Disasters - Soil erosion. Soil Erosion: Mechanics & forms of Soil Erosion - Factors 7 causes of Soil Erosion - Conservation measures of Soil Erosion. Chemical hazards / disasters: Release of toxic chemicals, nuclear explosion - Sedimentation processes Sedimentation processes :- Global Sedimentation problems - Regional Sedimentation problems - Sedimentation & Environmental problems - Corrective measures of Erosion & Sedimentation Biological hazards / disasters: Population Explosion.

Recommended Books / Suggested Readings:

1.Disaster Mitigation: Experiences And Reflections by Pradeep Sahni

2. Natural Hazards & Disasters by Donald Hyndman & David Hyndman - Cengage Learning

3. R. B. Singh (Ed) Environmental Geography, Heritage Publishers New Delhi, 1990

4. Savinder Singh Environmental Geography, Prayag Pustak Bhawann 1997

5. Kates, B. I & White, G. F The Environment as Hazards, oxford, New York, 1978

6. R. B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000

7. H. K. Gupta (Ed) Disaster Management, Universities Press, India, 2003

8. R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994

MCC1201: Computer-Aided Manufacturing

Credits : 3

LTP 300

Course Description: The course aims to equip the students with an understanding of the Advanced manufacturing process with modern machining systems like NC, CNC, EDM and DNC systems along with their programming.

The course includes part programming, Manufacturing Process of Dies and Mold for plastic, casting and sheet metal parts/components, Comparison of Conventional, NC, DNC and CNC machines.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the concepts of machining for the purpose of selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.

CO2: Create and validate NC part program data using manual data input (MDI) and automatically using standard commercial CAM package for manufacturing of required component using CNC milling or turning applicationsand understand integration of CAD to CAM system.

CO3: Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools integrated with DNC Systems.

CO4: To understand clamping methods of dies/moulds, materials and function of EDM.

Course Content

Unit I

Introduction: **Need of NC Technology, Fundamental Concepts in Numeric Control:** structure and functions of NC System, advantages of NC technology over conventional manufacturing.

CNC Machine Tools: Types, Definition and designation of control axes, Special constructional and design characteristics of CNC machine tools, Standard tooling used for CNC turning and milling centers.

Unit II

NC Part Programming: Work holding and tool setting procedure for NC turning and milling centers, Tool zero presetting, Block formats and introduction to ISO based G & M codes for NC part programming, Concepts of cutting tool, machining parameters, length and radius compensation used in CNC turning and milling centers, Introduction to data integration from CAD to CAM software's standard CAD/CAM software for machining of surfaces, moulds and dies etc

Unit III

Computer Numerical Control of Machine Tools: Types and functions of computer numeric control (CNC), Types and functions of direct numeric control (DNC), Need of adaptive control types, functions and types of adaptive control, its uses & benefits, Advantages of combined CNC/DNC systems, post processor interface generating NC codes with CAM programming.

Unit IV

Clamping Devices: Different types of clamping method, Function and advantages of jigs & fixtures ; clamping principles, concept of EDM process in mould's/ dies manufacturing, polishing etc, electrode design and materials.

Recommended Books / Suggested Readings:

1. Ibrahim Zeid and R. Sivasubramaniam, 2nd Edition, CAD/CAM – Theory and Practice, Tata McGraw Hill, India, 2009

2. M. Groover and E. Zimmers, CAD/CAM: Computer Aided Design and Manufacturing, Pearson Education, 2007

3. James A. Rehg, Henry W. Kraebber, “Computer Integrated Manufacturing”, Pearson Education. 2007

4. Chennakesava R. Alavala, “CAD/CAM: Concepts and Applications”, PHI Learning Pvt. Ltd

MCC1206: Finite Element Modeling & Analysis

Credits : 4

LTP 310

Course Description: The course aims to equip the students with knowledge of various approaches for analysis of a component under various conditions.

The course includes 1D and 2D problems for FEA, Analysis of Beams and Frames.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the procedure involved to solve a structural problem using Finite Element Methods.

CO2: Develop the element stiffness matrices using different approach.

CO3: Analyze a 2D problem using line, triangular, axi-symmetric and quadrilateral element.

CO4: Analyze a 3D problem using tetrahedral and hexahedral elements.

Course Content:

Unit I

Fundamental Concepts: Introduction, Historical background, stresses and. equilibrium, boundary conditions, strain-displacement relations, stress-strain relations, temperature effects, Rayleigh-Ritz Method, Galerkin's Method, Saint Venant's Principle, Matrix algebra, Gaussian Elimination.

Unit II

Finite Element Meshes: Choice of mesh, mesh data in numerical form, generation of mesh data, mesh modification.

One Dimensional Problems: Introduction, Finite element Modelling, Co-ordinates end Shape Functions. Potential energy approach, The Galerkin Approach, Assembly of Global stiffness matrix and load vector, properties of global stiffness, Finite element equations; 'Treatment of boundary conditions, quadratic shape functions, Temperature effects.

Unit III

Trusses: Introduction, plane trusses, three dimensional trusses, assembly of global stiffness matrix for the banded and skyline solution.

Two Dimensional Problems using Constant Strain Train: Introduction, finite element modelling, constant strain triangle (CST), Problem modelling and boundary conditions.

Unit IV

Two Dimensional Isoparametric Elements and Numerical Integration: Introduction, The four-node quadrilateral, Numerical Integration, Higher-order element, Problem related to beams.

Beams and Frames: Introduction, finite· element formulation, load vector, boundary considerations, shear force and bending moment beams on elastic supports, plane frames, three dimensional frames.

Recommended Books / Suggested Readings:

1. An Introduction to Finite Element Method by J.N. Reddy, McGraw-Hill, New York.
2. Introduction to FEM in Engineering by Tirupathi, R. .Chandrupatle and Ashoka D.Belegundu
3. The Finite Element Method in Engineering by S.S. Rao, Pergamon, New York.

MCC1204: Computer Integrated Manufacturing Systems

Credits : 3

LTP 300

Course Description: The course aims to equip the students with understanding of description of Flexible Manufacturing Systems and its components. The students will also learn about the other advanced techniques like AI and expert systems in CIMS. The course includes various advance technologies, Automated Material Handling Systems, different functions of CIMS.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Design the production systems for different types of industrial processes.

CO2: Perform design and analysis of different material handling systems for any type of industrial requirement.

CO3: Evaluate the space requirements of different storage system.

Co4: Design the workstation requirement for unattended operations and automated production system.

Course Content:

Unit I

Flexible Manufacturing Systems - Concept and Classification, Types of Flexibility, pallets, fixtures, work handling systems, simulation and analysis in the design of FMS

Functions and Components of CIM System: Concept of CIMS, Group Technology and Cellular Manufacturing.

