ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS
(Choice Based Credit System)

R24

CAD-CAM

For

Master of Technology (M.Tech)

(Applicable for batches admitted from 2024-2025)

SWARNANDHRA

COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)

SEETHARAMAPURAM, NARSAPUR-534 280, W.G.DT., A.P.

1. INTRODUCTION

Swarnandhra College of Engineering & Technology (Subsequently referred to as SCET) will be followed the norms of Jawaharlal Nehru Technological University Kakinada and Govt. of Andhra Pradesh.

Academic Programmes of the institute are governed by rules and regulations approved by the Academic Council, which is the highest Academic body of the Institute. These rules and regulations are applicable for the students of M. Tech (Regular) Course from the Academic Year 2019-20 onwards.

2. ADMISSIONS:

2.1. Admission into first year of M. Tech Programme: Admissions in each M.Tech program in the Institution are classified into **CATEGORY - A** through convener, PGECET and **GATE. CATEGORY- B** seats are filled by the college management.

2.2. Admissions with advance standing: These may arise in the following cases:

a) When a student seeks transfer from other colleges to SCET and desirous to pursue the study at SCET in an eligible branch of study.
b) When students of SCET get transferred from one regulation to another regulation or from previous syllabus to revised syllabus.
c) When a student after long discontinuity rejoins the college to complete his/her Program of study for the award of degree.

In all such cases for admission, when needed, permissions from the statutory bodies are to be obtained and the Programme of study at SCET will be governed by the transitory regulations.

3. DURATION OF THE PROGRAMME AND MEDIUM OF INSTRUCTION:

The duration of the M. Tech. Program is two academic years consisting of four semesters. Students, who fail to fulfill all the academic requirements for the award of the degree within minimum of four academic years, will forfeit their admission in M. Tech course**.** The medium of instruction and examinations are in English.

4. PROGRAMMES OF STUDY:

The following specializations are offered at present.

i) M. Tech – Power Electronics
ii) M. Tech – CAD/CAM

iii) M. Tech – VLSI System Design

iv) M. Tech – Communication Systems

v) M. Tech – Computer Science & Engineering

vi) M. Tech – Thermal Engineering

vii) M. Tech – Structural Engineering

5. AWARD OF M. TECH DEGREE

- The candidate pursues a course of study in not less than two and not more than four academic years.
- The student shall register for all 68 credits and secure the same.

6. ATTENDANCE

The minimum instruction days in each semester are 90.

i. A student will be eligible to appear for end semester examinations, if he/she acquired a minimum of 75% of attendance in aggregate of all the courses.

ii. Condonation of shortage of attendance in aggregate up to 10% on medical grounds (Above 65% and below 75%) in any semester may be granted by the College Academic Committee.

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

iv. Students with less than 65% of attendance in any semester are not eligible to take up their end examination of that particular semester and their registration for examination shall be allowed.

v. Attendance may also be condoned for those who participate in Intercollegiate/university sports, co- and extracurricular activities provided their attendance is in the minimum prescribed range for the purpose (>65%) and recommended by the concerned authority. He/ She shall pay the prescribed condonation fee.

vi. Prescribed Condonation fee shall be payable by the student to appear for the end examination.

vii. A Student will not be promoted to the next semester unless he/she satisfies the attendance requirement of the present semester as applicable. They may seek re-admission for that semester as and when offered consecutively by the Department.

7. EVALUATION

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

7.1 Continuous Internal Evaluation:

Theory

(a) For theory subjects, during a semester, there shall be two mid-term examinations. Each midterm examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks.

(b) The descriptive examination is set with 4 full questions from first two and half units (50% of the syllabus), the student has to answer all questions. In the similar lines, descriptive examination shall be conducted on the rest of the syllabus.

(c) The first mid (Mid-1) marks shall be submitted to the examination section within one week after completion of first mid examination.

(d) The mid marks submitted to the examination section shall be displayed in the concerned department notice boards for the benefit of the students.

(e) If any discrepancy found in the submitted Mid-1 marks, it shall be brought to the notice of examination section within one week from the submission.

(f) Second mid examination shall be conducted on the similar lines of mid-1 and its mid (Mid-2) marks shall also be submitted to examination section within one week after completion of second mid examination and it shall be displayed in the notice boards. If any discrepancy found in the submitted mid-2 marks, it shall be brought to the notice of examination section within one week from the submission.

(g) The final marks are the sum of average of two mid-term examinations i.e. $\frac{\text{Mid1+Mid2}}{2}$

7.2 End Semester Theory Examination Evaluation:

Theory:

- End semester examination is conducted for 60 marks. Question paper consists of five questions from five units with internal choice. Duration of exam is 180 minutes.

