M.Tech – CAD CAM

R24

Academic Regulations
Course Structure
&
Syllabus

PRAGATI ENGINEERING COLLEGE
(An Autonomous Institution)
ADB Road, Surampalem, Kakinada District, A.P.-533 437
(Approved by AICTE, New Delhi & Permanently Affiliated to JNTUK, Kakinada)
(Recognized by UGC under sections 2 (f) and 12 (b) of UGC act, 1956)

M.Tech

(Effective for the students admitted from the Academic Year **2024-25** onwards)

ACADEMIC REGULATIONS R24 FOR M. Tech (REGULAR) DEGREE COURSE

Applicable for the students of M. Tech (Regular) Course from the Academic Year 2024-25 onwards. The M. Tech Degree of Pragati Engineering College(Autonomous) shall be conferred on candidates who are admitted to the program and who fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the State Government and Affiliating University and College from time to time.

2.0 *AWARD OF M. Tech DEGREE*

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

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

2.3 The minimum instruction days in each semester are 90.

3.0 A. PROGRAMMES OF STUDY

The following specializations are offered by various departments for the M. Tech Programme of study.

1. **M.Tech- Power Electronics and Electrical Drives**
2. **M.Tech- CAD/CAM**
3. **M.Tech- VLSI System Design**
4. **M.Tech- Computer Science and Engineering**

and any other course as approved by AICTE/ University from time to time.

3.0 B. Departments offering M. Tech Programmes with specializations are noted below:

EEE	**M.Tech- Power Electronics and Electrical Drives**
ME	**M.Tech- CAD/CAM**
ECE	**M.Tech- VLSI System Design**
CSE	**M.Tech- Computer Science and Engineering**

4.0 ATTENDANCE

4.1 **A student shall be eligible to write End Semester Examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.**

4.2 **Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the Committee.**

4.3 **Shortage of Attendance below 65% in aggregate shall not be condoned.**

4.4 **Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.**

4.5 **A prescribed fee shall be payable towards condonation of shortage of attendance.**

4.6 **A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.**

5.0 EVALUATION

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

5.1 For the **theory subjects** 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the **average** of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks. Semester End Exam Paper contains FIVE mandatory questions (one question from one unit) with internal choice, each carrying 12 marks for a total of 60 marks.

5.2 For **Practical subjects**, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded as internal marks, based on the day to day work-10 marks, Record-10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup marks of Procedure-15, Experimentation-25, Results-10 , Viva-voce-10.

5.3 For **Technical seminar**, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For Technical seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. Out of 100 marks, supervisor awards 40% marks and remaining 60% marks are awarded by the project review committee.

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

5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to reappear for the End semester Examination in that subject. A candidate shall be given a chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled. For re-registration the candidates have to apply to the college by paying the requisite fees before the start of the semester in which re-registration is required.

5.6 In case the candidate secures less than the required attendance in any re registered subject (s), he shall not be permitted to write the End Examination in that subject. He shall again re-register the subject when next offered

5.7 Laboratory examination for M. Tech. programmes must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher from the same department and the second examiner shall be appointed by the Principal from the panel of examiners submitted by the respective HoD.

5.8 Student is allowed to register for 12 week SWAYAM / NPTEL MOOC courses (recommended by BoS Chairman) and obtain required credits during II Semester itself. In any case, if a student fails in obtaining credits, he is allowed to repeat the initially opted course / change to another MOOC course or regular course and will be considered as regular candidate only. After successful completion, by the end of III Semester, he needs to submit the course certificate (through HoD) to the exam section to perform credit transfer.

5.9 In addition to credit courses, for completing the programme and obtaining degree, a student needs to complete audit courses. Audit courses will be conducted, evaluated as normal credit courses, and the assessment will be graded as Pass or Fail.

5.10 Students shall undergo mandatory summer **internship** (2 credits) for a minimum of eight weeks duration at the end of II semester of the Programme/Summer Break. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the committee. The Committee comprises of Head of the Department and two faculty. The report and the oral presentation shall carry 40% and 60% weightages respectively. For internship, there will be only internal evaluation of 100 marks in the III semester. A candidate has to secure a minimum of 50% of marks to be declared successful.

6.0 EVALUATION OF PROJECT WORK(part-1 and Part-2)

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

6.1 For Project evaluation, out of 200 marks, 80 marks shall be for Internal Evaluation(40 internal marks for Project work Part-I and remaining 40 internal marks for project work Part-II) and 120 marks for the End Examination (Viva–Voce).

6.2 Student has to secure 40% of marks in the Viva–Voce examination and a minimum aggregate of 50% of total marks in Viva–Voce examination and Internal Evaluation taken together.

6.3 A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members.

6.4 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

6.5 After satisfying 6.4, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).

6.6 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the Project Review Committee (PRC) shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

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

6.8 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of all theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. The candidate has to pass all the theory and practical subjects before submission of the Thesis.

6.9 The candidate may be allowed to submit the project report, if the project work is published or accepted in a reputed national or international journal or conference.

6.10 Three copies of the Project Thesis certified by the supervisor shall be submitted to the department along with plagiarism report (<40%).

6.11 The thesis shall be adjudicated by one examiner selected by the Principal. For this, the Head of the Department shall submit a panel of five examiners, eminent in that field, with the help of the guide concerned and other PRC Members.

6.12 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is still unfavorable, the thesis shall be summarily rejected. The candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the Principal.

6.13 The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination.

6.14 If the candidate failed in the Viva-Voce examination, the candidate shall retake the Viva-Voce examination only after three months. If he failed again the second Viva-Voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the Principal.

7.0 Cumulative Grade Point Average (CGPA)

Marks Range (Max – 100)	Letter Grade	Level (G)	Grade Point
≥ 90	S	Excellent (S)	10
≥80 to <90	A	Very Good (A)	9
≥70 to <80	B	Good (B)	8
≥60 to <70	C	Fair (C)	7
≥50 to <60	D	Satisfactory (D)	6
<50	F	Fail (F)	0
		Absent	0

Computation of SGPA

The following procedure is to be adopted to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The SGPA **is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e**

$$SGPA\ (Si) = \sum (Ci \times Gi) / \sum Ci$$

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

Computation of CGPA

The CGPA **is also calculated in the same manner taking into account all the courses undergone by a student over all the semester of a programme, i.e.**

$$CGPA = \sum (Ci \; X \; Si) / \sum Ci$$

Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester. The SGPA and CGPA shall be rounded off to TWO decimal points and reported in the transcripts.

8.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	**CGPA to be secured**	
First Class with Distinction	≥ 7.75 without backlog history	**From the CGPA secured from 68 Credits.**
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	

9.0 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

10.0 TRANSITORY REGULATIONS

Discontinued or detained candidates are eligible for re-admission into same or equivalent subjects at a time as and when offered.

11.1 **GENERAL**

11.2 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

11.3 The academic regulation should be read as a whole for the purpose of any interpretation.

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

11.5 The College may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the College.

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

R24 M.TECH CAD/CAM COURSE STRUCTURE

I Semester

S.No	Category	Course Code	Course Title	L	P	C
1	Program Core	24061T01	Finite Element Methods	3	0	3
2	Program Core	24061T02	CAD/CAM	3	0	3
4	**PROGRAM ELECTIVE-I**			3	0	3
	Program Elective	24061T03	Theory of Elasticity and Plasticity			
	Program Elective	24061T04	Mechanical Behaviour of Materials			
	Program Elective	24061T05	Numerical Methods in Engineering			
5	**PROGRAM ELECTIVE -II**			3	0	3
	Program Elective	24061T06	Mechatronics			
	Program Elective	24061T07	Scaling Laws and Micro Manufacturing			
	Program Elective	24061T08	Flexible Manufacturing Systems			
6	Credit Course		Research Methodology and IPR	2	0	2
7	Program Core	24061L01	Advanced CAD Laboratory	0	4	2
8	Program Core	24061L02	Advanced CAM Laboratory	0	4	2
9	Audit Course	24061A01	Audit Course-1*	2	0	0
			Total Credits			**18**

***Student has to choose any one audit course listed at the end of the course structure.**

II Semester

S.No	Category	Course Code	Course Title	L	P	C
1	Program Core	24062T09	Industrial Robotics & Automation	3	0	3
2	Program Core	24062T10	Advanced Manufacturing Processes	3	0	3
4	**PROGRAM ELECTIVE-III**			3	0	3
	Program Elective	24062T11	Introduction to Artificial Intelligence and Machine Learning			
	Program Elective	24062T12	Product Design and Development			
	Program Elective	24062T13	Materials Characterization Techniques			
5	**PROGRAM ELECTIVE -IV**			3	0	3
	Program Elective	24062T14	Additive Manufacturing			
	Program Elective	24062T15	Optimization & Reliability			
	Program Elective	24062T16	Smart Manufacturing			
6	Program Core	24062L03	Advanced Manufacturing Processes Laboratory	0	4	2
7	Program Core	24062L04	Robotics & Automation Laboratory	0	4	2
8	Mini Project	24062S01	Technical Seminar	2	0	2
9	Audit Course	24062A02	Audit Course-2*	2	0	0
			Total Credits			**18**

***Student has to choose any one audit course listed at the end of the course structure.**

8 weeks Mandatory Industrial Training/Internship during summer / semester break, to be evaluated in III Semester

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III Semester

S.No	Category	Course Code	Course Title	L	P	C
1	**PROGRAM ELECTIVE-V**			3	0	3
	MOOCs	24063M01	MOOCs (NPTEL)-12 Week Course Recommended By The Department Relevant To The Program. **(OR)**			
	Program Elective	24063T17 24063T18 24063T19	• Non Destructive Evaluation • Design And Analysis of Experiments • Sustainable Manufacturing			
2	**OPEN ELECTIVE**			3	0	3
	MOOCs	24063M02	MOOCs (NPTEL)-12 Week Course Recommended By The Department Relevant To The Program. **(OR)**			
	Open Elective		Courses offered by other departments in the college • Principles of Cyber Security (CSE) • IoT Applications (ECE) • Hybrid Electric Vehicles (EEE)			
3	Internship	24063I01	**Internship**	0	0	2
4	Project	24063P01	**Project Work Part-I**	0	20	8
			Total Credits			**16**

IV Semester

S.No	Category	Course Code	Course Title	L	P	C
1	Project	24064P02	**Project Work Part-II**	0	32	16
			Total Credits			**16**

NOTE:

- ***Audit Course 1 :**
  1)Writing Skills for Research Paper
  2)Value Education
- ***Audit Course 2 :**
  1) Pedagogy Studies
  2) Personally Development through Life Environment Skills.

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DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

FINITE ELEMENT METHODS

(ME)

Course Category	Program Core	**Course Code**	24061T01
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Engineering Mechanics, Strength of Materials, Matrix Algebra & Basic Mathematics	***Continuous Internal* Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	To study the basic principles of finite element analysis procedure.
2	To study the analysis of 1-D structures, Trusses and Beams.
3	To study the analysis of 2-D structures.
4	To study the analysis Iso Parametric Formulation & Convergence Requirements.
5	To present analytical approaches for structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Apply several kinds of computational methods to develop and evaluate the governing equations for various engineering problems..	K3
CO2	Develop, solve, and analyse problems involving one-dimensional Axially loaded bars, trusses, and beam elements.	K3
CO3	Apply the numerical methods of FEM to derive element matrices. Solve and analyse two dimensional CST, Axi-symmetric problems subjected to various boundary conditions.	K3
CO4	Apply and develop the solutions for the numerous engineering problems Using the concepts of iso-parametric formulation and convergence techniques	K3
CO5	Evaluate various engineering problems subjected to dynamic and Thermal conditions for optimum solutions.	K5

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2			2		3
CO2	3	2	1			2
CO3	1		2	3		2
CO4	3				3	
CO5		3	1	2	2	3

COURSE CONTENT

UNIT–I:

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

UNIT–II:

One-dimensional Problems: Bar, trusses, beams and frames, displacements, stresses and temperature effects.

UNIT–III:

Two Dimensional Problems: CST, Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions.

UNIT–IV:

Isoparametric Formulation: Concepts, sub-parametric, super parametric elements, numerical integration, LST, four-nodded and eight-nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions.

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

UNIT–V:

Static and Dynamic Problems: Analysis, Eigen value problems, and their solution methods.

Heat Transfer problems: Conduction and convection, examples:-two- dimensional fin.