Unit II

Planning and Scheduling Functions in CIM System, 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 III

Automated Material Handling Systems: Industrial Robots, Conveyors, AGVs, Automatic Storage and Retrieval Systems

Computer Aided Quality Control: Co-ordinate Measuring Machine (CMM), Machine Vision and Image Processing

Unit IV

Advance Technologies in CAD/CAM: Introduction to Rapid prototyping, Knowledge Based Engineering, Virtual Reality, Augmented Reality, Artificial Intelligence and Expert system in CIM.

Recommended Books/ Suggested Readings:

1. Ibrahim Zeid and R. Sivasubramaniam, 2nd Edition, CAD/CAM – Theory and Practice, Tata McGraw Hill, India, 2009

2. M. Groover and E. Zimmers, CAD/CAM: Computer Aided Design and Manufacturing, Pearson Education, 2007

3. P. N. Rao, CAD/CAM – Principles and Applications, Tata McGraw Hill, India.

Dr. Miltiadis A. Boboulos

4. CAD-CAM & Rapid prototyping Application Evaluation,

MCC1205: Rapid Prototyping and Tooling

Credits : 3

LTP 300

Course Description: The course aims to equip the students with techniques of reverse engineering which can be used for rapid prototyping in various industries.

The course includes tools for additive manufacturing like SLA, SGC, FDM etc.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the reverse engineering concepts for design development.

CO2: Understand the variety of additive manufacturing techniques.

CO3: Design and develop newer tooling models.

CO4: Analyze the cases relevant to mass customization and some of the important research challenges associated with AM and its data processing tools

Course Content:

Unit I

Introduction: Need - Classification of manufacturing processes, Different manufacturing systems, Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes- Benefits Applications.

Unit II

Reverse engineering and CAD modeling: Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies. Presentation and public defence, Engineer's verify the accuracy and validity of their designs by testing the system, creating prototyping and experimenting with the results.

Unit III

Liquid based and solid based additive manufacturing systems: Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

Unit IV

Powder based additive manufacturing systems: Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

Tooling: Basic concept of tooling: Cutting tool, hand tool, moulding tool, forging process and casting process. Die development and Materials: Materials for die block component, computer aided die design, flow line parting line, open and close forging plastic moulding dies.

Recommended Books/ Suggested Readings:

1. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.

2.Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.

3. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.

Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

MCC1221: Computer Aided Manufacturing Lab

Credits : 2

LTP 004

Course Description: This course enables the students to:

1 To learn the concepts and principles of Computer aided Manufacturing (CAM).

2 To understand the various types of CAM Software's like Fanuc, Siemen's, etc. and their practical usage in manufacturing applications.

3 Understand concepts of machining for selection of appropriate machining parameters, and cutting tools for CNC milling and turning jobs.

4 Develop industrial components by interpreting 3D part models/ part drawings.

5 Understand the concepts of CAM Software, CNC technology, to convert a CNC-lathe into a CNC-Milling machine and vice-versa.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to

CO1: Apply the concepts of machining for selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.

CO2: Create and validate NC part program data using manual data input (MDI) for manufacturing of required component using CNC milling or turning applications Through CAM Software's like Fanuc, Siemen's, Unimat etc.

CO3: Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.

List of Experiments:

1. To practically demonstrate the use of various Geometry (G) and Machine (M) codes.

2. To recognize origin point for 2D profiles and calculate absolute coordinate point calculation for cutter locations to generate an ISO Manual Part Program for 2D Profile.

3. Practical Demonstration of Data Migration to a CAM workstation.

4. Practical Demonstration of Part Specification and Raw Material Setting and set the Work Coordinate System and Machine Coordinate System for the Die to be manufactured.

5. Practical Demonstration of Roughing Operation, tool parameters, cutting parameters, feed and speed setting and tool path generation. (Casting, forging and sheetmetal dies)

6. Practical Demonstration of Rest Roughing Operation to maintain specific stock upon Die. (Casting, forging and sheetmetal dies)

7. Practical Demonstration of Finishing Operations for Die Finishing.

8. Practical Demonstration of Super Finishing Operations to achieve super smooth Die surface.

9. To perform Tool Path Dynamic Verification and validate the result and calculate total cutting time using simulate tool.

10. Live demonstration of cutting operation of CNC Program in VMC through DNC System.

MCC1222: Computer Aided Engineering Lab

Credits : 2

LTP 004

Course Description: The primary aim of this course is to train the students to solve complex engineering structural mechanics problems with finite element analysis. The course will provide deep insight into the operation of finite element analysis software like ANSYS, NASTRAN etc. by teaching students the underlying computational methods involved. students will be taught to execute a detailed finite element study including planning, modelling, meshing, solving, evaluating results and validating against real world data.

Course Outcomes (CO):

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

CO1: APPLY basics of Theory of Elasticity to continuum problems.

CO2: FORMULATE finite elements like bar, truss, and beam elements for linear static structural analysis.

CO3: FORMULATE 2D and axisymmetric finite elements.

Co4: DEVELOP finite element equations for 1D heat transfer elements and solve numerically.

CO5: APPLY finite element simulation tool to solve practical problems (Lab and Self-study).

Course Content:

List of Experiments:

MODELLING

(Creation of 3D assembly model of following machine elements using 3D modeling software)

1. Piston
2. Connecting Rod
3. Flange Coupling
4. Screw Jack
5. Knuckle Joint
6. Plummer Block

ANALYSIS

(Model and analyze the following field problems using Finite Element Analysis software)

7. Study Of Software Packages.
8. Structural analysis of Stepped bar
9. Structural analysis of Tapered bar
10. Stress analysis of 3D beams (simply supported, cantilever, etc.)
11. Stress analysis of a rectangular plate with a circular hole
12. Stress analysis of latch spring
13. Thermal analysis of rectangular plate
14. Thermal analysis of composite bars
15. Mode frequency analysis of simply supported beam
16. Mode frequency analysis of connecting rod

Recommended Books / Suggested Readings

1. A first course in the Finite element method, Daryl L Logan,Thomason, Third Edition
2. Fundaments of FEM, Hutton – McGraw Hill, 2004
3. Finite Element Analysis, George R. Buchanan, Schaum Seri
4. Versteeg H; An introduction to Computational Fluid Dynamics (The Finite Volume Method);Pearson
5. Reddy JN; Introduction to the Finite Element Method;McGraw Hill Inc.

MCC1223: Rapid Prototyping& Tooling Lab

Credits : 1

LTP 002

Course Description: To make students understand the wide range of additive manufacturing processes, capabilities and materials. To provide comprehensive knowledge on the various software tools and techniques that enable additive manufacturing and students learn to create physical objects that satisfies product development/prototyping.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Demonstrate appropriate levels of understanding on the principles of additive manufacturing processes.

CO2: Demonstrate competency in the use of materials for additive manufacturing processes.

CO3: Demonstrate the methodology of CAD tools and CAD interface with additive manufacturing systems.

CO4: Identify suitable additive manufacturing process, define optimum process parameters and develop physical prototypes using suitable additive manufacturing systems.