7.3 Laboratory Evaluation:

Internal Evaluation: The internal marks for laboratory are 40 marks and the marks shall be awarded based on the day to day work: 10 marks, Record: 5 marks and the remaining 25 marks to be awarded by conducting an internal laboratory test.

External Evaluation: For external marks for laboratory are 60 and marks shall be awarded based on the performance in the end laboratory examinations. Laboratory examination must be conducted with two Examiners, one of them being the Laboratory Class Teacher and the second examiner shall be appointed by the COE from the panel of examiners submitted by the respective college. Laboratory examination must be conducted with a breakup marks of Procedure-15, Experimentation-25, Results-10, Viva-voce-10.

7.4 For MOOCs Course, the student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL/JNTUK MOOCs through online with the approval of committee comprises of Head of the Department and two senior faculty. The Head of the Department shall appoint one mentor for each of the MOOC courses offered. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate.

7.5 A candidate shall be deemed to have secured the minimum academic requirement in a course 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.

7.6 A candidate shall be given one chance to re-register for each course provided the internal marks secured by a candidate are less than 50% and has failed in the end examination after completion of the third semester. The candidate's attendance in the re- registered course(s) shall be calculated separately to decide upon his/her eligibility for writing the end examination in those courses(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 Institute by paying the requisite fees and get approval from the concern authorities before the start of the semester in which re-registration is required. In case the candidate secures less than the required attendance in any re-registered course(s), he/she shall not be permitted to write the End Examination in that course.

7.7 Laboratory external examination must be conducted with internal and external examiner. External examiner will be appointed by the COE from the approved panel of examiners.

7.8 For non-credit Audit Courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/Percentage

7.9 For Mini Project with 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/mentor and two other senior faculty members of the department. For Mini Project with Seminar, there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

8. EVALUATION OF PROJECT/DISSERTATION WORK

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

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

ii. Registration of Dissertation/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.

iii. After satisfying (ii), 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).

iv. 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 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.

v. Continuous assessment of Dissertation-I and Dissertation-II during the Semester(s) will be monitored by the PRC.

vi. A candidate shall submit his status report in two stages to the PRC, at least with a gap of 3 months between them.

vii. The work on the project shall be initiated at the beginning of the 3rd Semester and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of 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.

viii. Three copies of the Project Thesis certified by the supervisor shall be submitted to the College.

ix. The thesis shall be adjudicated by one examiner from the approved panel of examiners, by the COE.

x. Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination. The Board shall jointly report the candidate's work as one of the following:

A. Excellent

B. Good

C. Satisfactory

D. Unsatisfactory

If the report of the Viva-Voce is unsatisfactory, the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at 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 Concern authorities.

9. GRADING SYSTEM:

9.1 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 C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

9.2 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.,

$$CGPA = \sum (Ci \times Si) / \sum Ci$$

Where Si is the SGPA of the it 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.

9.3 Award of Grade in Each Semester:

a. Based on the performance during a given semester, a final letter grade will be awarded at the end of the semester for each subject. The letter grades and the corresponding grade points are as given in the Table.

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

b. Grade Sheet: A grade sheet (memorandum) will be issued to each student indicating his performance in all courses taken in that semester and also indicating the Grades.

c. Transcripts: After successful completion of the total program of study, a Transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued up to any point of study to any student on request and by paying the stipulated fee in force.

d. Candidates shall be permitted to apply for revaluation within the stipulated period with payment of prescribed fee.

10. 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 any supplementary appearance)	**From the CGPA secured from 68 Credits.**
First Class	≥ 7.75 (With any supplementary appearance) ≥ 6.75 to < 7.75	
Second Class	≥ 6.0 to < 6.75	
Pass Class	≥ 5.0 to < 6.0	

11. CONDUCT AND DISCIPLINE:

Students admitted in SCET are to be followed the conduct and discipline of the college and which will be updated from time to time.

12. MALPRACTICES:

If any malpractices held in internal assessment tests or Semester-End Examinations, Principal constitute a Malpractice Enquiry Committee to enquire the case. The principal shall take necessary action based on the recommendations of the committee as per stipulated norms.

13. WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the university 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.

14. GENERAL

- Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.
- The academic regulation should be read as a whole for the purpose of any interpretation.
- In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman, Academic Council is final.
- 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.