TEXT BOOKS:

1. Finite Element Methods by Chandrupatla&Belegundu.
2. Finite Element Analysis by P.Seshu, PHI learning private limited, NewDelhi

REFERENCE BOOKS:

1. J.N.Reddy,Finite element method in Heat transfer and fluid dynamics,CRCpress,1994
2. Zienckiwicz O.C. and R. L. Taylor, Finite Element Method, McGraw-Hill, 1983.
3. K.J.Bathe,Finiteelementprocedures,Prentice-Hall,1996
4. Concepts and applications of finite element analysis, R.D.Cooketal. Wiley

WEB REFERENCES:

1. https://archive.nptel.ac.in/courses/112/105/112105308/
2. https://archive.nptel.ac.in/courses/112/104/112104116/
3. https://www.coursera.org/lecture/finite-element-method/02-01-the-galerkin-or-finite-dimensional-weak-form-GVp5u
4. https://seismovlab.com/

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

CAD/CAM

(ME)

Course Category	Program Core	**Course Code**	24061T02
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to AutoCAD software and fundamentals of assembly drawing	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	To study about the CAD process and exposure to CAD tools for use in mechanical engineeringdesignconceptualization,geometricmodelling,communication,analysisand optimization, further use in CAD.
2	Impart knowledge related to principles, methods and techniques of surface modelling, wireframe modelling and 3D modelling in parametric CAD software.
3	To Introduce standard terminologies, conventions, processes, operations, design and operational characteristics of key hardware components, programming techniques, applications, merits and demerits of Computer Numerical Controlled (CNC) machines, CIM and CAQC.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the CAD process and analyse the use of different geometric curves in the correct manner for making geometric part models.	K4
CO2	Apply and create the assemblies and automated drawings of mechanical components and assemblies with use of parametric 3D CAD software tools.	K6
CO3	Apply the concept so automatic machining to create and validate NC Part program data using manual data input (MDI) and automatically using standard commercial CAM packages for CNC machining.	K6
CO4	Explain and apply computer-based integration between various functions like manufacturing, sales, design, materials etc. to analyse the real time problems.	K4
CO5	Apply the concept of CAQC and Automatic Identification and Data Capture technology, FMS, concurrent engineering, Simulation and AI in CIM systems.	K5

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1			1	2		2
CO2	1		2	3	2	2
CO3	2		2		2	3
CO4		2		2	2	3
CO5		3	2	3		

COURSE CONTENT

UNIT–I:

Cubic splines: Algebraic and geometric forms of cubic spline,

Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.

B-Spline Curves: B-Splinebasis, equations, knotvectors, properties, NURBS.

UNIT–II:

Surface modeling: Bicubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.

UNIT–III:

Solid Modelling: Wire frames, Boundary representation, Half space modelling, spatial cell, cell decomposition, CSG

CNC: Differences between NC,CNC,DNC, types of CNC,DNC machines, Elements of CNC system, CNC tooling– cutting tools materials, high speed steel tools, cement carbide tools, ceramic tools, tools magazines, Automatic Tool Changer, modular accessories in CNC, CNC part programming – manual, computer assisted, APT, CAD/CAM programming, CAM software.

UNIT–IV:

CIM: Introduction to CIM, Data flow in CIM, CIM wheel, Process involved in CIM, Need for CIM, Advantages & disadvantages of CIM, CIM integration, Challenges, Sub systems in CIM, Present Scenario, Future prospects; Production system: automation in production systems, Manual labour in production systems, Automation principles and strategies.

UNIT–V:

Automatic Identification and Data Capture: Introduction, Reasons for AIDC, bar code, RFID and other AIDC technologies, CAQC – Inspection metrology, CMM, Machine Vision, other optical inspection methods, Non optical Non- contact inspection technologies, Material handling and identification, computers in manufacturing industry– current scenario(AI, ML,DL, Digital manufacturing, IOT, Cloud based manufacturing).

TEXT BOOKS:

1.Elements of Computer Graphics by Roger & Adams Tata McGraw Hill.

2. Geometric Modelling by MichealE.Mortenson, McGraw Hill Publishers.

3. CAD/CAM: Theory and Practice, Ibrahim, McGraw Hill Publishers.

4. Chang T C and Wysk R A, 1997, Computer Aided Manufacturing, Prentice hall PTR.

5.XuX, 2009, Integrating Advanced computer aided design, manufacturing and numerical control, Information science reference.

REFERENCE BOOKS:

1. GrooverMP,2007,Automation, Production systems and computer integrated manufacturing, Prentice hall Press.

2. WeatherallA,2013, Computer integrated manufacturing from fundamentals to implementation. Butterworth – Heinemann.

3. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.MallikarjunaRao, M.M.M.Sarcar, PHIPublishers

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1. https://archive.nptel.ac.in/courses/112/102/112102101/
2. https://nptel.ac.in/courses/112102102
3. http://vlabs.iitkgp.ac.in/cim/
4. https://fab-coep.vlabs.ac.in/exp/3d-scanning/theory.html

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

THEORY OF ELASTICITY AND PLASTICITY

(ME)

Course Category	Program Elective	**Course Code**	24061T03
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Engineering Mechanics and Mechanics of Solids.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	To impart knowledge of Principal stresses and strains to develop analytical skills of solving problems using plain stress and plain strain.
2	To develop analytical skills for solving two-dimensional elasticity problems in rectangular and polar coordinates.
3	To impart knowledge of engineering application of torsion and plasticity.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate, apply and analyse the 2D plane stress and plane strain problems subjected to various boundary conditions.	K4
CO2	Generate and solve the governing equations for the 2D elasticity Problems in rectangular and polar co-ordinate systems using various methods.	K6
CO3	Analyse the stress and strain in 3D elasticity problems by employing Different general methods.	K6
CO4	Apply the theory of elasticity concepts to solve torsional problems of Both circular and non-circular shafts.	K4
CO5	Demonstrate the plastic behavior from stress-strain curves for different Materials and describe different strain-hardening models.	K5

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2		2		
CO2	2		2	2	3	
CO3		2			3	3
CO4	3	2	2	3		
CO5		2		2	3	2

COURSE CONTENT

UNIT–I:

Introduction: Elasticity –Notation for forces and stresses – Components of stresses –components of strain – Hooke's law.

Plane Stress and Plane Strain Analysis: Plane stress-plane strain – Differential equations of equilibrium– Boundary conditions– Compatibility equations–stress function–Boundary conditions.

UNIT–II:

Two Dimensional Problems in Rectangular Coordinates: Solution by polynomials–Saint Venant's principle–Determination of displacements–bending of simple beams–Application of Fourier series for two dimensional problems – gravity loading.

Two Dimensional Problems in Polar Coordinates: General Equation in polar coordinates – stress distribution symmetrical about an axis –Pure bending of curved bars – strain components in polar coordinates – Displacements for symmetrical stress distributions – simples symmetric and asymmetric problems – Generalsolutionoftwodimensionalprobleminpolarcoordinates–Applicationof thegeneralsolutionoftwodimensionalprobleminpolarcoordinates–Application of the general solution in polar coordinates.

UNIT–III:

Analysis of Stress and Strain in Three Dimensions: Principle stress – ellipsoid and stress – director surface – Determination of principle stresses – Maximum shear stresses– Homogeneous deformation – principle axis of strain rotation.

GENERALTHEOREMS: Balance laws– Differential equations of equilibrium– conditions of compatibility – Determination of displacement–Equations of equilibrium in terms of displacements–principle of superposition–Uniqueness of solution –the Reciprocal theorem.

UNIT–IV:

Torsion of Prismatic Bars: General solution of problems by displacement (St. Venant's warping function) & force (Prandtl's stress function) approaches – Membraneanalogy–Torsionofcircularandnon-circular(ellipticandrectangular) sections – Torsion of thin rectangular section and hollow thin-walled section – Single and multi-celled sections.

UNIT–V:

Theory of Plasticity: Stress-straincurve–Theories of strength and failure –Yield Criteria – Yield Surface – Plastic Flow – Plastic Work – Plastic Potential – Strain hardening.

TEXT BOOKS:

1. Timoshenko, S.,Theory of Elasticity and Plasticity, MCGraw Hill Book company.
2. Sadhu Singh, Theory of Elasticity and Plasticity, Khanna Publishers.

REFERENCE BOOKS:

1. Popov, Advanced Strength of materials, MC Graw Hill Book Company.
2. Chen, W.F. and Han, D.J, Plasticity for structural Engineers, Springer-Verlag, New York.
3. Lubliner, J., Plasticity Theory, MacMillan Publishing Co, NewYork.
4. Y.C.Fung., Foundations of Solid Mechanics, Prentice Hall India.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc21_ce45/preview
2. https://www.sciencedirect.com/topics/materials-science/theory-of-elasticity
3. https://home.iitm.ac.in/kramesh/SOM_course_content.pdf

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

MECHANICAL BEHAVIOUR OF MATERIALS

(ME)

Course Category	Program Elective	**Course Code**	24061T04
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Engineering Mechanics, Mechanics of Solids and Metallurgy& Material Science.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	To teach students the mechanical properties and behavior of materials.
2	Todevelopthestudent'sabilitytounderstandandapplythevarioustheoriesofstressand strain in three dimensions along with the applications.
3	Totrainstudentstoidentify,formulate,andsolveengineeringproblemsinvolving resistance to plastic deformation, fatigue, and fracture.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Describe effects of elasticity and plastic deformation on mechanical properties of engineering materials subjected to various static and dynamic loadings.	K2
CO2	Apply the Griffith's theory to different materials to analyse the fracture Toughness and stress intensity factor on their performance.	K3
CO3	Analyse the effect of various metallurgical properties on the engineering materials subjected to fatigue and creep.	K4
CO4	Identify modern metallic materials for the various engineering applications.	K3
CO5	Describe the properties, processing and applications of polymer–matrix And ceramic–matrix composites.	K2

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

contribution of Course Outcomes towards achievement of Program Outcomes

(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1				3		
CO2				3	3	
CO3			2	3		
CO4			2	3	3	
CO5			2	3		

COURSE CONTENT

UNIT–I:

Elasticity in metals, mechanism of plastic deformation, slip and twinning, role of dislocations, yield stress, shear strength of perfect and realcrystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behaviour, super plasticity, Yield criteria: Von-mises and Tresca criteria.

UNIT–II:

Griffth's Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson – Miller parameter, Deformation and Fracture mechanism maps.

UNIT–III:

Fatigue, fatigue limit, features of fatigue fracture, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis. Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep.

UNIT–IV:

Dual Phase Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Inter metallics, Ni and Ti Aluminides.

Processing and applications of Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials, High Entropy alloys.

UNIT–V:

Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings; Structure, Properties and Applications of Engineering Polymers; Advanced Structural Ceramics- WC, TiC, TaC, A12O3, SiC, Si3N4, CBN and Diamond–properties, Processing and applications.

TEXT BOOKS:

1. Mechanical Behaviour of Materials / Thomas H. Courtney / McGraw Hill / 2nd Edition / 2000.
2. Mechanical Metallurgy / George E.Dieter / McGraw Hill, 1998.
3. Material Science and Engineering / William Callister / John Wileyand Sons.

REFERENCE BOOKS:

1. Selection and use of Engineering Materials 3e / Charles J.A / Butterworth Heiremann.
2. Engineering Materials Technology/James A Jacob Thomas F Kilduff / Pearson.
3. Introduction to Ceramics, 2nd Edition by W. David Kingery, H. K. Bowen, Donald R. Uhlmann.

WEB REFERENCES:

1.https://onlinecourses.nptel.ac.in/noc21_mm27/preview
2. https://archive.nptel.ac.in/courses/113/106/113106101/
3. https://mme.iitm.ac.in/researchinner.php?l=TVVWTE9XWmljVGxFWGpoaVdBPT0=
4. https://courses.iitm.ac.in/course/info.php?id=4872

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

NUMERICAL METHODS IN ENGINEERING

(ME)

Course Category	Program Elective	**Course Code**	24061T05
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to the basic science and engineering fundamentals &computational Problem Solving	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	Theaimofthissubjectistoequipstudentswithcomputationaltoolsforsolvingcommon physical engineering problems.
2	Thefocusofthelecturesisontypicalphysicalengineeringproblemsandtheir solutions via the effective implementation of classical algorithms.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Apply various numerical methods to solve common physical and engineering problems.	K3
CO2	Apply the Shooting method and Rayleigh–Ritz method to evaluate Boundary value problems.	K3
CO3	Demonstrate and applying various transformation techniques to model and solve various engineering/boundary value problems.	K3
CO4	Solve partial differential equations developed by employing various transformation techniques to different engineering problems.	K3
CO5	Apply and solve partial differential equations using both implicit and Explicit numerical methods.	K3

K1-Remembering, K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3			2	2	
CO2			2	3		
CO3	2		3	3	2	
CO4	2	3		2		3
CO5			3	3	2	

COURSE CONTENT

UNIT–I:

Introduction to numerical methods applied to engineering problems: solving sets of equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations. Least square approximation fitting of nonlinear curves by least squares – regression analysis- multiple linear regression, nonlinear regression – computer programs.