Course Content:

List of Practical's

1. Practical implementation and comparison of various rapid prototype technologies.
2. To import CAD STL file of the part to be printed in CATALYST EX Software and set part orientation units and scale.
3. To add the print model to pack and analysis model and support material requirement and time consumption for printer.
4. To prepare work table and set up the material cartridge in dimension SST 1200es for proper loading and unloading.
5. Practical demonstration of SLA.
6. To perform machine maintenance and verify stable condition of machine nozzle.
7. Experiment on study of laminated object manufacturing.

Recommended Books / Suggested Readings:

1. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.
2. Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
3. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
4. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

Elective -I

MCC1142: Artificial Intelligence

Credits: 3

LTP 300

Course Description: This course aims to impart knowledge to the students for building an expert systems and also building of intelligent machines which can work as the human minds do.

This course includes Expert Systems, Artificial Neural Networks, Fuzzy Logics etc.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to

CO1: Apply the Artificial Intelligence technique to solve the problems.

CO2: Apply the knowledge of neural network theory for developing an expert system.

CO3: Apply the knowledge of Fuzzy logic for knowledge acquisition and inference.

CO4: Develop a robust expert system using hybrid Neuro-fuzzy Technique.

Course Content:

Unit I

Introduction to Artificial intelligence: AI Problems, AI Techniques, Defining the Problem as a State Space Search, Problem Characteristics, Production Systems, Search: Issues in The Design of Search Programs.

Unit II

Expert system: Structure of an Expert Systems, Different Types of Expert Systems, Knowledge Acquisition and Validation Techniques, Black Board Architecture, Knowledge Building System Tools, Expert System Shells.

Unit III

Artificial Neural Network: Physiology of Human Brain, Machine learning, Models of Neuron, Learning Processes, Single Layer Perceptrons, Multi-Layer Feed Forward Neural Networks, Back Propagation Algorithm.

Unit IV

Fuzzy Logic: An introduction to fuzzy logic, Operations on fuzzy sets, Fuzzy relations , Fuzzy implications , Linguistic variables; An introduction to fuzzy logic controllers , Construction of data base and rule base of FLC; Defuzzification methods Inference mechanisms; A robustness study of fuzzy logic controller, Applications of fuzzy systems; Neuro-Fuzzy systems.

Minor Project (Individual): Development of an expert system using the concept of ANN and Fuzzy logic.

Recommended Books:

1. Rich, E., Knight, K., and Nair, S.B., Artificial Intelligence, TMH (2019).
2. Timothy J Ross , Fuzzy Logic with Engineering Applications, Wiley publication.
3. David Kriesel, A Brief Introduction to Neural Networks.

MCC1143: Management Information System

Credits : 3

LTP 300

Course Description: This course provides the students with techniques and skills which help in proper flow of information to the management at various levels of it. The student will also learn about the ERP software.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

After learning the course the students should be able to:

CO1: Apply MIS to any organization.

CO2: Develop an effective management information system.

CO3: Properly manage the database and retrieve it when required.

CO4: Understand and apply the ERP system in the organization.

Course Content:

Unit I

Management within organizations: Management activities, roles and levels, Management Planning and Control, Strategic Planning within an organization: activities, techniques and results. The nature of decision-making: decision making models and classification of decision-making situations, the nature of information: classifications and characteristics. MIS sub types, Measurement of MIS performance and capabilities.

Unit II

MIS applications and relationships: Kinds of Information Systems: Transaction Processing System(TPS) – Office Automation System (OAS) – Management Information System (MIS) – Decision Support System (DSS) and Expert System (ES) – Executive Support System (ESS) Data warehouses and data mining facilities: the relationship between data warehousing and other MIS facilities

Unit III

Development of MIS: Development of Long range plans, Determining information requirement, Organization for Development of MIS, Choice of Information Technology, Strategic decision, IT implementation plan, Phases of MISD implementation Assessing information needs, Identification and development of information sources, design and development of information flow network and cost considerations, need and design of an integrated information system for MIS, role of computers in MIS: Processing information flow, Maintaining records and generating outputs for decision making. Implementation and evaluation of MIS

Unit IV

Information System Application: Transaction Processing Applications, Applications for Budgeting and Planning, Automation, Manufacturing Management System, Database management system, relational database management system.

Enterprise System: Enterprise Resources Planning (ERP)-Features, selection criteria, merits, issues and challenges in Implementation.

Recommended Books / Suggested Readings:

1. Kenneth C. L. and Jane P. L., Management Information Systems – Managing the Digital Firm – Tenth Edition.

2.Jame O Brien, Management Information System, TMH.

3. Alexis Leon and Mathews Leon, Fundamentals of Information Technology.

4. Jaiswal and Mittal, Management Information Systems, Oxford Printing Press.

MCC1145: Non Destructive Testing

Credits : 3

LTP 300

Course Description: This course will equip the students with the techniqus of Non-Destructive Testing (NDT), its types and applications in engineering and research fields.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Understand the fact where to apply NDT.

CO2: Use the various Non-Destructive Testing and testing methods understand for defects and characterization of industrial components.

Course Content:

Unit I

OVERVIEW OF NDT : NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT, Visual inspection – Unaided and aided.

Unit II

SURFACE NDT METHODS: Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

Unit III

THERMOGRAPHY : Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications.

Unit IV

EDDY CURRENT TESTING (ET): Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/EvaluationRecommended Books

Recommended Books

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.

2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.

3. ASM Metals Handbook,”Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.

4. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005

5. Charles, J. Hellier,“ Handbook of Nondestructive evaluation”, McGraw Hill, New York 2001.

6. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,

- Vol. 1, Leak Testing,
- Vol. 2, Liquid Penetrant Testing,
- Vol. 3, Infrared and Thermal Testing
- Vol. 4, Radiographic Testing,
- Vol. 5, Electromagnetic Testing,
- Vol. 6, Acoustic Emission Testing,
- Vol. 7, Ultrasonic Testing.

ELECTIVE-II

MCC1244: Vehicle Dynamics

Credits : 3

LTP 300

Course Description: The course aims to equip the students with understanding of various different aspects of dynamics of vehicle

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: The students will be able to possess the knowledge to understand the aerodynamics of vehicles

CO2: The student will be able to apply principles of dynamics in real time vehicles

CO3: The student will be able to apply different techniques to measure and test vehicles on-road and in test labs.

CO4: The student will be able to employ CFD to understand the flow behavior over the road vehicle model

Course Content:

Unit I

Introduction to vehicle dynamics: evolution of road vehicles; commercial vehicles; motorcycles; shape and detail optimization; futuristic trends; performance analysis of cars and light Trucks.

Tyre Mechanics: Tyre types and construction, Tyre forces and moments, Tyre slip-grip and rolling resistance Cornering properties of tyres, Tyre models, Tyre performance on wet surfaces, Ride properties of tyres.