M.TECH COURSE STRUCTURE

I SEMESTER

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	24CC1T01	Research Methodology and IPR	2	0	0	2	40	60	100
2	24CC1T02	Geometric Modeling	3	0	0	3	40	60	100
3	24CC1T03	Computer Aided Manufacturing	3	0	0	3	40	60	100
4	**Elective – I**								
	24CC1E01	Computational Methods in Engineering	3	0	0	3	40	60	100
	24CC1E02	Mechanical Vibrations							
	24CC1E03	Advanced Manufacturing Processes							
5	**Elective – II**								
	24CC1E04	Mechatronics	3	0	0	3	40	60	100
	24CC1E05	Industrial Robotics							
	24CC1E06	Simulation of Manufacturing Systems							
6	24CC1L01	Advanced Computer Aided Design Lab	0	0	4	2	40	60	100
7	24CC1L02	Computer Aided Manufacturing Lab	0	0	4	2	40	60	100
8		Audit Course- I	2	0	0	0			
		Total Credits	**16**	**0**	**8**	**18**	**280**	**420**	**700**

II SEMESTER

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	24CC2T01	Advanced Finite Element Methods	3	0	0	3	40	60	100
2	24CC2T02	Additive Manufacturing Technologies	3	0	0	3	40	60	100
3	**Elective - III**								
	24CC2E07	Intelligent Manufacturing Systems	3	0	0	3	40	60	100
	24CC2E08	Optimization and Reliability							
	24CC2E09	Fracture mechanics							
4	**Elective - IV**								
	24CC2E10	Product Design and Development	3	0	0	3	40	60	100
	24CC2E11	Design and Manufacturing of MEMS and Micro Systems							
	24CC2E12	Advances in Nano Technology							
5	24CC2P01	Mini Project with Seminar	0	0	4	2	50	-	50
6	24CC2L01	Simulation of Manufacturing Systems Lab	0	0	4	2	40	60	100
7	24CC2L02	Material Characterization Lab	0	0	4	2	40	60	100
8		Audit Course- II	2	0	0	0	-	-	-
		Total Credits	**14**	**0**	**12**	**18**	**290**	**360**	**650**

III SEMISTER

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	**Elective - V**								
	24CC3E13	Nondestructive Evaluation	3	-	-	3	40	60	100
	24CC3E14	Computer Graphics							
	24CC3E15	Quality Engineering in Manufacturing							
2	**Open Elective**								
	24CM3O01	Business Analytics	3	-	-	3	40	60	100
	24CC3O02	Industrial Safety							
	24CC3O03	Operations Research							
	24MB3O04	Cost Management of Engineering Projects							
	24CC3O05	Composite Materials							
	24PE3O06	Waste to Energy							
3		Project Phase-I	-	-	20	10	-	-	-
		Total Credits	6	-	20	**16**	**80**	**120**	**200**

IV SEMISTER

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	24CC4P01	Project Phase-II	-	-	32	16	80	120	200
		Total Credits	-	-	**32**	**16**	**80**	**120**	**200**

LIST OF AUDIT COURSES I & II

S.No.	Course Code	Name of the Course
1	24ACXM01	English for Research Paper Writing
2	24ACXM02	Disaster Management
3	24ACXM03	Sanskrit for Technical Knowledge
4	24ACXM04	Value Education
5	24ACXM05	Constitution of India
6	24ACXM06	Pedagogy Studies
7	24ACXM07	Stress Management by yoga
8	24ACXM08	Personality Development Through Life Enlightenment Skills

- X‟ indicates semester number

I Year I Semester	L	P	C
	2	0	2
24CC1T01 :: RESEARCH METHODOLOGY AND IPR			

COURSE OUTCOMES: Students will be able to

CO1. Formulate a research problem for a given engineering domain. [K6]

CO2. Analyse the available literature for given research problem. [K4]

CO3. Develop technical writing and presentation skills. [K6]

CO4. Explain concepts related to patents, trademark and copyright. [K2]

CO5. Explain about developments in Intellectual Property Rights. [K2]

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

UNIT-III:
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format ofresearch proposal, a presentation and assessment by a review committee

UNIT-IV:
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-V:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:
1. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", 2nd Edition, Juta Academic
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007

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

I Year I Semester	L	P	C
	3	0	3
24CC1T02 :: GEOMETRIC MODELING			

UNIT - I

Cubic splines –I Definition, Explicit and implicit equations, parametric equations, Algebraic and geometric form of cubic spline, Hermite cubic spline, tangent vectors, parametric space of a curve, blending functions.

UNIT - II

Cubic Splines-II:

Four point form, reparametrization, truncating and subdividing of curves. Graphic construction and interpretation, composite pc curves.

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

UNIT - III

B-Spline Curves: B-Spline basis, equations, knot vectors, properties, and derivatives.

UNIT – IV

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

UNIT – V

Solids: Tricubic solid, Algebraic and geometric form.

Solid modeling concepts: Wire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.