UNIT–II:

Boundary value problems and characteristic value problems: Shooting method-Solution through asset of equations–Derivative boundary conditions–Rayleigh-Ritz method –Characteristic value problems.

UNIT–III:

Transformation Techniques: Continuous Fourier series, frequency and time domains, Laplace transform, Fourier integral and transform, discrete Fourier transform (DFT), Fast Fourier transform (FFT).

UNIT–IV:

Partial differential equations – I: Laplace's equations – Representations as a differenceequation– IterativemethodsforLaplace'sequations–Poissonequation – Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

UNIT–V:

Partial differential equations–II: Explicit method–Crank- Nickelson method– Derivative boundary condition – Stability and convergence criteria. Solving wave equation by finite differences- stability of numerical method–method of Characteristics – wave equation in two space dimensions - computer programs.

TEXTBOOKS:

1. Steven C. Chapra, Raymond P. Canale "Numerical Methods for Engineers" Tata Mc- Graw Hill.

2. CurtisF.Gerald, Partick.O.Wheatly," Applied numerical analysis"Addison-Wesley,1989.

3. DouglasJ.Faires, RichedBurden"Numerical methods", Brooks/ Cole publishing company,1998.Second edition.

4. Sastry, S.S., "Introduction Methods of Numerical Analysis", PHI

REFERENCEBOOKS:

1. Ward Cheney and David " Numerical mathematics and computing" Brooks/Cole publishing company1999, Fourth edition.

2. RileyK.F, M.P.HobsonandBenceS.J, "Mathematical methods for physics and engineering", Cambridge University press,1999.

3. Kreysis, Advanced Engineering Mathematics Hardcover – 8 December 2010,John Wiley & Sons Inc.

WEB REFERENCES:

. https://archive.nptel.ac.in/courses/127/106/127106019/

. https://nptel.ac.in/courses/105105043

. https://www.geos.iitb.ac.in/index.php/ma-214-introduction-to-numerical-analysis/

. https://www.coursera.org/learn/numerical-methods-engineers

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

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DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

MECHATRONICS

(ME)

Course Category	Program Elective	**Course Code**	24061T06
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Mathematics, Basic Electrical Engineering,	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	To impart the basic knowledge and importance on Mechatronics in Engineering Fields among the students.
2	To create the awareness on Mechatronics in Research and Application area.
3	To impart the knowledge about the application and utility of Mechatronics used in various sectors and fields.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Identification and demonstration of key elements of mechatronics system and its representation in terms of block diagram.	K2
CO2	Describe the use of solid-state electronic devices, diodes, amplifiers, etc. in designing the mechatronics systems and MEMS.	K2
CO3	Illustrate the applications of various hydraulic, pneumatic, mechanical, electrical actuating systems and valves in designing the mechatronic systems.	K3
CO4	Develop the PLC ladder programming for the creation of real-time mechatronic system.	K6
CO5	Develop dynamic models using system interfacing and data acquisition methods to design mechatronics systems for future applications.	K6

K1-Remembering, K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1		3		3		
CO2				2	3	3
CO3		3		3	2	3
CO4	2		3	3	2	3
CO5	3	3	3		2	3

COURSE CONTENT

UNIT – I:

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT – II:

Solid state electronic devices, P-N junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

UNIT – III:

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro pneumatic, electro-hydraulic servo systems, Mechanical actuating systems and electrical actuating systems.

UNIT – IV:

Digital electronics and systems, digital logic control, microprocessors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT – V:

System and interfacing and data acquisition, DAQS, SCADA, Analogue to Digital and Digital to Analogue conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

TEXTBOOKS:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran& GK VijayaRaghavan/WILEY India Edition/2008.

2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.

REFERENCEBOOKS:

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.

2. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.

3. Mechatronics System Design / Devdasshetty / Richard / Thomson.

4. Mechatronics / M.D. Singh / J.G. Joshi/PHI.

5.Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton.

6. Mechatronics – Principles and Application Godfrey C. Onwubolu, Wlsevier, 2006 Indian print.

WEB REFERENCES:

1. https://www.coursera.org/certificates/robotics-mechatronics-iitguwahati
2. https://www.classcentral.com/subject/mechatronics
3. https://archive.nptel.ac.in/courses/112/107/112107298/
4. https://www.youtube.com/watch?v=4lilX8cHDHI

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

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DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

SCALING LAWS AND MICRO-MANUFACTURING

(ME)

Course Category	Program Elective	**Course Code**	24061T07
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Conventional Manufacturing Processes, Conventional Machining Processes and Fundamentals of Nano materials.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	To impart the knowledge on Micro-manufacturing and Scaling Laws.
2	To train the students to gain the skill in Mechanical micromachining, Advanced micromachining processes and associated computer/laboratory work.
3	To create the awareness on Metrology, Micro-machine tool system, machining essentials including part registration and micro-manufacturing case studies.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		Cognitive Level
CO1	Apply and analyse scaling laws that are used extensively in the conceptual design of micro devices and systems.	K3
CO2	Demonstrate and select the appropriate micromachining process to fabricate MEMS devices based on the application.	K2&K3
CO3	Explain the new modern finishing processes and their applications in manufacturing field.	K2
CO4	Demonstrate the advanced skills in forming and welding by using or developing modern techniques like laser/electron beams.	K2&K3
CO5	Describe the metrology for micro machined components and select the processes for micro components including Microelectronic devices	K2

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1		2			3	3
CO2		2	3	3		
CO3			3	2	3	
CO4	2	3				
CO5		2	2	2		3

COURSE CONTENT

UNIT – I:

Introduction to Micro-manufacturing, Scaling Laws: importance and applications Micromachining–I: Mechanical Micromachining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micromachining.

UNIT – II:

Micromachining–II: Beam Energy based micromachining – Electron Beam, Micro Machining – Laser Beam, Micro Machining – Electric Discharge, Micro Machining – Ion Beam, Micro Machining –Plasma Beam, Micro Machining – Hybrid, Micromachining – Electro Discharge Grinding – Electro Chemical spark micro machining – Electrolytic in process Dressing.

UNIT – III:

Nano Finishing: Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemo mechanical Polishing.

UNIT – IV:

Micro Forming and Welding: Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding.

UNIT – V:

Recent Trends and Applications: Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications. Fabrication of Microelectronic Devices: Crystal growth and wafer preparation, Film Deposition, oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, surface mount technology, Integrated circuit economics.

TEXTBOOKS:

1. McGeough. J. A., Micromachining of Engineering Materials, CRC press 2001, ISBN10:0824706447.

REFERENCEBOOKS:

1. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012.
2. Janocha H., Actuators – Basics and applications, Springer publishers – 2012 .
3. Jain V.K., Introduction to Micromachining, Narosa Publishing House, 2011.
4. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
5. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN: 8122422578.
6. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002.

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1. https://archive.nptel.ac.in/courses/112/105/112105231/
2. https://archive.nptel.ac.in/courses/117/108/102108078/
3. http://digimat.in/nptel/courses/video/112105231/L07.html
4. https://www.coursera.org/learn/scaling-product-and-processes
5. https://graphsearch.epfl.ch/en/course/MICRO-470

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

FLEXIBLE MANUFACTURING SYSTEMS

(ME)

Course Category	Program Elective	**Course Code**	24061T08
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Manufacturing Technology.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	To understand the Evolution of manufacturing systems and its applications.
2	To study about different types of Flexible manufacturing systems.
3	To understand the different process layouts and their applications in industries
4	To learn the different material handling systems in various industrial applications.
5	To analyze the design of Flexible manufacturing systems and also various case studies.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Illustrate the different manufacturing systems and their characteristics	K2
CO2	Apply the different flexible manufacturing systems to the industrial applications	K3
CO3	Analyze the different process layouts and their salient features	K4
CO4	Explain different material handling Systems and their applications	K2
CO5	Evaluate design of flexible manufacturing systems and their case studies.	K5

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3			
CO2	2	3	2	2		
CO3	2	3	2			
CO4	2	3	3			
CO5	2	3	3			

COURSE CONTENT:

UNIT I:

Understanding of FMS: Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type.

UNIT II:

Classification of FMS Layout: Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc.

UNIT III:

Processing stations: Salient features Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/ Deburring station.

UNIT IV:

Material Handling System: An introduction, Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS) Management technology: Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, routing, Production Planning and Control, Scheduling and loading of FMS.

UNIT V:

Design of FMS: Performance Evaluation of FMS, Analytical model and Simulation model of FMS Case studies: Typical FMS problems from research papers

TEXTBOOKS:

1. William W Luggen, “Flexible Manufacturing Cells and System” Prentice Hall of Inc New Jersey, 1991.

2. Reza A Maleki “Flexible Manufacturing system” Prentice Hall of Inc New Jersey, 1991 3. John E Lenz “Flexible Manufacturing” marcel Dekker Inc New York ,1989.

REFERENCEBOOKS:

1.Groover, M.P “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall

WEB REFERENCES:

1. http://www.ignou.ac.in/upload/UNIT6-55.pdf
2. https://nptel.ac.in/courses/112103174/module1/lec2/3.html

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

RESEARCH METHODOLOGY AND IPR

(ME)

Course Category	Credit Course	**Course Code**	
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to good communication skills, proficiency in Basic English, Science and good writing skills.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	To understand the knowledge on basics of research and its types.
2	To impart the concept of Literature Review, Technical Reading, Attributions and Citations.
3	To know the Ethics in Engineering Research.
4	To know the concepts of Intellectual Property Rights in Engineering.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Explain the meaning of engineering research and apply to develop an appropriate framework for research studies.	K2
CO2	Identify the procedure of Literature Review, Technical Reading, etc. and apply to develop a research design during their project work.	K2
CO3	Explain and apply the fundamentals of patent laws and drafting procedure in their research works.	K2
CO4	Demonstrate the copyright laws, subject matters of copyrights, designs etc. to apply in patent filing.	K3
CO5	Identify the new developments in IPR and employ the applications of computer software in writing/filing patents in future.	K2

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes

(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3		
CO2	2	3				
CO3			2	3		
CO4		2		3		
CO5	2		3		2	

COURSE CONTENT

UNIT – I:

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

UNIT – II:

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

UNIT – III:

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

UNIT – IV:

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

UNIT – V:

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

TEXT BOOKS:

1. C.R. Kothari , 2nd Edition, “Research Methodology: Methods and Techniques”.
2. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step-by-Step Guide for beginners”.

REFERENCE BOOKS:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students.
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”.
3. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
4. Mayall, “Industrial Design”, McGraw Hill, 1992.
5. Niebel, “Product Design”, McGraw Hill, 1974.