Unit II

Longitudinal Dynamics: Performance characteristics; Maximum tractive effort; Power plant and Transmission characteristics; Braking performance; Study of tractor; semitrailer; Anti-lock braking system; Traction control system;

Lateral Dynamics- Bicycle Model; Low speed turning; High speed cornering; and State space approach, Steady state handling characteristics of two axle vehicle, neutral steer, under-steer, and over-steer.

Vertical Dynamics- Vehicle ride characteristics, Human response to vibration, Vehicle ride models, Quarter car model, pitch and bounce model, Suspension performance for ride, vibration isolation, suspension travel, Road holding, active and Semi-active suspensions.

Unit III

Vehicle Aerodynamics: vehicle equation of motion, aerodynamic drag, tire rolling resistance, climbing resistance, effective mass, traction diagram, acceleration capability and vehicle elasticity, fuel consumption and economy.

Race cars: Front wings, Rear wings, Weight distribution, over steer and under steer, Center of gravity effects, Split streaming.

Commercial vehicle aerodynamics: Truck Aerodynamics, Improvements in design, Different styles of trailers, Effect of gap between truck and trailer, fairings.

Unit IV

Fundamentals of Acoustics: Noise and Vibrations, Frequency response functions, Modal analysis, Transfer path analysis, Single reference, Multi reference analysis.

Stability, comfort and safety: Flow field around a vehicle; interior and exterior flows; attached, separated and oscillating flows; aerodynamic forces and moments; cornering and side wind behaviors; stability index; passing maneuvers; spoiler design; safety and aesthetics; water and dirt accumulation; visibility impairment; ventilation, air flow and odor removal; Engine and interior cooling; radiators; HVAC systems.

Recommended Books

1. Reza N Jazar "Vehicle Dynamics: Theory and Application", 3rd Edition, Springer International Publishing AG, Switzerland, 2017.

2. Theory and Applications of Aerodynamics for Ground Vehicles- T. Yomi Obidi. Published by SAE, 2014, ISBN 978-0-7680-2111-0.

3. Thomas D. Gillespie,(1992), "Fundamentals of Vehicle Dynamics (R114) Publisher: Society of Automotive Engineers Inc.,1992 .

4. C. Sujatha, "Vibration and Acoustics: Measurements and Signal Analysis", McGraw Hill Education (India) Private limited, 2010.

5. Aerodynamics of Road Vehicles, W.H.Hucho, Published by SAE International, 2015.

6. Low Speed Wind Tunnel Testing, 3rd Edition, Jewel B. Barlow, William H. Rae Jr., Alan Pope, Wiley India Pvt Ltd, 2010.

MCC1245: Product Design and Development

Credits: 3

LTP 300

Course Description: The course aims to equip the students with knowledge from conceptual design to design for manufacturing.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Select an appropriate product design and development process for a given application

CO2: Choose an appropriate ergonomics for the product.

CO3: Select an appropriate standardization method.

CO4: Develop the methods to minimize the cost

Course Content

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.

Unit III

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

Unit IV

Ergonomics / Aesthetics: Gross human autonomy. Anthropometry, Man-Machine interaction, Concepts of size and texture, color .Comfort criteria, Psychological & Physiological considerations. Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design.

Recommended Books / Suggested Readings:

1. Karl T Ulrich, Steven D Eppinger , " Product Design & Development." Tata McGraw Hill New Delhi 2003

2. David G Ullman, "The Mechanical Design Process." McGraw Hill Inc Singapore 1992 N J M Roozenberg , J Ekels ,

3. N F M Roozenberg" Product Design Fundamentals and Methods ." John Willey & Sons 1995

MCC1246: Mechanics of Composite Materials

Credits: 3

LTP 300

Course Description: The course aims to equip the students with detailed knowledge of properties of composites and their advantages over the conventional materials.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Understand the significance of replacing existing metal structures with composite materials wherever beneficial

CO2: Highlight the appropriate use of composite structures in the industry

CO3: Comprehend the complexity of design of composite materials and structures

CO4: Mainly understand the mechanics of composite materials

Course Content

Unit I

Introduction to Composite material: Definitions: Composite material, Fiber, Matrix. Types of fibers and Raw Fiber Properties, Types of Matrix, Prepegs, Fillers and other Additives

Basics of composites: Mechanical Behavior of Composite Materials. Lamina, Laminate: The basic building block of a composite material, Introduction, Evaluation of the four elastic moduli – Rule of mixture, ultimate strengths of unidirectional lamina.

Unit II

Macro Mechanics of a Lamina: Hooke's law for different types of materials, number of elastic constants, Two – dimensional relationship of compliance & stiffness matrix. Hooke's law for two dimensional angle lamina, engineering constants – angle lamina, Invariants, Theories of failure.

Unit III

Micromechanical Analysis of Composite Strength and Stiffness: Micromechanical Analysis of Composite Strength and Stiffness: Properties of typical composite materials, Volume and Weight Fractions, Longitudinal Strength and Stiffness. Transverse Modulus. In-plane shear Modulus. Poisson's ratio

Unit IV

Analysis of Laminated Composites: Laminates, Basic Assumptions, Strain-Displacement Relationship, Stress-Strain Relationships, Equilibrium Equations, Laminate Stiffness, Determination of Lamina Stresses and Strains, Types of Laminate Configuration, Balanced Laminate, Anti-symmetric Laminate, Examples

Advantages and applications: Advantages of Composite Materials and Structures. Applications and Use of Composite materials in present world

Recommended Books / Suggested Readings:

1. Mukhopadhyay, M., Mechanics of Composite Materials and Structures, University Press.
2. Jones, R. M., Mechanics of Composite Materials, CRC Press.
3. Autar K. Kaw, Mechanics of Composite Materials, CRC Press.

ELECTIVE-III

MCC1344: Product Lifecycle Management

Credits : 3

LTP 300

Course Description: All industries that have tangible products need to understand PLM. Professionals who have responsibilities in engineering, manufacturing, or information systems or who have strategic planning responsibilities at the corporate or divisional levels will benefit from an understanding of PLM and its implementation.

Course Outcomes (CO): Students will be able

Upon successful completion of the course, the students should be able to:

CO1: Present the latest material on PLM and its importance in the organization.

CO2: Provide an overview of the current thinking on the principles, strategies, practices, and applications of Product Lifecycle Management followed by an in-depth understanding of various applications and solutions PLM offered that are the focus of today's innovative organizations.

CO3: Build conceptual foundation of PLM, along with the latest industry views on PLM applications.

CO4: Present frameworks which provide economic justifications for PLM projects and explain the pitfalls of a piecemeal approach to PLM.

Course Content:

Unit I

Introduction: Overview, Need, Benefits, Concept of Product Life Cycle, Components / Elements of PLM, Emergence and Significance of PLM, PLM implementation cases in various industry verticals.

Unit II

PLM Strategy and Vision: Company's PLM vision, PLM Strategy, Principles for PLM strategy, preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, PLM business goals.

Information, Tools, Information systems and people involved in PLM. Product data and processes like New Product Development, Change Management, Concurrent Design & Process Management, product data linkages across the domain.

Unit III

PLM Solutions: Different phases of product lifecycle and corresponding technologies, Enterprise information, knowledge and IP, Change Process, Product Structure & Configuration, Bill of Material, Requirement, Portfolio, Program & Project, Engineering Process, Supplier Relationship, Manufacturing Process, Maintenance Repair & Overhaul process and Simulation Process Management.

Unit IV

Human resources in product lifecycle, Methods, Techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information Standards, Vendors of PLM Systems and Components.

Recommended Books / Suggested Readings:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi
2. Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, New Delhi.
3. Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M., Standard Book House. New Delhi
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, New Delhi
6. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi

References

- Relevant recent technical articles, research papers, key note addresses, etc

MCC1345: COMPUTER GRAPHICS

Credits : 3

LTP 300

Course Description: Computer graphics is one of the fundamental aspects of any computing system. Its primary role is to render the digital content (0's and 1's) in a human-comprehensible form on the computer screen. The topics covered include various object representation techniques of modeling transformation, 3D to 2D viewing transformation and scan conversion (rendering). In order to complete the coverage, the present-day graphics hardware (I/O devices, GPU) and the widely popular openGL graphics library are also included.

Course Outcomes (CO): Students will be able

Upon successful completion of the course, the students should be able to:

1. Students will be able to describe the basics of computer graphics, different graphics systems and applications of computer graphics.
2. Students will be able to apply various algorithms for scan conversion and filling of basic objects and their comparative analysis.
3. Students will be able to apply geometric transformations on graphics objects and their application in composite form.
4. Students will be able to summarize different hidden surface elimination algorithms and shading techniques used in computer graphics and digital media production.

Course Content:

Unit I

Introduction: Introduction to Computer Graphics & its application, Interactive Computer Graphics (ICG), Overview of Graphics System, Graphics Input Devices, Graphics Output Devices, Display Devices: Common display devices, CRT Technology, storage Tube, Calligraphic (Random), Raster refresh display, Basic Concept: Refresh, Flicker, Scan Rate, Screen Size, Aspect Ratio, Interlacing and Non-Interlacing techniques. Raster color graphics, Frame Buffer, Addressing a Raster. Adapters: Basic Function, Video BIOS, Video RAM, operating Modes, Introduction to real time scan conversion, cell and run length encoding. Introduction & basic function of MGA, CGA,VGA, EGA, SVGA.

Unit II

2D entities generation: Digital Differential Algorithm (DDA), Mid-point algorithm, Bresenham's algorithms for line, circle, ellipse generation. Line segments, Pixels and frame buffers, Aliasing & Antialiasing techniques

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

Unit III

Polygons: Polygons representation, An inside test, Filling polygons, Filling with a pattern.

Three dimensions transformations: 3D geometry, 3D primitives, 3D transformations - Scaling, Rotation, Translation, Matrix representation, Homogeneous Coordinates & Composite transformations, rotation and reflection about an arbitrary point, Parallel projection, Perspective projection, Isometric projections.

Unit IV

Segments: The segment table, Segment creation, closing a segment, Deleting a segment. Windowing and clipping: The viewing transformation, Clipping, the clipping of polygons, Generalized clipping.

Light, color and shading: Point-source illumination, Shading algorithms, Shadows, Color models.

Curves and fractals: Curve generation, Interpolation, B splines, Curved surface patches, Bezier curves, Fractals, Fractal lines, Fractal surfaces.

Text Books:

1. Procedural Elements for Computer Graphics: David F. Rogers, Me Graw Hill.
2. Principles of Interactive Graphics: Newman Sproull, Mc Graw Hill, International student Publication.
3. Mathematical Elements of Computer Graphics by David F. Rogers and Adams.

Reference books:

1. Computer Graphics 2nd edition: Donald Heam, M. Pauline Beker, Prentice Hall of India
2. Computer Graphics A programming approach: Steven Harrignton, Mc Graw Hill, International student edition.
3. Mathematical Elements for Computer Graphics by David F. Rogersadn Adams.

MCC1346: Heat Transfer

Credits : 3

LTP 300

Course Description: The course aims to equip the students with mechanisms of heat transfer under steady and transient conditions and the effectiveness of different types of material used for insulation. To evaluate different materials according to their specific heat capacities. To understand the concepts of heat transfer through extended surfaces. To help the students to design fin enhanced systems, evaporators, condensers and heat exchangers.

The course includes Basic modes of Heat Transfer & their mechanisms, Forced Convection, Natural Convection, Condensation, Radiation, and Heat Exchanger

Course Outcomes (CO): Students will be able

Upon successful completion of the course, the students should be able to

CO1: Analyze the heat conduction process and solve problems involving steady state heat conduction in simple geometries.

CO2: Analyze the heat convection process and solve problems involving natural and forced heat convection on plates and ducts.

CO3: Analyze the heat radiation process and solve problems involving radiations and its exchange.

CO4: Ability to design and analyze the performance of heat exchangers and analyze the drop-wise and film wise condensation process.

Course Contents:

Unit I

Basic modes of Heat Transfer & their mechanisms: Introduction, Conduction: Fourier law of heat conduction, Thermal conductivity, General conduction equation, thermal diffusivity, One Dimensional, steady-state, without heat generation heat transfer, Concept of thermal resistance and electrical analogy, Conduction through composite slab/cylinders/spheres, Contact resistance/ Fouling Factor, Overall heat transfer coefficient, Critical thickness of Insulation, Analysis of extended surfaces: Rectangular profile longitudinal fins/ spines.

Unit II

Forced and Natural Convection:

Forced Convection; Flow over flat plate, Hydrodynamic & thermal boundary layer, Prandtl Number, Nusselt Number, Reynolds Number, Local and average heat transfer coefficient, Empirical relations for external flows, Flow through ducts.

Natural Convection; Natural Convection from vertical plate, Grashoff's Number, Empirical relations for natural convection from various bodies.

Unit III

Radiation: Laws of Radiation, Black body, Grey body &Colored body, Emissivity, Black body radiation, Shape factor &its properties, Radiation exchange between two gray surfaces.

Unit IV

Heat Exchanger: Classification of heat exchangers, LMTD Approach for parallel & counter flow heat exchangers, NTU approach for parallel/counter flow heat exchangers, Design aspects of heat exchangers.

Condensation: Film wise and Drop wise condensation, Nusselt theory for film wise condensation on vertical plates, Pool Boiling Curve.