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1. https://www.coursera.org/learn/research-methodologies
2. https://archive.nptel.ac.in/courses/127/106/127106227/
3. https://archive.nptel.ac.in/courses/121/106/121106007/
4.https://www.studocu.com/in/course/anna-university/research-methodology-and-ipr/5881061

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

ADVANCED CAD LABORATORY

(ME)

Course Category	Program Core	**Course Code**	24061L01
Course Type	Laboratory	**L-T-P-C**	0-0-4-2
Prerequisites	Familiar with Design & Modelling software, coordinate systems, geometric transformations, etc.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	To carry out the modeling and FE analysis of trusses, beams, plates and cylinders

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Describe the modeling and FE analysis of trusses, beams, plates and cylinders	K2

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3			

Students shall carry out the modeling and FE analysis of the following to predict deflection and stress distributions:

1. Trussess – 2D and 3D
2. Beams
3. Plate with Plane stress condition
4. Plate with Plane strain condition
5. Cylinders – Axi-symmetric condition
6. Natural frequencies of Beam

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

ADVANCED CAM LABORATORY

(ME)

CourseCategory	Program Core	**Course Code**	24061L02
Course Type	Laboratory	**L-T-P-C**	0-0-4-2
Prerequisites	Familiar with Lathe, Milling Operations.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES	
1	To carry out the metal removal processes on lathe and milling machines

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Describe the metal removal processes on lathe and milling machines	K2

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2			

List of experiments:

CNC – Lathe

1. Stock removal Cycle
2. Contour Turning Cycle
3. Grooving Cycle
4. Threading Cycle
5. Drilling Cycle.

CNC – Milling

1. Linear And Circular Interpolation
2. Circular Pocketing
3. Rectangular Pocketing
4. Peck Drilling
5. Contour milling

NOTE: Any 6 experiments can be conducted from the above

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

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DEPARTMENT OF MECHANICAL ENGINEERING

R24

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

WRITING SKILLS FOR RESEARCH PAPER

(ME)

Course Category	Audit Course	**Course Code**	24061A01
Course Type	Theory	**L-T-P-C**	2-0-0-0
Prerequisites	It is expected that the students should have good communication skills, proficiency in basic English, Science and good writing skills.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	**40** **60** **100**

COURSEOBJECTIVES: The objectives of the course are to	
1	To identify and use appropriate research resources, including books, articles, and websites.
2	To evaluate the credibility of information sources.
3	To write a clear and concise research question.
4	To organize their research findings in a logical and persuasive way.
5	To use correct grammar and punctuation in documenting their sources correctly.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Analyse and interpret data by using data to write clear, concise technical reports, research articles and practice professional writing style	K3&K4
CO2	Understand and apply an appropriate plan, assemble a protocol, writing task and perform original research with ethics.	K2
CO3	Identify and apply the proper methods to do to the literature and scope of the research work plan.	K2
CO4	Demonstrate improved writing skills and apply to reflect the growth in writing and communicate outcomes of the research effectively.	K3
CO5	Apply the proper methodology for writing the research reports making use of appropriate phrases.	K3

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3		2		
CO2		2	2	2		
CO3	3	3				
CO4	3	3	2	3		
CO5		3				

COURSE CONTENT

UNIT – I:

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness, Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising.

UNIT – II:

Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT – III:

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT – IV:

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

TEXT BOOKS:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.

REFERENCE BOOKS:

1.Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
2. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

WEB REFERENCES:

1. https://www.scribbr.com/category/research-paper/
2. https://www.grammarly.com/blog/how-to-write-a-research-paper/
3. https://archive.nptel.ac.in/courses/110/105/110105091/
4. https://nptel.ac.in/courses/110105091

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DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech I Year I Semester **R24Specialization: CAD/CAM**

VALUE EDUCATION
(ME)

Course Category	Audit Course	**Course Code**	
Course Type	Theory	**L-T-P-C**	2-0-0-0
Prerequisites		**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	**40** **60** **100**

COURSEOBJECTIVES: The objectives of the course are to	
1	Understand value of education and self- development.
2	Imbibe good values in students.
3	Let the should know about the importance of character.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Infer the knowledge of self-development	K2
CO2	Describe the importance of Human values	K2
CO3	Developing the overall personality	K6

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes

(1 – Low, 2 - Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3		2	2	
CO2		2	2	2	2	
CO3	3	3			2	

COURSE CONTENT

UNIT–I:
Values and self-development-Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation, Standards and principles, Value judgments.

UNIT–II:
Importance of cultivation of values- Sense of duty, Devotion, Self-reliance,Confidence,Concentration.Truthfulness,Cleanliness,Honesty,Humanity,Power offaith,NationalUnity, Patriotism. Love for nature, Discipline.

UNIT–III:
Personality and Behaviour Development-Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking.

UNIT–IV:
Free from anger, Dignity of labour- Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

UNIT–V:
Character and Competence- Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively.

TEXT BOOKS:

1. ValuesandEthicsfororganizationsTheoryandpractice,LatestEdition,Chakroborty,S. K.,OxfordUniversityPress,NewDelhi

WEB REFERENCES:
1.https://nptel.ac.in/courses/109104068

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

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DEPARTMENT OF MECHANICAL ENGINEERING

R24

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

INDUSTRIAL ROBOTICS & AUTOMATION

(ME)

CourseCategory	Program Core	**Course Code**	24062T09
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Matrix Algebra,Mechanics, ControlSystems, ProblemSolving andProgramWritingSkills.	**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To introduce Robotics and Automation including robot classification, design and selection, analysis and applications in industry.
2	To provide information on various types of end effectors, their design, interfacing and selection.
3	To provide the details of operations for a variety of sensory devices that are used on robot , the meaning of sensing, classification of sensor, that measure position, velocity & acceleration of robot joint.
4	To familiarize the basic concepts of transformations performed by robot, to perform kinematics to and to gain knowledge on programming of robots.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Figureout,demonstratetheterminologiesrelatedtoroboticstechnology, Hardwarecomponentsandapplylogicforselectionofroboticsubsystemsand systems.	K2
CO2	Applythespatialtransformationstoevaluate forwardKinematics, Inverse kinematicsandJacobianforserialandparallelrobots.	K3
CO3	Demonstrateknowledgeofendeffectors,designconsiderationsandthe Interpretationofdatafromdataacquisitionsystems.	K2
CO4	Applythefundamentalknowledgeofrobotprogrammingmethodsto writesmallprogramsfordesiredapplication.	K3
CO5	Applyanddesignrobotcelllayoutsandanalyzetheirapplicationsin variousfields.	K3

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes (1– Low, 2-Medium, 3 – High)						
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3	2		
CO2	2			2	2	
CO3		2	3			
CO4	3		3	3	2	
CO5					3	3

COURSE CONTENT:

UNIT–I:

Introduction: Automation and Robotics, Robot anatomy, robot configuration,motionsjointnotationscheme,workvolume,robotdrivesystems,controlsystemsanddynamic performance, precision of movement.

Control System and Components: basic concepts and motion controllers,controlsystem analysis,robot actuationandfeedbackcomponents.

Sensors: Desirable features, tactile, proximity and range sensors, uses sensors inrobotics.Positionssensors,velocitysensors,actuators,powertransmissionsystems

UNIT–II:

Motion Analysis and Control: Manipulator kinematics, position representation,forward and inverse transformations, homogeneous transformations, manipulatorpath control, robot arm dynamics, configuration of a robot controller. Robot jointcontrol design.

UNIT–III:

EndEffectors: Grippers-types,operation,mechanism,forceanalysis,toolsasendeffectorsconsiderationin gripperselection anddesign.

Machine Vision: Functions, Sensing and Digitizing-imaging devices, Lightingtechniques, Analog to digital single conversion, image storage: Image processingandAnalysis-imagedatareduction,Segmentation,featureextraction,Objectrecognition.Trainingthevisionsystem, Roboticapplication.

UNIT–IV:

Robot Programming: Lead through programming, Robot program as a path inspace,Motioninterpolation,WAIT,SIGNALANDDELAYcommands,Branching,capabilitiesand Limitationsofleadthrough methods.

RobotLanguages:TextualrobotLanguages,Generations ofrobotprogramming languages,Robotlanguagestructures,Elementsandfunction.

UNIT–V:

Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-linerobot cell, Considerations in work design, Work and control, Interlocks, Errordetection,Work cell controller.

RobotApplications:Materialtransfer,Machineloading/unloading,Processing Operation, AssemblyandInspection, FutureApplication.

TEXTBOOKS:

1. IndustrialRoboticsByGrooverM P/PearsonEdu.

2. IntroductiontoRobotic MechanicsandControlbyJJ Craig,Pearson,3rdedition.

REFERENCEBOOKS:

1. Robotics/FuKS/McGraw Hill.
2. Robotic Engineering/RichardD.Klafter, Prentice Hall.
3. RobotAnalysisandIntelligence/ Asada andSlotine/WileyInter-Science.
4.Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley .
5. Introductionto RoboticsbySKSaha, TheMcGrahHill Company,6th, 2012.
6. RoboticsandControl/MittalRK&NagrathIJ/TMH.

WEBRESOURCES:

1. https://nptel.ac.in/courses/112105319
2. https://elearn.nptel.ac.in/shop/nptel/robotics/?v=c86ee0d9d7ed
3. https://www.youtube.com/playlist?list=PLXDsvE7qtfNf_N99hJZbdTEM001mOii6_
4. https://www.mech-mind.com/videos/solution-videos.html

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

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DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

ADVANCEDMANUFACTURINGPROCESSES

(ME)

CourseCategory	Program Core	**Course Code**	24062T10
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Conventional ManufacturingProcesses,Metallurgy	**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To make acquainted the various unconventional manufacturing processes.
2	To know about the applications of advanced manufacturing processes (which are exceptional).
3	To encourage the students for developing the models of Advanced Manufacturing Processes.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Describethevariousnon-traditionalmachiningprocessesandanalysetheirperformancecharacteristics.	K3
CO2	Explaintheworkingprinciplesofadditivemanufacturingmethodsand theirapplicationsinthefieldofmanufacturing.	K2
CO3	Describethedifferentsurfacetreatmentprocesses,processingof ceramicsandtheirapplications.	K2
CO4	Demonstrateandapplydifferentmethodforprocessingofcomposites andnanomaterialstoanalysetheircharacteristicssubjectedtothefieldofapplication.	K3
CO5	Describedifferentmicrofabricationmethodsofmicroelectronicdevices	K2

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes
(1– Low, 2-Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	3	3	-	-
CO2	-	-	2	2	-	-
CO3	-	-	3	3	-	-
CO4	-	-	2	3	3	-
CO5	-	-	-	3	3	2

COURSE CONTENT:

UNIT–I:

Advanced Machining Processes: Introduction, Need, AJM, WJM, Wire-EDM,ECM, LBM, EBM, PAM – Principle, working, advantages, limitations, ProcessParameters& capabilitiesandapplications.

UNIT–II:

Additive Manufacturing: Working Principles, Methods, Stereo Lithography,LENS, LOM, Laser Sintering, Fused Deposition Method, 3DP Applications andLimitations,Directand Indirect Rapid toolingtechniques.

UNIT–III:

SurfaceTreatment: Scope,Cleaners,Methodsofcleaning,Surfacecoatingtypes, Electro forming, Chemical vapour deposition, Physical vapour deposition,thermalsprayingmethods,Ionimplantation,diffusioncoating,ceramicandorganic methodsof coating, and claddingmethods.

Processing of Ceramics: Applications, characteristics, classification Processingofparticulateceramics,Powderpreparations,consolidation,hotcompaction,drying,sintering, andfinishingof ceramics,Areasofapplication.

UNIT–IV:

Processing of Composites: Composite Layers, Particulate and fiber reinforcedcomposites,Elastomers,Reinforcedplastics,processingmethodsforMMC,CMC,Polymer matrix composites.

ProcessingofNanomaterials: Introduction,Top-downVsBottom-uptechniques-Ballmilling,Lithography,PlasmaArcDischarge,PulsedLaserDeposition,Sputtering, Sol-Gel,Molecular beamEpitaxy.

UNIT–V:

Fabrication of Microelectronic Devices: Crystal growth and wafer preparation,Film Deposition, oxidation, lithography, bonding and packaging, reliability andyield,PrintedCircuitboards,surfacemounttechnology,Integratedcircuit economics.

TEXTBOOKS:

1. Manufacturing Engineering and Technology, Kalpakijian /Adisson Wesley, 1995.
2. ProcessandMaterialsofManufacturing/ R.A.Lindburg/11thedition,PHI1990.