Suggested Books /Suggested Readings:

1. Fundamental of Heat & Mass Transfer; Incropera FP, Dewitt D P; 4th Ed; John Wiley & Sons, 1996

2. Heat Transfer; Holman J. P.; 8th Ed; McGraw Hill, 2003

3.A Textbook on Heat Transfer, Sukhatme S. P.; Orient Longman Ltd., Bombay, 1985

4. A data book on Thermal Engg, Thombre SB;, 1st Ed; Green Brains Publication, 2003

5. Fundamentals of Heat and Mass Transfer, D.S. Kumar, SK Kataria& Sons (6th/7th Edition)

6. Heat and Mass Transfer YunusA.Cengel, Tata McGraw Hills Education Private Ltd (Special Indian Edition).

7. P. K. Nag, (2005), Heat Transfer, Tata McGraw Hill Publishing Company Limited

8. C. P. Kothandaraman and S. Subramanyan, (2004), Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers

Elective III LABORATORTY

MCC1324: Product Life-cycle Management Laboratory

Credits : 1

LTP 002

Course Description: Demonstrate prerequisites of PLM; Make able to understand implementation procedures of PLM tools and build confidence in using CAD /CAE software along with PLM software.

Course outcomes: Graduate can demonstrate practical uses of various PLM technologies. b) Configure the various CAD/CAE and PLM tools. c) Build the various CAD/CAE models to use in PLM applications.

Course Content:

- Introduction, Installation & maintenance of following software: Oracle / SQL Server / Db2, PLM Server, CAD Software, MS Office, Rich client, Web client, Application server, Software/ Hardware/ Network issues resolutions
- CAD: Modeling (at least 5 parts) and Assembly using any High End CAD Software. Assembly should include top down and bottom-up approaches, Drafting (at least 1 assembly). CAD File/data exchange amongst the various CAD software and software for CMM, CAE, CNC, CAM
- FEA: Analysis (structural, thermal and both) of at least two parts, Introduction to nonlinear analysis
- PLM: Exhibiting use of following modules of any PLM software through at least six assignments Organization Workflow Product Structure Access Manager Query Builder Change Management Schedule Manager Manufacturing Process Planner.

MCC1325: COMPUTER GRAPHICS LABORATORY

Credits : 1

LTP 002

Course Description: The course aims to equip the students to learn how to 'understanding of the Computer Graphics techniques concepts and algorithm. The course includes implementation of line drawing, circle drawing, polygon drawing, transformation of objects, scaling, viewing.

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to

CO1: Understand practical fundamental of line drawing, circle drawing, polygon drawing and curve drawing.

CO2: Understand the concepts of different type of geometric transformation of objects in 2D and 3D.

CO3: Understand the practical implementation of modeling, rendering, viewing of objects in 2D and 3D.

CO4: Get knowledge about clipping algorithms. List out the shapes and filling algorithms.

Lab Exercises:

1. Implementation of DDA Line Drawing algorithms to draw the line between two points.
2. Implementation of Bresenham Line Drawing algorithms to draw the line between two points.
3. Implementation of Circle using Mid-point algorithm.
4. Implementation of Area Filling Algorithm: Boundary Fill, Flood Fill and Scan line Polygon Fill.
5. Program for performing Two Dimensional Transformations: Translation, Scaling, Rotation Reflection, Shear by using a homogeneous Matrix representation, use of a function for matrix multiplication is desirable, to perform composite transformation.
6. Program to represent a 3D object using polygon surfaces and then perform 3D transformation.
7. Implementation of Cohen-Sutherland line clipping algorithm.

8. Implementation of Sutherland-Hodgeman polygon clipping algorithm.

Text Books:

1. Procedural Elements for Computer Graphics: David F. Rogers, Me Graw Hill.

2. Principles of Interactive Graphics: Newman Sproull, Mc Graw Hill, International student **Publication.**

3. Mathematical Elements of Computer Graphics by David F. Rogers and Adams.

Reference books:

1. Computer Graphics 2nd edition: Donald Heam, M. Pauline Beker, Prentice Hall of India

2. Computer Graphics A programming approach: Steven Harrignton, Mc Graw Hill, International student edition.

MCC1326: Heat Transfer Laboratory

Credits : 1

LTP 002

Course Description: The course aims to equip the students with experimentation on heat transfer equipment and improve practical knowledge of the systems and to develop trouble shooting abilities of students for practical heat transfer systems. To teach students how to measure heat transfer through various systems.

The course includes various experiments on heat transfer system

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to

Upon successful completion of the course, the students should be able to:

CO1: Experimentally determine the thermal conductivity of a solid insulating material.

CO2: Experimentally determine coefficient of heat transfer for free/forced convection and radiation

CO3: Determine shape factor of a complex body by an analog technique.

CO4: Classify and analyse different types of heat exchangers

Course Content:

List of Experiments

1. Determination of thermal conductivity of a solid insulating material by slab method
2. Determination of coefficient of heat transfer for free convection from the surface of a cylinder
3. Determination of coefficient of heat transfer for forced convection from the surface when kept across the direction of flow.
4. Determination heat transfer coefficient by radiation and hence find the Stefan Boltzman's constant.
5. Determination of shape factor of a complex body by an analog technique.
6. Study of various types of heat exchangers

Recommended Books / Suggested Readings:

1. Yunus A. Cengel, "Heat Transfer a Practical Approach", Tata McGraw-Hill Education, 4th Edition,2012.

2. R. C. Sachdeva, "Fundamentals of Engineering, Heat and Mass Transfer", New Age publication, 3 rd Edition, 2012.

3. M. NecatiOzisik, Heat Transfer – A Basic Approach, McGraw Hill, New York, 2005.

4. 2. Incropera, F. P. and De Witt, D. P., Fundamentals of Heat and Mass Transfer, 5th Edition, John Wiley and Sons, New York, 2006.

5. 3. Holman, J. P., Heat Transfer, 9th Edition, Tata McGraw Hill, New York, 2008.

Web References:

1. https://en.wikipedia.org/wiki/Heat_Transfer

2. https://en.wikipedia.org/wiki/Heat and Mass Transfer

Elective IV

MCC1347: Computational Fluid Dynamics

Credits : 3

LTP 300

Course Description: The course aims to equip the students with understanding of various algorithms behind any CFD packages.

The course includes FDM, FVM, Mesh Generation, Various Algorithms and Solution Procedure for CFD

Course Outcomes (CO): Students will be able

Upon successful completion of the course, the students should be able to

CO1: Understand the various types of fluid flow governing equations.

CO2: Analyze the internal fluid flow phenomena of thermal and fluid system.

CO3: Implement the Finite volume Approach to solve various fluid flow problems

CO4: Analyse the solutions generated using structured grid and unstructured grid

Course Content

Unit I

Introduction: Definition of CFD, Application of CFD Technique, Principles of Conservation, Conservation of Mass and Momentum: Continuity and Navier Stokes Equation, Energy Equation and General Structure of Conservation Equations.

Finite Difference Method: Classification of Partial Differential Equations and Physical Behaviour,

Unit II

Approximate Solutions of Differential Equations: Error Minimization Principles, Variational Principles and Weighted Residual Approach and Introduction to Discretization

Fundamentals of Discretization: Finite Element Method, Finite Difference and Finite Volume Method

Finite Volume Method: Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems, Boundary Condition Implementation and Discretization of Unsteady State Problems, Discretization of Unsteady State Problems.