REFERENCE BOOKS:

1. Microelectronicpackaginghandbook/Rao.R.ThummalaandEugene,J.Rymaszewski/VanNostrandRenihold,

2. MEMS&MicroSystemsDesignandmanufacture/Tai—RunHsu/TMGH.3] AdvancedMachiningProcesses/V.K.Jain/ Allied Publications.

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/112/107/112107077/
2. https://nptel.ac.in/courses/112107078
3. https://elearn.nptel.ac.in/shop/nptel/advanced-machining-processes/
4. https://www.coursera.org/learn/advanced-manufacturing-process-analysis

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

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DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

INTRODUCTIONTOARTIFICIALINTELLIGENCE&MACHINELEARNING

(ME)

CourseCategory	Program Elective	**Course Code**	24062T11
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	C–Programming, DataStructuresandAlgorithms.	**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To comprehend the classical and symbolic approach to Artificial Intelligence
2	To understand the principles of the main paradigms for learning from data and their applications.
3	To explore Machine Learning techniques for building new adaptive systems
4	To learn and analyse predictive models for intelligent data analysis.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	DescribetheconceptsofArtificialIntelligence anditsapplications.	K3
CO2	ApplyAItechniquestoreal-worldproblemstodevelopintelligentsystems.	K2
CO3	ExplainandapplyvariousclassificationalgorithmsofML	K2
CO4	Applyprinciplesandalgorithmstosolve problems.	K3
CO5	Applyandevaluate deeplearningalgorithms.	K2

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes
(1– Low, 2-Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3		
CO2			2	2		
CO3			3	3		
CO4			2	3	3	
CO5				3	3	2

COURSE CONTENT

UNIT–I:

Introduction: DefinitionofArtificialIntelligence,Evolution,Need,andapplications in real world. Intelligent Agents, Agents and environments; GoodBehaviour-The concept of rationality, the nature of environments, the structure ofagents.

NeuralNetworksandGeneticAlgorithms: Neuralnetworkrepresentation,problems,perceptron,multilayernetworksandbackpropagationalgorithms,Genetic algorithms, hypothesisspace search.

UNIT–II:

Knowledge–Representation and Reasoning: Logical Agents: Knowledge basedagents,theWumpusworld,andlogic.PatternsinPropositionalLogic,InferenceinFirst-OrderLogic-Propositionalvs.firstorderinference,unificationandlifting.

UNIT–III:

IntroductiontoMachineLearning(ML): Definition,Evolution,Need,applications of ML in industry and real world, classification; differences betweensupervisedand unsupervised learningparadigms.

BayesianandComputationalLearning: Bayestheorem,conceptlearning,maximum likelihood, minimum description length principle, Gibbs Algorithm,NaïveBayesClassifier,InstanceBasedLearning-K-Nearestneighbourlearning.

UNIT–IV:

Basic Methods in Supervised Learning: Distance-based methods, Nearest-Neighbours,Decision,Trees,SupportVectorMachines,Nonlinearityand KernelMethods.

Unsupervised Learning: Clustering: K-means, Dimensionality Reduction: PCAandkernelPCA,GenerativeModels(GaussianMixtureModelsandHiddenMarkovModels).

UNIT–V:

MachineLearningAlgorithmAnalytics: EvaluatingMachineLearningalgorithms,Model,Selection,EnsembleMethods(Boosting,Bagging,andRandomForests).

Modelling Sequence/Time-Series Data and Deep Learning: Deep generativemodels,DeepBoltzmannMachines,Deepauto-encoders,ApplicationsofDeep Networks.

TEXTBOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e,PearsonEducation, 2010.

2. TomM.Mitchell,MachineLearning,McGrawHill,2013.2.EthemAlpaydin,Introduction to Machine Learning (Adaptive Computation and Machine Learning), theMIT Press, 2004.

REFERENCE BOOKS:

1. ElaineRich,KevinKnightandShivashankarB.Nair,ArtificialIntelligence,3/e,McGrawHill Education, 2008.
2. DanW.Patterson,IntroductiontoArtificialIntelligenceandExpertSystems,PHILearning,2012.
3. T.Hastie,R.Tibshirani,J.H.Friedman,TheElementsofStatisticalLearning,1/e,Springer,2001.
4. Bishop,C.,M., PatternRecognitionandMachineLearning,Springer,2006.
5. MNarasimhaMurty,IntroductiontoPatternRecognitionandMachineLearning,WorldScientific PublishingCompany, 2015.

WEB REFERENCES:

1.https://www.coursera.org/learn/introduction-to-ai
2. https://nptel.ac.in/courses/106102220
3. https://www.youtube.com/watch?v=fC7V8QsPBec

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

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DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

PRODUCT DESIGN AND DEVELOPMENT

(ME)

CourseCategory	Program Elective	**Course Code**	24062T12
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Auto CAD, CAD/CAM, Design Optimization, Manufacturing Design and RapidPrototyping.	**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To direct the learners to use their creativity, design thinking, and design process to bring new ideas, products, experiences, and value to companies, communities, and people
2	To learn a wide range of hand skills and processes using soft and hard materials, digital design skills in 2-D graphics, and 3-D modelling skills to create well-conceived and executed objects and products that service a human need.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Applytheproductdesignanddevelopmentprocesstomanagethedevelopmentofmodern productdevelopmentprocessfromthenew idea.	K3
CO2	Applytheprinciplesofproductarchitecture,industrialdesignanddesign formanufacturingprinciplesinnewproductdevelopment.	K3
CO3	Applytheprinciplesofproductarchitectureandtheimportanceof DFM, valueengineeringandAnalysisprinciplesfornewproductdevelopment.	K3
CO4	Applyandanalysethequalitative&quantitativeeconomicergonomics toevaluatethe newproduct development.	K3
CO5	Applytheadoptprototypingtechniquesanddesignofexperiment principlestodeveloparobustdesignanddocumentanewproductforpatent.	K3

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes (1– Low, 2-Medium, 3 – High)						
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				2	3	3
CO2			2	3	3	
CO3				3	3	
CO4	2		2	3		
CO5				3	3	3

Course Content:

UNIT–I:

Introduction:Classification/SpecificationsofProducts,Productlifecycle.Productmix,Introductiontoproductdesign,Modernproductdevelopmentprocess,Innovativethinking.

UNIT–II:

Morphologyofdesign&ConceptualDesign:Generation,selection&embodiment of concept. Product architecture, Industrial design: process, need,RobustDesign:Taguchi Designs&DOE,DesignOptimization.

UNIT–III:

DesignforManufacturing&Assembly:MethodsofdesigningforManufacturingandassembly,DesignsforMaintainability,DesignsforEnvironment, Product costing, Legal factors and social issues, Engineering ethicsand issues of society related to design of products.Value Engineering / ValueAnalysis:Definition. Methodology, Casestudies.

UNIT–IV:

Economic Analysis: Qualitative & Quantitative Ergonomics/Aesthetics, Grosshuman autonomy,Anthropometry, Man-Machine interaction, Concepts of sizeandtexture,colour.Comfortcriteria,Psychological&Physiologicalconsiderations.

UNIT–V:

CreativityTechniques:Creativethinking,conceptualization,brainstorming,primarydesign,drawing,simulation,detaildesign.ConcurrentEngineering,Rapidprototyping,Toolsforproductdesign–Drafting/Modellingsoftware,CAM Interface,Patents&IPActs.Overview,Disclosurepreparation.

TEXTBOOKS:

1. KarlTUlrich,StevenDEppinger,"ProductDesign&Development."TataMcGraw-HillNewDelhi 2003.
2. DavidG Ullman,"TheMechanicalDesignProcess."McGraw-HillIncSingapore1992.
3. NJMRoozenberg,JEkels,NFMRoozenberg"ProductDesignFundamentalsandMethods", John Willey&Sons1995.

REFERENCE BOOKS:

1. KevinOtto&KristinWoodProductDesign: "Techniques inReverseEngineeringandNewProductDevelopment." 1/e2004,Pearson Education

NewDelhi.
2. LDMiles“Value Engineering.”
3. HollinsB&PughS“SuccessfulProductDesign.”Butterworths London.
4. Baldwin E N &Neibel B W “Designing for Production.” Edwin Homewood Illinois.
5. JonesJC“DesignMethods.” Seedsof HumanFutures.JohnWilleyNewYork.
6. BrallaJG“HandbookofProduct DesignforManufacture,McGraw-Hill,NewYork.

WEB REFERENCES:

1. https://cfi.iitm.ac.in/clubs/product-design-club
2. https://ed.iitm.ac.in/
3. https://www.coursera.org/specializations/product-ideation-design-and-management

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

MATERIAL CHARATERIZATION TECHNIQUES

(ME)

CourseCategory	Program Elective	**Course Code**	24062T13
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Basic science and Engineering Fundamentals	**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To provide an introduction about the materials characterization and its importance.
2	To impart the knowledge about different types of characterization techniques and their use in reviewing the crystal structure.
3	To provide the application knowledge of the properties and behaviour of x-rays and their use in materials characterization and use of TEM and SEM.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Applyappropriatecharacterizationtechniquesformicrostructureexaminationatdifferentmagnificationlevelandusethemtounderstand themicrostructureofvariousmaterials	K3
CO2	Chooseandapplyappropriateelectronmicroscopytechniquesto investigatemicrostructureofmaterialsathighresolution.	K3
CO3	ApplyX-raydiffractiontechniquestodeterminecrystalstructureof specimenandestimateitscrystallitesizeandstress.	K3
CO4	Selectanappropriatespectroscopictechniquetoanalyzethevibrational/ electronictransitionstoestimateparameterslikeenergybandgap,elementalconcentration,etc.	K4
CO5	Applythermalanalysistechniquestodeterminethermalstabilityand thermodynamictransitionsofthespecimen.	K3

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes(1–Low, 2-Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2		2		
CO2	2	2		3		
CO3	3	2		3		
CO4	2	2		3	3	
CO5	3	2		3		

Course Content :

UNIT–I:

OpticalMicroscopy–Introduction,Opticalprinciples,Instrumentation,Specimenpreparation-metallographicprinciples,ImagingModes,ApplicationsandLimitations.

TransmissionElectronMicroscopy(TEM)–Introduction,Instrumentation,Specimen preparation-pre thinning, final thinning, Image modes- mass densitycontrast,diffractioncontrast,phasecontrast,ApplicationsandLimitations.

UNIT–II:

Scanning Electron Microscopy (SEM)– Introduction, Instrumentation, Contrastformation,Operationalvariables,Specimenpreparation,imagingmodes,Applications andLimitations.

X- Ray Diffraction (XRD)– Introduction, Basic principles of diffraction, X - raygeneration,Instrumentation,Typesofanalysis,Datacollectionforanalysis,Applications andLimitations.

UNIT–III:

Scanning Probe Microscopy (SPM) & Atomic Force Microscopy (AFM)– Introduction,Instrumentation,ScanningTunnellingMicroscopy-Basics,probetips,workingenvironment,operationalmodes,ApplicationsandLimitations.

Electron Probe Micro Analyser (EPMA) – Introduction, Sample preparation,Workingprocedure, ApplicationsandLimitations.

UNIT–IV:

X-RaySpectroscopyforElementalAnalysis–Introduction,CharacteristicsofX-rays, X- ray Fluorescence Spectrometry, Wavelength Dispersive Spectroscopy-Instrumentation,Workingprocedure,ApplicationsandLimitations.

UNIT–V:

Energy Dispersive Spectroscopy– Instrumentation, working procedure, ApplicationsandLimitations.

Thermal Analysis– Instrumentation, experimental parameters, Different typesusedforanalysis,Differentialthermalanalysis,DifferentialScanningCalorimetry.Basicprinciples,Instrumentation,workingprinciples,ApplicationsandLimitations.

TEXTBOOKS:

1. Yang Leng: Materials Characterization-Introduction to Microscopic and

SpectroscopicMethods,John Wiley& Sons(Asia) PteLtd., 2008.
2. RobertF.Speyer:ThermalAnalysisofMaterials,MarcelDekkerInc.,NewYork,1994.

REFERENCE BOOKS:

1. V.T.CherapinandA.K.Mallik:ExperimentalTechniquesinPhysicalMetallurgy,Asia PublishingHouse,1967.
2. ASM Handbook:MaterialsCharacterization,ASMInternational,2008.