Unit III

Important Consequences of Discretization of Unsteady State Problems, Time Dependent Diffusion Type Problems and Stability Analysis

Solution of Systems of Linear Algebraic Equations, Elimination Methods, Error Analysis, Iterative Methods for Numerical Solution of Systems of Linear Algebraic Equations, Combination of Iteration & Elimination Techniques, Introduction to Gradient Search Methods

Unit IV

Discretization of Convection-Diffusion Equations: A Finite Volume Approach, Discretization of Navier Stokes Equations, Fundamentals of Unstructured Grid Formulation

implementing a CFD Code: The basic structure of a CFD code: Pre-processor, Solver and Postprocessor, User-defined subroutines, Solution to some basic problems in heat transfer and fluid flow

Introduction to Turbulence Modeling: Important features of turbulent flow, Vorticity transport equation, Necessity of turbulence modeling, Different types of turbulence model.

Recommended Books / Suggested Readings:

1. Ghosdastidar, P. S., Computer Simulation of Flow and Heat Transfer, McGraw Hill (1998)
87th Senate approved Courses Scheme & Syllabus for M.E. CAD/CAM Engg. (2015)
2. Roache, P. J., Computational Fluid Dynamics, Hermosa (1998).
3. Wendt, J. F., Computational Fluid Dynamics An Introduction, Springer-Verlag (2008).
4. Muralidhar, K. and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Narosa (2008).
5. Jaluria, Y. and Torrance, K. E., Computational Heat Transfer, Taylor & Francis (2003)

MCC1348: Mechatronics

Credits : 3

LTP 300

Course Description: The course aims to equip the students with the knowledge of modern electro-mechanical devices. The student is also imparted with the knowledge to control, measure and interpret various process with the help of mechatronics.

The course includes introduction to mechatronics, various sensors, transducers and actuators used for the control of various processes using mechatronics, mathematical modeling of physical process.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Integrate mechanical, electronics, computer science to develop a mechatronic system to control any physical process.

CO2: Convert any physical model to the mathematical model and write equation of motion for mechanical, electrical, pneumatic and hydraulic systems.

CO3: Interface the sensors and actuators of a mechatronic device to the computer/laptop.

CO4: Develop a suitable controller to obtain the desired performance from the system by recognizing the key features of different type of controllers.

Course Contents:

Unit I

Introduction Introduction to Mechatronics Systems - Integration of mechanical, electronics, control and computer science engineering, Elements of mechatronics system, Mechatronics in products - Measurement systems - control systems - traditional design and Mechatronics Design

Unit II

Sensors, Transducers, Actuators Introduction - performance terminology - displacement position and proximity - velocity and motion - fluid pressure - temperature sensors - light sensors - selection of sensors - signal processing - servo systems. Actuators in Mechatronics System: Electric actuators, Stepper motors, DC motors, and AC motors.

Unit III

Mathematical Modeling of Dynamic Systems: Equations of motion of mechanical, electrical, pneumatic and hydraulic systems, Transforming physical model to mathematical model, Linearization, Frequency response, Modeling of different motors and generators, Laplace transformations, Sensitivity of the open-loop and closed-loop systems, Types of controller, Controller design using frequency domain and Laplace domain methods.

Unit IV

Microprocessors and Programmable Logic Controllers Introduction - Architecture - pin configuration - instruction set - programming of microprocessor using 8085 instructions - interfacing input and output devices - interfacing D/A converters and A/D converters - applications - temperature control - stepper motor control - traffic light controller. PLC- Mnemonics timers, internal relays and counters - data handling - analog input and output - selection of PLC

Recommended Books / Suggested Readings:

1. *Bolton, W., Mechatronics, Pearson Education Asia (2004).*

2. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics" , Prentice-Hall, 2000.

3. Nagrath, *I. J. and Gopal, M., Control System Engineering, New Age International (2008).*

MCC1349: Machine Tool Design

Credits : 3

LTP 300

Course Description: This program is designed to equip the students with the knowledge of various machine tools and their designs from all aspects i.e. mechanical, electrical etc.

Course Outcomes (CO): After completion of this course, student will be able to

CO1: Develop the conceptual design, manufacturing framework and systematic analysis of design problems on the machine tools.

CO2: apply the design procedures for different types of design problems such as gear box design, guide way design, shaft loading and its associated parts, rolling bearings, die design and jigs and fixtures and so on.

CO3: Design, develop and evaluate cutting tools and work holders for a manufactured product.

Unit I

General Requirements of the Machine Tool: Accuracy of Shape, Dimensional accuracy and surface finish of the components produced, High Productivity, High Technical and Economic Efficiency.

Design Principles: Stiffness and Rigidity of the Separate Constructional Elements and their combined behavior under Load, Static Rigidity, Dynamic Rigidity, Natural frequencies, Damping, Mode of Vibration.

Unit II

Electrical, Mechanical and Hydraulic Drives for the Operational Movements: Electric Drive and Control Equipment, Mechanical and Hydraulic Drives, Drives for Producing Rotational Movements, Stepped Drives, Step less Drives, Drives for Producing Rectilinear Movements, Backlash Eliminator in the Feed Drive Nut.

Unit III

Design of Constructional Elements: Machine Tool Structures, Structural Elements Design for Centre Lathe, Drilling Machine, Knee Type Milling Machine, Planning Machine, Boring Machine and Grinding Machines.

Design of Slide Ways: Design of Slide ways for Tables, Saddles and Cross-slides, Anti-friction

Bearings for slide ways, hydrostatically lubricated slide ways.

- **Unit IV**

Design of Spindles and Spindle Bearings: Design of Spindles for Strength and Stiffness, Design of Spindles for Balancing, General Layout and Design of the Driving Elements and the Spindle Bearings, Selection and General Layout of Ball and Roller Bearings for Supporting Spindles.

Design of Secondary Drives for Machine Tools: Design of Cutting Drives, Feed Drives and Setting Drives.

Recommended Books / Suggested Readings:

1. Design Principles of Metal-Cutting Machine Tools by F. Koenigsberger
2. Machine Tool Design by N. K. Mehta. McGraw Hill Publishing
3. Machine Tool Design by Acherkan, Mir publishing
4. Machine Tool Design by S.K, Basu, Oxford and IBH Publishing
5. Machine tool design by Sen and Bhattacharya, CBS Publication.

MCC1327: Computational Fluid Dynamics Laboratory

Credits : 1

LTP 002

Course Description: The purpose of the CFD Lab is to provide an independent, secure, and adequate computing environment for diverse large-scale simulation projects that involve several engineering disciplines like fluid dynamics, heat transfer, Aerodynamics, and shock waves.