WEB REFERENCES:

1. https://www.coursera.org/learn/mechanics-1
2. https://www.classcentral.com/course/swayam-material-characterization-13029
3.https://archive.nptel.ac.in/courses/113/105/113105101/

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

ADDITIVE MANUFACTURING

(ME)

CourseCategory	Program Elective	**Course Code**	24062T14
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Materialscience,MetallurgyandManufacturingprocesses.	**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To provide comprehensive knowledge of the wide range of additive manufacturing processes, capabilities and materials.
2	To understand the software tools and techniques used for additive manufacturing.
3	To create physical objects that facilitates product development/prototyping requirements.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Demonstrate a basic technical understanding of the physical principles,materials, and operation of the types of AM processes such as VATPhotopolymerization.	K2
CO2	Explaintheworkingprinciplesandanalysetheprocessparametersof jettingandextrusion-basedadditivemanufacturingprocesses.	K2
CO3	Describethelaminatedsheetbasedandpowderbasedadditive manufacturingprocessesandanalysethecharacteristicfeatureofthedevelopedAMcomponents.	K2
CO4	Identifyappropriatesold-stateadditivemanufacturingprocessforthe desiredapplicationtogeneratemetalAMcomponents.	K3
CO5	Applythekeyconceptsofmaterialscience,andwell-designedguidelinestoanalysetheeffectofpostprocessingoperationsofdifferent AMprocesses.	K3

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes(1–Low, 2-Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1		2	2	2		
CO2	2		2	2	2	
CO3		2	2			
CO4		2		3	3	
CO5				3	3	3

COURSE CONTENT

UNIT–I:

Introduction to Additive Manufacturing: Introduction to AM, AM evolution,Distinction between AM & CNC machining, Steps in AM, Classification of AMprocesses,AdvantagesofAMand TypesofmaterialsforAM.

VAT Photo polymerization AM Processes: Stereo lithography (SL), Materials,ProcessModelling,SLresincuringprocess,SLscanpatterns,Micro-stereolithography, Mask Projection Processes, Two-Photon vat photo polymerization,Process Benefits and Drawbacks, Applications of Vat Photo polymerization, casestudies.

UNIT–II:

MaterialJettingAMProcesses: EvolutionofPrintingasanAdditiveManufacturing Process, Materials, Process Benefits and Drawbacks, ApplicationsofMaterial JettingProcesses.

BinderJettingAMProcesses: Materials,ProcessBenefitsandDrawbacks,Research achievements in printing deposition, technical challenges in printing,Applicationsof Binder JettingProcesses.

Extrusion-BasedAMProcesses: FusedDepositionModelling(FDM),Principles,Materials, Process Modelling, Plotting and path control, Bio-Extrusion, ContourCrafting,ProcessBenefitsandDrawbacks,ApplicationsofExtrusion-BasedProcesses,casestudies.

UNIT–III:

Sheet Lamination AM Processes: Bonding Mechanisms, Materials, LaminatedObject Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermalbonding,LOM and UCapplications, casestudies.

Powder Bed Fusion AM Processes: Selective laser Sintering(SLS),Materials,Powderfusionmechanismandpowderhandling,ProcessModelling,SLSMetal andceramic partcreation,

ElectronBeammelting(EBM): ProcessBenefitsandDrawbacks,ApplicationsofPowder BedFusion Processes,casestudies.

UNIT–IV:

DirectedEnergyDepositionAMProcesses: ProcessDescription,MaterialDelivery,LaserEngineer haping(LENS),DirectMetalDeposition(DMD),ElectronBeamBasedMetalDeposition,Processing-structure-properties,relationships,Benefitsanddrawbacks,ApplicationsofDirectedEnergyDepositionProcess

Frictionstiradditivemanufacturing:process,parameters,advantages,limitations and applications, Additive friction stir deposition process: principle,parameters,applications,functionallygradedadditivemanufacturingcomponents,Case studies.

WireArcAdditiveManufacturing: Process,parameters,applications,advantagesand disadvantages, casestudies.

UNIT–V:

MaterialsscienceforAM-MultifunctionalandgradedmaterialsinAM,Roleofsolidificationrate,Evolutionofnon-equilibriumstructure,microstructuralstudies,Structure propertyrelationship, casestudies.

PostProcessingofAMParts: SupportMaterialRemoval,SurfaceTextureImprovement, Accuracy Improvement, Aesthetic Improvement, Preparation foruseasaPattern,PropertyEnhancementsusingNon-thermalandThermalTechniques,casestudies.

GuidelinesforProcessSelection:Introduction,SelectionMethodsforaPart,ChallengesofSelection, ExampleSystemforPreliminarySelection,ProcessPlanningand Control.

TEXTBOOKS:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and DirectDigitalManufacturing,IanGibson,DavidWRosen,BrentStucker,Springer,2015, 2nd Edition.
2. 3D Printing and Additive Manufacturing: Principles & Applications, Chua CheeKai,LeongKahFai,WorldScientific, 2015, 4th Edition.

REFERENCE BOOKS:

1. RapidPrototyping:Laser-basedandOtherTechnologies,PatriK.VenuVinodandWeiyinMa, Springer, 2004.
2. RapidManufacturing:TheTechnologiesandApplicationsofRapidPrototypingandRapidTooling, D.T.Pham, S.S. Dimov,Springer 2001.
3. RapidPrototyping:PrinciplesandApplicationsinManufacturing,RafiqNoorani,JohnWiley& Sons, 2006.
4. AdditiveManufacturing,SecondEdition,AmitBandyopadhyaySusmitaBose,CRCPressTaylor &FrancisGroup, 2020.
5. AdditiveManufacturing:Principles,TechnologiesandApplications,C.PPaul,A.N.Junoop,McGrawHill, 2021.

WEB REFERENCES:

- https://www.nist.gov/additive-manufacturing
- https://www.metal-am.com/
- http://additivemanufacturing.com/basics/
- https://www.3dprintingindustry.com/
- https://www.thingiverse.com/
- https://reprap.org/wiki/RepRap

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

OPTIMIZATION AND RELIABILITY

(ME)

CourseCategory	Program Elective	**Course Code**	24062T15
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Mathematics,Fundamentalof Design andManufacturing.	**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To study classical optimization techniques
2	To get knowledge of numerical methods for optimization
3	To learn genetic algorithm and genetic programming
4	To apply optimization in design and manufacturing systems
5	To understand reliability concepts

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Applythetheoryofoptimizationmethodsandalgorithmstodevelopandforsolvingvariou stypesof optimizationproblems.	K2
CO2	Applynumerousnumericalmethodstosolvetheengineeringproblems foroptimization.	K2
CO3	ApplyGAandGPoptimizationmethodstosolvethedifferential equationsandanalyzethe differencesbetweenGAandGP.	K4
CO4	Applyoptimizationtechniquestodesignandmanufacturingsystemsfor theoptimizationofprocessparameters.	K3
CO5	Understandandapplymajorconceptsofreliabilityinengineeringdesign foranalyzingthestatisticalexperimentsleadingtoreliabilitymodeling.	K4

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes(1–Low, 2-Medium, 3 – High)						
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2			2	2	
CO2	3	2		2	2	
CO3				3		3
CO4				2	3	3
CO5		3	3			

COURSE CONTENT

UNIT–I:

ClassicalOptimizationTechniques: Singlevariableoptimizationwithandwithout constraints, multi – variable optimization without constraints, multi –variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tuckerconditions,meritsanddemeritsofclassicaloptimizationtechnique.

UNIT–II:

Numerical Methods for Optimization: Nelder Mead's Simplex search method,Gradientofafunction,Steepestdescentmethod,Newton'smethod,Patternsearchmethods, conjugate method, types of penalty methods for handling constraints,advantagesof numerical methods.

UNIT–III:

Genetic Algorithm (GA) : Differences andsimilarities between conventionalandevolutionaryalgorithms,workingprinciple,reproduction,crossover,mutation,terminationcriteria,differentreproductionandcrossoveroperators,GAforconstrainedoptimization, drawbacksof GA,

Genetic Programming (GP): Principles of genetic programming, terminal sets,functional sets, differences between GA & GP, random population generation,solvingdifferential equationsusingGP.

Multi-Objective GA: Pareto's analysis, non-dominated front, multi – objectiveGA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems.

UNIT–IV:

Applications of Optimization in Design and Manufacturing Systems: Sometypical applications like optimization of path synthesis of a four-bar mechanism,minimization of weight of a cantilever beam, optimization of springs and gears,general optimization model of a machining process, optimization of arc weldingparameters,andgeneralprocedureinoptimizingmachiningoperationssequence.

UNIT–V:

Reliability: ConceptsofEngineeringStatistics,riskandreliability,probabilisticapproachtodesign,reliabilitytheory,designforreliability,numericalproblems, hazardanalysis.

TEXTBOOKS:

1. OptimizationforEngineeringDesign–KalyanMoyDeb,PHIPublishers.
2. EngineeringOptimization–S.S.Rao, NewAge Publishers.
3. ReliabilityEngineeringbyL.S.Srinath.
4. MultiobjectivegeneticalgorithmbyKalyanMoyDeb,PHIPublishers.

REFERENCE BOOKS:

1. GeneticalgorithmsinSearch,Optimization,andMachinelearning–D.E.Goldberg,Addison-WesleyPublishers.
2. Multi objective Genetic algorithms - Kalyan Moy Deb, PHI Publishers.
3. Optimaldesign–JasbirArora,McGrawHill(International)Publishers.
4. AnIntroductiontoReliabilityandMaintainabilityEngineeringbyCEEbeling,WavelandPrintersInc., 2009
5. ReliabilityTheoryandPracticebyIBazovsky,DoverPublications,2013

WEB REFERENCES:

1. https://nptel.ac.in/courses/108105019
2. https://onlinecourses.nptel.ac.in/noc23_ce102/preview

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

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DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

SMART MANUFACTURING

(ME)

CourseCategory	Program Elective	**Course Code**	24062T16
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Manufacturingprocesses,Manufacturingsystems,Systems engineering,IT,Networks,Basicshop floor communications.	**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	This course is introduced to impart the knowledge of smart manufacturing for industry 4.0 for making student innovative.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	EmploytheconceptofIndustry4.0forSmartManufacturingandanalyse thechallengesmore effectivelyincontextofIndustry4.0.	K3
CO2	Recognizetherequirementfordifferenthardwareandsoftware,as well astheIoTLayersandtheirrelativesignificance,inordertoconstructanIndustry4.0-compliant smart machineinterface.	K2
CO3	DescribetheArchitectureofCyber–PhysicalSystem(CPS)andapply tomakethemachinesmoreorientedtowardsIndustry4.0inenhancingthe productivity.	K2
CO4	Describethecloud-computingIoTplatformforsmartmanufacturingand applytheAI&MLtechniquesinanalysingthepredictivemaintenanceofmanufacturingsystems.	K3
CO5	Demonstratetheapplicationofhardware,communicationprotocol,IOT platform, machine learning etc. to implement IoT for smartmanufacturingfor theneed of Industry4.0.	K2

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes(1– Low, 2-Medium, 3 – High)						
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		2	3		2	
CO2	2		2	3		
CO3			3	2		
CO4			3		2	
CO5			3			2

UNIT–I:
Concepts of Smart Manufacturing: Definition and key characteristics of smartmanufacturing,corporateadaptationprocesses,manufacturingchallenges,challenges vs technologies, Stages in smart manufacturing. Minimizing Six biglossesin manufacturingwith Industry4.0,and their benefits.

UNIT–II:
SmartMachinesandSmartSensors: ConceptandFunctionsofaSmart,Machine Salient features and Critical Subsystems of a Smart Machine, Smartsensors; smart sensors ecosystem, need, benefits and applications of sensors inindustry, Sensing for Manufacturing Process in IIoT, Block Diagram of aIIoTSensingDevice,SensorsinIIoTApplications,SmartMachine Interfaces.

UNIT–III:
ArchitectureofCyber-Physicalsystem(CPS): FunctionsofCPS,5CArchitecture; Smart Connection Level, Data-to- Information Level, Cyber Level,CognitionLevel,ConfigurationLevel.DesignofPHMbasedCPSsystems.Comparison of today's factory and Industry 4.0 factory by the implementation of5C CPSarchitecture.

UNIT–IV:
Digital Twin: Introduction, applications of digital twins, impact zones of digitaltwins in manufacturing (factories/plants and OEMs), advantages of digital twins,basic stepsof digitaltwintechnology.
MachineLearning(ML)andArtificialIntelligence(AI)inManufacturing:Introduction,benefitsandapplicationsofMLinindustries,commonapproachesofML;supervisedandunsupervised,semi-supervisedandreinforcedML**PredictiveMaintenance:**Introductionofpredictivemaintenance,differencebetweenpreventiveandpredictivemaintenance,workingandvariouscomponents ofpredictivemaintenance,benefitsandtoolsofpredictivemaintenance.Common approachestoIoTpredictivemaintenance;Rule-based(conditionmonitoring)andAI(artificial intelligence)based predictive maintenance.
AugmentedRealityinMaintenance(Electrical&Mechanical).

UNIT–V:

IoT connectivity for Industry 4.0: Industrial communication requirement and itsinfrastructure,anoverviewofdifferenttypesofnetworks,meshnetworkinindustrialIoT,IoTprotocols andtheinternet,TCP/IP(transmissioncontrolprotocol/internet protocol) model, IoT connectivity standards: common protocols,applicationlayerprotocols,internet/networklayerprotocols,physicallayerIoT protocols,choosingtherightIoT connectivityprotocol.

TEXTBOOKS:

1. Industry4.0TheIndustrialInternetofThingsbyAlasdairGilchrist,Apress.
2. IndustrialInternetofThings,CyberManufacturingSystembySabinaJeschke,ChristianBrecher,HoubingSongDandaB. Rawat, Springer.

WEB REFERENCES:

1. https://archive.nptel.ac.in/courses/106/105/106105195/
2. https://archive.nptel.ac.in/courses/110/105/110105155/

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

R24

(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAMADVANCED**

MANUFACTURING PROCESSES LABORATORY

(ME)

CourseCategory	ProgramCore	**Course Code**	24062L03
Course Type	Laboratory	**L-T-P-C**	0-0-4-2
Prerequisites		**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To impart the knowledge of metal joining and forming process.
2	To familiarize the various advanced manufacturing processes to develop bulk materials.
3	To train the students to make them expertise in operating material characterisation testing equipment to interpret the results for further analysis.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Applythedifferentmanufacturingoperationssuchasjoiningandformingprocessesto develop simpleadditivecomponents.	K3
CO2	Applythesubtractivemanufacturingprocessestothebulkmaterialsto studytheeffectsofprocessparametersonmorphologicalandmechanicalpropertiesof the materials.	K3
CO3	Applythesolid-stateadditivemethodstostudytheeffectsofoperational parametersonthemorphologyand densityof the materials.	K3
CO4	Developtheadditivelymanufacturedcomponentstoinvestigatethe mechanicalpropertiesofthevariousengineeringmaterials.	K2
CO5	AnalysetheeffectsofprocessparametersofEDMtechniquetoinvestigate the surface integrity of the test specimen using differentcharacterizationmethodslikeXRD,POD	K3

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes(1– Low, 2-Medium, 3 – High)						
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2			2	2	
CO2				2	3	2
CO3		2		3	3	3
CO4	2		2	2	2	
CO5	2	2		3		

Perform the following experiments during the laboratory duration:

1] Topreparethecup/holeshapefromthegivenworkpieceusingdeepdrawingpress.
2] Studyofcuttingratio/chipthicknessratioinorthogonalcuttingwithdifferentmaterials.
3] DeterminationofcuttingForcesandroughnessonmachinedsurfaceinorthogonalcuttingwith differentmaterials.
4] Studyofarc, andspot-weldingprocesses.
5] StudyofTIG,MIGweldingandFrictionstirweldingprocesses.
6] Studyofsintereddensityandrelativedensityofgivensamplesusing Archimedesprinciple.
7] Studyandpreparationofsimple partsin3Dprinting.
8] Studyof MRRandroughnessonWireEDM.
9] Estimationofparticlesizeusingtop-downapproachesandimageanalyzer.
10] Tofindthe ultimatetensile strengthofgivenspecimenusingUTM.
11] TofindtheVickers/ Rockwellhardnessofgivenspecimenusinghardnesstester
12] Tofindthe wearrate ofa givenspecimenusingPin-onDisc apparatus
13] Studyofroughnessonmachinessurfacesfordifferentmaterialsusingabrasive flowfinishing.
14] Tofindthefatiguestrengthofagivenspecimenusingfatigue-testingmachine.
15] Tofindthecrystallitesizeandmillerindicesplanesofagivenspecimenusing X-raydiffractometer.
16] Studyof Raman/FTIR spectroscopy

NOTE: Any 6 experiments can be conducted from the above

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

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DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

ROBOTICS AND AUTOMATION LABORATORY

(ME)

CourseCategory	ProgramCore	**Course Code**	24062L04
Course Type	Laboratory	**L-T-P-C**	0-0-4-2
Prerequisites		**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To develop the student's knowledge in various robot structures and their workspace, skills in performing spatial transformations, analysis skills associated with trajectory planning and robot control

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Demonstrate the functional aspects of various subcomponents of robot in the workspace environment.	K2
CO2	Write and simulate trajectory planning in performing various operations like Pick and Place. Loading and unloading, etc.	K3

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes(1–Low, 2-Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1		3		3	2	
CO2		3		3		

Perform the following experiments during the laboratory duration:

1. Operator control and jogging in the world coordinate system; Jogging in the tool coordinate system
2. Tool calibration – pen; Tool calibration – gripper, 2-point method
3. Jogging in the base coordinate system; Base calibration – table, 3-point method
4. Executing robot programs
5. CP motion and approximate positioning

6. Path contour with spline block
7. Motion programming with spline
8. Gripper programming – plastic panel and Pen.
9. Jogging with a fixed tool; Calibrating an external tool and robot-guided work piece
10. Motion programming with external TCP
11. Programming a subprogram call
12. Use of loops, Constant velocity range and conditional stop and Automatic External.
13. Demonstrate the use of a robot for automation of pick and place and arc and spot-welding processes
14. Demonstrate automation of machining processes using a Flexible Manufacturing system

NOTE: Any 6 experiments can be conducted from the above

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DEPARTMENT OF MECHANICAL ENGINEERING

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SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

TECHNICAL SEMINAR

CourseCategory		**Course Code**	24062S01
Course Type		**L-T-P-C**	2-0-0-2
Prerequisites		**Continuous Internal AssessmentSemesterEndExaminationTotalMarks**	40 60 100

COURSEOBJECTIVES	
1	To identify and use appropriate research resources, including books, articles, and websites.
2	To evaluate the credibility of information sources.
3	To write a clear and concise research question
4	To organize their research findings in a logical and persuasive way.
5	To use correct grammar and punctuation.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Conductingathoroughassessmentoftheliteratureonachosenresearch topicthatcanhelptofindanygapsintheknowledgebaseanddevelopa research problem.	K4
CO2	CreateandprovideatechnicalSeminar indetail	K6

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes(1–Low, 2-Medium, 3 – High)

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3					
CO2		3				

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DEPARTMENT OF MECHANICAL ENGINEERING

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SYLLABUS

M.Tech I Year II Semester **R24Specialization: CAD/CAM**

PEDAGOGYSTUDIES

(ME)

CourseCategory	Audit Course	**Course Code**	24062A02
Course Type	Theory	**L-T-P-C**	2-0-0-0
Prerequisites		**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	ReviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicymakingundertakenbytheDfID,otheragenciesandresearchers.
2	Identifycriticalevidencegapstoguidethedevelopment.

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassroomsindevelopingcountries?	K1
CO2	What is the evidence on the effectiveness of these pedagogicalpractices,inwhatconditions,andwithwhatpopulationoflearners?	K1
CO3	Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumandguidancematerialsbestsupport effectivepedagogy?	K1

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes
(1– Low, 2-Medium, 3 – High)

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	2	3		2	-
CO2	2	-	2	3	-	-
CO3	-	-	3	2	-	-

COURSE CONTENT:

UNIT–I:

IntroductionandMethodology: Aimsandrationale,Policybackground,Conceptualframeworkandterminology,Theoriesoflearning,Curriculum,Teachereducation,Conceptualframework,Researchquestions,OverviewofmethodologyandSearching.

UNIT–II:

Thematic overview: Pedagogical practices are being used by teachersin formal and informal classrooms in developing countries, Curriculum, Teachereducation.

UNIT–III:

Evidenceontheeffectivenessofpedagogicalpractices: Methodology for the in depth stage: quality assessment of included studies, Howcan teacher education (curriculum and practicum) and the school curriculumandguidancematerialsbestsupporteffectivepedagogy,Theoryofchange,Strength and nature of the body of evidence for effective pedagogical practices,Pedagogictheoryandpedagogicalapproaches,Teachers'attitudesandbeliefs andPedagogicstrategies.

UNIT–IV:

Professional development: Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT–V:

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

TextBooks:

1. ClassroominteractioninKenyanprimaryschools,AckersJ,HardmanF,Compare,31(2):245-261,2001
2. Curricularreforminschools:Theimportanceofevaluation,AgrawalM,JournalofCurriculumStudies,36(3):361-379,2004

ReferenceBooks:

1. Teacher training in Ghana: does it count? Multi-site teacher educationresearch project (MUSTER) country report 1, Akyeampong K, London:DFID,2003.

PRAGATI ENGINEERING COLLEGE: SURAMPALEM

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DEPARTMENT OF MECHANICAL ENGINEERING

PERSONALITYDEVELOPMENTTHROUGH LIFEENLIGHTENMENTSKILLS

(ME)

CourseCategory	Audit Course	**Course Code**	
Course Type	Theory	**L-T-P-C**	2-0-0-0
Prerequisites		**Continuous Internal AssessmentSemesterEndExamination TotalMarks**	40 60 100

COURSEOBJECTIVES	
1	Tolearntoachievethehighestgoalhappily
2	To become a person with stable mind, pleasing personality anddetermination
3	Toawakenwisdominstudents

COURSEOUTCOMES		
Uponsuccessfulcompletionofthecourse,thestudentwillbeableto:		**Cognitive Level**
CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life	K2
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity	K3
CO3	Study of Neetishatakam will help in developing versatile personality of students.	K5

K1-Remembering,K2-Understanding,K3-Applying,K4-Analyzing,K5-Evaluating,K6-Creating

ContributionofCourseOutcomestowardsachievementofProgramOutcomes
(1– Low, 2-Medium, 3 – High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	2	2	-
CO2	2	2	2	2	-	2
CO3	2	-	3	2	-	-

COURSE CONTENT:

UNIT–I:
Neetisatakam-Holisticdevelopmentofpersonality,Verses-19,20,21,22(wisdom),Verses-29,31,32(pride&heroism),Verses-26,28,63,65(virtue),
Verses-52,53,59(don'ts),Verses-71,73,75,78(do's)

UNIT–II:
Approachtodaytodayworkandduties.ShrimadBhagwadGeeta:Chapter2-Verses41,47,48

UNIT–III:
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48

UNIT–IV: Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses56,62,68
Chapter12-Verses13,14,15,16,17,18

UNIT–V:
PersonalityofRolemodel.ShrimadBhagwadGeeta:Chapter2-Verses17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18–Verses37,38,63

TextBooks:
1. Srimad Bhagavad Gita, Swami Swarupananda AdvaitaAshram(PublicationDepartment),Kolkata
2. Bhartrihari'sThreeSatakam(Niti-sringar-vairagya),P.Gopinath

ReferenceBooks:
1. RashtriyaSanskritSansthanam,NewDelhi.

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DEPARTMENT OF MECHANICAL ENGINEERING

R24

SYLLABUS

M.Tech II Year I Semester **R24Specialization: CAD/CAM**

NON-DESTRUCTIVE EVALUATION

(ME)

Course Category	Program Elective	**Course Code**	24063T17
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Fluid Mechanics, Basic Electrical Engineering, Magnetic Physics, Production Technology	**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSEOBJECTIVES: The objectives of the course are to	
1	To impart knowledge on various NDT methods
2	To describe appropriate techniques to detect the defects in components.
3	To impart knowledge on quantification and calibration of equipment.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Demonstrate various surface NDE techniques and apply to carry out various inspection in accordance with the established procedures to analyse the testing and evaluation of the results for further analysis.	K3
CO2	Understand the complete theoretical/practical knowledge of radiographic testing, interpretation and evaluation to interpret the various defect types and characterize them.	K3
CO3	Apply the ultrasonic testing to perform inspection of samples and evaluation of various defects in the test specimen for further analysis.	K4
CO4	Understand the basics of creating artistic imagery using holography as an art tool and analyse the master holograms developed.	K3
CO5	Select and apply the suitable NDT techniques to interpret the nature and quantifying the defects in respective fields of application.	K5

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low,2 -Medium, 3– High)						
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		3	3		2	
CO2		2		3		
CO3				2	2	
CO4			2	2	2	
CO5	2	2		2		2

COURSE CONTENT

UNIT – I:

General Methods: Flaw Detection Using Dye Penetrants. Magnetic Particle Inspection, introduction to electrical impedance, Principles of Eddy Current testing, Flaw detection using eddy currents.