Course Outcomes (CO):

Upon completion of this course, students will be able

CO1: To understand the importance of modeling and simulation of CFD problems

CO2: To analyse the laminar flow over different structures.

CO3: To solve real-life CFD problems.

Co4: To analyse the turbulent flow under different conditions

CO5: To examine the aerodynamics of the structure.

CO6: To analyse Shock wave phenomena.

CO7: To evaluate Computational Fluid Dynamics data to extract meaningful insights

Course Content:

CFD Lab Exercise:

CFD Solution Procedure: Problem setup – creation of geometry, mesh generation, selection of physics and fluid properties, initialization, solution control and convergence monitoring, results report and visualization.

Minor Project (Individual):

List of Experiment

1. Introduction to any one of the suitable software employed in modeling and simulation of CFD problems.
2. Analysis of flow over cylinder 2d
3. Analysis of flow through a bend pipe.
4. Analysis of temperature distribution through 2d plate.

5. Analysis of flow through a butterfly valve.

6. Analysis of flow through a circular pipe.

7. Radiation and convection in a 3d cube.

8. To visualize the shock wave boundary layer intersection over a flat plate and plot the velocity profile at x = 1m. Compare the accuracy of your results from FLUENT with empirical correlations.

9. To visualize the flow through convergent divergent nozzle and calculate the flow properties ate different velocities.

10. To visualize the circulation of the lift over a circular cylinder.

11. To visualize the pressure distribution over a symmetric aerofoil at different velocities.

12. To visualize the pressure distribution over a cambered aerofoil at different velocities.

13. To observe the shock wave phenomena around a wedge at supersonic flow.

14. To visualize the flow through diffuser at different velocities

Recommended Books / Suggested Readings:

1. Ghosdastidar, P. S., Computer Simulation of Flow and Heat Transfer, McGraw Hill (1998)

87th Senate approved Courses Scheme & Syllabus for M.E. CAD/CAM Engg. (2015)

2. Roache, P. J., Computational Fluid Dynamics, Hermosa (1998).

3. Wendt, J. F., Computational Fluid Dynamics An Introduction, Springer-Verlag (2008).

4. Muralidhar, K. and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Narosa (2008).

5. Jaluria, Y. and Torrance, K. E., Computational Heat Transfer, Taylor & Francis (2003)

MCC1328: MECHATRONICS LABORATORY

Credits : 1

LTP 002

Course Description: This course aims to acquaint the students with the method of programming the microprocessor and also the design, modeling and analysis of basic electrical, hydraulic and pneumatic Systems which enable the students to understand the concept of mechatronics.

Course Outcomes (CO):

Upon the completion of this course the students will be able to

CO1: Demonstrate the functioning of mechatronics system with various pneumatic, hydraulic and electrical systems.

CO2: Demonstrate the functioning of control systems with the help of PLC and microcontrollers.

List of Experiments:

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.

2. Stepper motor interface.

3. Traffic light interface.

4. Speed control of DC motor.

5. Study of various types of transducers.

6. Study of hydraulic, pneumatic and electro-pneumatic circuits.

7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.

8. Study of PLC and its applications.

9. Study of image processing technique.

Recommended Books / Suggested Readings:

1. *Bolton, W., Mechatronics, Pearson Education Asia (2004).*

2. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics" , Prentice-Hall, 2000.

3. *Nagrath, I. J. and Gopal, M., Control System Engineering, New Age International (2008).*

MCC1329: Machine Tool Design Lab

Credits : 002

LTP 002

Course Description: Machine tool design involves the design, building, and construction of machine tools used for a variety of industrial purposes. Types of machine tools commonly used in today's industries include lathes, drilling machines, and milling machines, as well as transfer, grinding, and honing machines. This course aims to develop a solution oriented approach by providing in depth knowledge of Machine Tool Design and address the underlying concepts, methods and application of Machine Tool Design.

Course Outcomes (CO):

Upon the completion of this course the students will be able to

CO1. Evaluate strategies for critical mechanical components of a machine tool based on design principles.

CO2. Design and analyze kinematic motions in a machine tool.

CO3. Design and analyze systems used for achieving required speeds and feeds.

CO4. Select Slide ways, and spindles for reducing friction and achieving high product accuracy.

Course Content:

1. Study of functional requirements of machine tools.
2. Study of working and auxiliary motion of machine tool
3. Design criterion for machine tool structure, Static & dynamic stiffness.
4. Function & important requirements of spindle unit
5. Study of different mechanism used for transforming rotary motion into translator Slider crank mechanism

1. Cam mechanism 2. Rack and pinion mechanism 3. Nut and screw mechanism

6. Study of various device for intermittent motion and draw the schematic diagram for various application. (Application and sketching of Ratchet gear mechanism, Geneva mechanism, Reversing mechanism, Differential mechanism, Norton mechanism, Mender's

mechanism.)

7. To study the aim of speed & feed rate regulation, stepped regulation of speed.

8. Study of Speed-Series used in machine tool gear box. (G.P. series is used in steeped regulation of speed.)

9. Design Procedure of machine tool gear box design. (Design a four / six speed Gear Box.)

10. Application of slide-ways profiles and their combinations. (Design of Guide ways / Slide ways.)

Recommended Books / Suggested Readings:

1. Design Principles of Metal-Cutting Machine Tools by F. Koenigsberger

2. Machine Tool Design by N. K. Mehta. McGraw Hill Publishing

3. Machine Tool Design by Acherkan, Mir publishing

4. Machine Tool Design by S.K, Basu, Oxford and IBH Publishing

5. Machine tool design by Sen and Bhattacharya, CBS Publication.

Audit Course

MCC1301: Technical Writing

Credits : 0

LTP 020

Course Description: The course aims to equip the students with an overview of concepts and terms of technical writing and forms of definitions, descriptions, process explanations, and technical reports.

The course includes overview of reading, analyzing, and interpreting material from technical fields, and practicing research and writing skills appropriate for technical topics.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

Co1: Comprehend and know how to follow the stages of writing process (prewriting/writing/rewriting) and apply them to technical and workplace writing tasks.

Co2 : Produce a set of documents related to technology and writing in the workplace and will have their ability to write clearly and accurately.

Co3: Read, understand and interpret material on technology. They will have an appreciation for some of the ideas, issues, and problems involved in writing about technology.

Co4: Be familiar with basic sources and methods of research and documentation on topics in technology, including on-line research. They will be able to synthesize and integrate material from primary and secondary sources with their own ideas in research papers.

Course Content:

The course to be run on workshop mode and students be made to write a research article during the same. Following content need to be covered during the course:

- What, why and how of technical and research writing
- Literature review
- Writing about methods, results, and discussion of results
- Referencing, academic integrity, and writing for different types of readers (Research proposals, Dissertations, Journal articles, Magazine articles)

Recommended Books / Suggested Readings:

1. Research articles, theses and other technical work in their own field.
2. https://nptel.ac.in/courses/110105091
3. https://www.slideserve.com/file-download/3835103