UNIT – II:

X-Ray Radiography: The Radiographic process, X-Ray and Gamma-ray sources, Geometric Principles, Factors Governing Exposure, Radio graphic screens, Scattered radiation, Arithmetic of exposure, Radiographic image quality and detail visibility, Industrial X-Ray films, Fundamentals of processing techniques, Process control, The processing Room, Special Processing techniques, Paper Radiography, Sensitometric characteristics of x-ray films, Film graininess signal to noise ratio in radiographs, The photographic latent image, Radiation Protection.

UNIT – III:

Ultrasonic Testing: Generation of ultrasonic waves, Horizontal and shear waves, Near field and far field acoustic wave description, Ultrasonic probes- straight beam, direct contact type, Angle beam, Transmission/reflection type, and delay line transducers, acoustic coupling and media, Transmission and pulse echo methods, A-scan, B-scan, C-scan, F-scan and P-scan modes, Flaw sizing in ultrasonic inspection: AVG, Amplitude, Transmission, TOFD, Satellite pulse, Multi-modal transducer, Zonal method using focused beam. Flow location methods, Signal processing in Ultrasonic NDT; Mimics, spurious echos and noise. Ultrasonic flaw evaluation.

UNIT – IV:

Holography: Principles and practices of Optical holography, acoustical, microwave, x-ray and electron beam holography techniques.

UNIT – V:

Applications: NDT in flaw analysis of Pressure vessels, piping, NDT in Castings, Welded constructions, etc., Case studies.

Text Books:

1. Ultrasonic testing by Krautkramer and Krautkramer
2. Ultrasonic inspection to Training for NDT : E. A. Gingel, Prometheus Press.

Reference Books:

1. ASTM Standards, Vol 3.01, Metals and alloys.

Web References:

1. https://archive.nptel.ac.in/courses/113/106/113106070/
2. https://archive.nptel.ac.in/noc/courses/noc16/SEM2/noc16-mm07/

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DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech II Year I Semester **R24Specialization: CAD/CAM**

DESIGN AND ANALYSIS OF EXPERIMENTS

(ME)

Course Category	Program Elective	**Course Code**	24063T18
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	100

COURSEOBJECTIVES: The objectives of the course are to	
1	To impart the knowledge about different philosophical approaches to experimental design, get familiar with Design of experiment.
2	To build a solid foundation for the statistical concepts for experimental design.
3	To gain knowledge of experimental design, signal to noise ratio, parameter design and analysis & interpretation methods.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Identify and apply the basic principles of experimental design, including randomisation, replication and control.	K2
CO2	Manipulate and present experimental data using appropriate statistical tools like analysis of variance tables and other statistical summaries to analyse experimental data.	K3
CO3	Design and analyse factorial experiments for investigating multiple factors	K4
CO4	Determine the sample size required to meet a required level of accuracy for an experiment by developing empirical models using experimental data	K3
CO5	Gaining knowledge in signal to noise ratio and parameter design and apply to analyse the interpreted experimental data	K3

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low,2 -Medium, 3– High)						
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				3		
CO2	2	2		2	2	
CO3					2	2
CO4	2			2	2	2
CO5		2	3			

COURSE CONTENT

UNIT – I:

Fundamentals of Experimentation: Role of experimentation in rapid scientific progress, Historical perspective of experimental approaches, Steps in experimentation, Principles of experimentation.

UNIT – II:

Simple Comparative Experiments: Basic concepts of probability and statistics, Comparison of two means and two variances, Comparison of multiple (more than two) means & ANOVA.

UNIT – III:

Experimental Designs: Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data.

UNIT – IV:

Response Surface Methodology: Concept, linear model, steepest ascent, second order model, regression.

UNIT – V:

Taguchi's Parameter Design: Concept of robustness, noise factors, objective function & S/N ratios, inner-array and outer-array design, data analysis.

TEXTBOOKS:

1] Montgomery DC, Design and Analysis of Experiments, 7th Edition, John Wiley & Sons, NY, 2008.

2] Ross PJ, Taguchi Techniques for Quality Engineering, McGraw-Hill Book Company, NY, 2008.

REFERENCE BOOKS:

1] Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley and sons, 2005.

2] Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005

WEB REFERENCES:

1. https://archive.nptel.ac.in/courses/110/105/110105087/
2. http://www.digimat.in/nptel/courses/video/110105087/L52.html

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DEPARTMENT OF MECHANICAL ENGINEERING

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SYLLABUS

M.Tech II Year I Semester **R24Specialization: CAD/CAM**

SUSTAINABLE MANUFACTURING

(ME)

Course Category	Program Elective	**Course Code**	24063T19
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to fundamental Engineering & Science courses and Environmental Science courses.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	This course provides an overview of the Sustainability through Green Manufacturing Systems, various methodologies and its application in improving the eco-efficiency are focused.
2	Students will also learn about the commonly used Sustainable manufacturing tools such as Environmentally Conscious Quality Function Deployment (ECQFD) and Life Cycle Assessment (LCA).

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Describe the relevance & concept of sustainability, Identify the drivers for sustainable manufacturing to provide solutions for different types of environmental pollution problems.	K2
CO2	Explain and select environment friendly materials for alternative manufacturing practices as initiative for the sustainable manufacturing.	K2
CO3	Demonstrate and apply suitable sustainable manufacturing tools to design, control and planning the green manufacturing systems.	K3
CO4	Explain the concepts and implementation of green manufacturing methods to suggest/develop suitable design for sustainable manufacturing.	K2
CO5	Apply carbon footprint analysis and elucidate the principles of LCA to specific manufacturing systems and processes.	K3

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low,2 -Medium, 3– High)						
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3			
CO2			2	3		
CO3			3	2	2	
CO4			3		2	2
CO5		2		3	3	3

COURSE CONTENT

UNIT – I:

Introduction: Concept of sustainability, manufacturing, operations, processes, practices, Resources in manufacturing, five Ms, system approach to manufacturing, Basic experimental design, factor identification, quantification, comparison, Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing. Metrics for Green Manufacturing, Metrics Development Methodologies.

Management of Waste &Pollution: Types, sources and nature of wastes, waste processing, green processing & engineering operations, Energy recovery, and 3R& 6R principle. Types of pollution and management: Anti-pollution approaches &guidelines.

UNIT – II:

Environment Friendly Materials: Materials for sustainability, eco-friendly and new age energy efficient and smart materials, alternative manufacturing practices, materials and selection of manufacturing processes, control on use of renewable materials, Bio-degradable materials recycling of materials.

UNIT – III:

Sustainable Manufacturing Tools: Principles of green manufacturing and its efficiency, green manufacturing and sustainability, System model architecture and module, Design and planning, control or tools for green manufacturing (Qualitative Analysis), Consumption Analysis, Life Cycle Analysis, Efficiency, Sustainability tools). Standards for green manufacturing (ISO14000 and OHSAS 18000), Waste stream mapping and application, Design for environment and for sustainability– Discuss the Product Life Cycle of manufactured goods.

UNIT – IV:

Green manufacturing techniques: Dry and near-dry machining, edible oil based cutting fluids green manufacturing, cryogenic machining for eco-efficiency green manufacturing, Lean manufacturing, Lean techniques for green manufacturing, Waste assessment and strategies for waste reduction in green manufacturing, Reconfigurable manufacturing systems.

UNIT – V:

Life Cycle Analysis: Remanufacture and disposal, Tools for LCA, Optimization for achieving sustainability in unit manufacturing, green manufacturing lean models, value analysis, carbon footprint, analysis for carbon footprint green manufacturing: sustainability framework green manufacturing techniques: factors effecting sustainability.

Green Supply Chain: Carbon footprints in transportation Green Supply chain: techniques and implementation Green Supply chain, Logistics management Green Supply Chain as Product Life Cycle Management, Servitization. Case Studies: Green packaging and supply chain,implementation of lean manufacturing at industries.

TEXT BOOKS:

1. Design of Experiments, Montgomery Douglas, John Wiley and Sons, Inc. 2017.
2. Green manufacturing: fundamentals and applications. Dornfeld, D.A. Springer Science & Business Media, 2012.
3. Materials and the environment: eco-in formed material choice. Ashby, M. F. Elsevier, 2012.

REFERENCE BOOKS:

1. Sustainability in the process industry, Klemes, J., McGraw-Hill, 2011.
2. Green Management, M. Karpagam, GeethaJaikumar, An E-Books Pvt. Ltd., 2010.
3. Design for Environment: A guide to sustainable Product Development Sustainable Development M.K. Ghosh Roy, An eBook Pvt. Ltd, 2009.

WEB REFERENCES:

1. https://archive.nptel.ac.in/courses/112/104/112104225/

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DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

M.Tech II Year I Semester **R24Specialization: CAD/CAM**

INTERNSHIP

(ME)

Course Category		**Course Code**	24063I01
Course Type		**L-T-P-C**	0-0-0-2
Prerequisites		**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	

COURSEOBJECTIVES: The objectives of the course are to	
1	Internships provide students with an opportunity to put into practice skills they have learned while in college.
2	In addition, students should have an opportunity to enhance those skills, obtain the perspective of a work environment and benefit from a mentor or supervisor's experience and advice

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Integrate theory and practice to assess interests and abilities in their field of study.	K3&K4
CO2	Develop work habits, attitudes necessary to appreciate work and its function in the economy	K3

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes
(1– Low,2 -Medium, 3– High)

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			2	2		
CO2			2			2

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SYLLABUS

M.Tech II Year I Semester **R24Specialization: CAD/CAM**

NANO TECHNOLOGY

(ME)

Course Category	Open Elective	**Course Code**	
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites	Exposure to Physics, Chemistry, Materials Science, Engineering and Computer Science.	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	100

COURSEOBJECTIVES: The objectives of the course are to	
1	The fundamentals of nano-scale engineering, manufacturing, current and future applications of nanostructured materials with respect to their impact in commercial products and technologies.
2	Particular emphasis will be placed in biomedical applications. Well-established and novel synthesis/fabrication methods nanostructures will be critically discussed giving a broad overview of the state-of-the-art nano manufacturing processes.
3	Standard characterization methods will be elucidated using various examples and exercises throughout the course

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Describe the fundamental principles of nanotechnology and apply engineering and physics concepts to the nano-scale and non-continuum domain.	K2
CO2	Identify, compare contemporary nano synthesis methods and design processing conditions to perform a critical analysis of engineer functional nano materials.	K3
CO3	Discuss and evaluate state-of-the-art characterization methods for nano materials to verify nano material safety and handling methods required during characterization.	K2
CO4	Apply and transfer interdisciplinary systems engineering approaches to the field of biomedical engineering and nanotechnology projects.	K3
CO5	Explain the structure and synthesis of carbon nanotubes to develop fast response electromechanical devices.	K2

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low,2 -Medium, 3– High)						
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2		3	2	2	
CO2				2	2	
CO3	2		2	2	2	
CO4				2	3	2
CO5			2	2		2

COURSE CONTENT

UNIT – I:

Introduction: Size and shape dependence of material properties at the nano scale, scaling relations, can nano robots walk, and nano planes fly, Nano scale elements in conventional technologies, Mechanics at nanoscale Enhancement of mechanical properties with decreasing size, Nano electromechanical systems, nano machines, Nano fluidics, filtration, sorting, Molecular motors, Application of Nano Technology.

UNIT – II:

Nano material Synthesis Techniques: Top-down and bottom-up nanofabrication, Synthesis of nano composites, The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, nano coatings and nano indentation, Electron beam lithography, soft lithography, nano imprinting and micro contact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

UNIT – III:

Imaging/characterization of nanostructures General considerations for imaging, Scanning probe techniques: XRD, SEM, TEM, AFM and NSOM.

UNIT – IV:

Metal and semiconductor nanoparticles Synthesis, stability, control of size, Optical and electronic properties, Ultra-sensitive imaging and detection with nanoparticles, bioengineering applications, Catalysis. Semiconductor and metal nanowires Vapor/liquid/solid growth and other synthesis techniques, Nanowire transistors and sensors.

UNIT – V:

Carbon nanotubes: Structure and synthesis, Electronic, vibrational, and mechanical properties, how can carbon nanotubes enable faster computers, brighter TV screens, and stronger mechanical reinforcement.

TEXT BOOKS:

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005)

REFERENCE BOOKS:

1. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004)

WEB REFERENCES:

1. https://nptel.ac.in/courses/118102003
2.https://archive.nptel.ac.in/courses/113/106/113106093/
3. https://archive.nptel.ac.in/courses/118/107/118107015/