TEXT BOOKS:

1. Elements of Computer Graphics by Roger & Adams Tata McGraw Hill.
2. Geometric Modeling by Micheal E. Mortenson, McGraw Hill Publishers

REFERENCES:

1. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, PHI Publishers

I Year I Semester	L	P	C
	3	0	3
24CC1T03 :: COMPUTER AIDED MANUFACTURING			

COURSE OUTCOMES: Students are able to

CO1. Write APT programming for various machining processes. [K3]
CO2. Explain Interchangeable tooling system and Adaptive control of machining processes. [K2]
CO3. Explain the Post Processors and its necessity. [K2]
CO4. Explain Applications and Programming of Micro Controllers. [K3]
CO5. Explain Computer aided process planning and Computer Aided Inspection processes. [K2]

UNIT - I

COMPUTER AIDED PROGRAMMING: General information, APT programming, Examples APT programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors .Introduction to CAD/CAM software, Automatic Tool Path generation

UNIT - II

TOOLING FOR CNC MACHINES: Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, grinding.

UNIT - III

POST PROCESSORS FOR CNC: Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP — based- Post Processor: Communication channels and major variables in the DAPP — based Post Processor, th creation of a DAPP — Based Post Processor.

UNIT - IV

MICRO CONTROLLERS: Introduction, Hardware components, I/O pins, ports, external memory:counters, timers and serial data I/O interrupts. Selection of Micro Controllers, Embedded Controllers, Applications and Programming of Micro Controllers. Programming Logic Controllers (PLC' s): Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.

UNIT - V

COMPUTER AIDED PROCESS PLANNING: Hybrid CAAP System, Computer Aided Inspection and quality control, Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods, Artificial Intelligence and expert system: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.

TEXT BOOKS:

1. Computer Control of Manufacturing Systems / Yoram Koren / Mc Graw Hill. 1983.
2. CAD/CAM Principles and Applications, P.N.Rao, TMH

REFERENCES:

1. Computer Aided Design Manufacturing – K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, PHI, 2008.
2. CAD / CAM Theory and Practice,/ Ibrahim Zeid,TMH
3. CAD / CAM / CIM, Radhakrishnan and Subramanian, New Age
4. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson
5. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson

I Year I Semester	L	P	C
	3	0	3
24CC1E01 :: COMPUTATIONAL METHODS IN ENGINEERING (Professional Elective I)			

UNIT – I

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

UNIT – II

Boundry value problems and charecteristic value problems: Shooting method – Solution through a set 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

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

UNIT – V

Partial differential equations: 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.

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale ―Numerical Methods for Engineers‖ Tata Mc-Graw Hill 2.Curtis F.Gerald, Partick.O.Wheatly,‖Applied numerical analysis‖Addison-Wesley,1989 3.Douglas J.Faires,Riched Burden‖Numerical methods‖, Brooks/Cole publishing company,1998.Second edition.

REFERENCES:

1. Ward Cheney and David Kincaid ―Numerical mathematics and computing‖ Brooks/Cole publishing company1999, Fourth edition.
2. Riley K.F,. M.P.Hobson and Bence S.J,‖Mathematical methods for physics and engineering‖, Cambridge University press,1999.

I Year I Semester	L	P	C
	3	0	3
24CC1E02 :: MECHANICAL VIBRATIONS (Professional Elective - I)			

UNIT I

Single degree of Freedom systems: Undamped and damped free vibrations: forced vibrations ; coulomb damping; Response to harmonic excitation; rotating unbalance and support excitation, Vibration isolation and transmissibility, Vibrometers, velocity meters & accelerometers.

UNIT II

Response to Non Periodic Excitations: unit Impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT III

Multi degree freedom systems: Principal modes – undamped and damped free and forced vibrations ; undamped vibration absorbers, Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi – rotor systems and geared systems; Discrete-Time systems.

UNIT IV

Numerical Methods: Rayliegh's, Stodola's, Matrix iteration, Rayleigh-Ritz Method and Holzer's methods

UNIT V

Application of concepts: Free vibration of strings – longitudinal oscillations of bars-transverse vibrations of beams- Torsional vibrations of shafts. Critical speeds without and with damping, secondary critical speed.

TEXT BOOKS:

1. Elements of Vibration Analysis by Meirovitch.
2. Mechanical Vibrations by G.K. Groover.

REFERENCES:

1. Vibrations by W.T. Thomson
2. Mechanical Vibrations – Schaum series.
3. Vibration problems in Engineering by S.P. Timoshenko.
4. Mechanical Viabrations – V.Ram Murthy.

I Year I Semester	L	P	C
	3	0	3
24CC1E03 :: ADVANCED MANUFACTURINGPROCESSES (Professional Elective - I)			

UNIT-I

SURFACE TREATMENT: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapor deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT- II

PROCESSING OF CERAMICS: Applications, characteristics, classification .Processing of **particulate** ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT- III

FABRICATION OF MICROELECTRONIC DEVICES:

Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in micro electronics, surface mount technology, Integrated circuit economics.

UNIT - IV

ADVANCED MACHINING PROCESSES: EDM, WireEDM, ECM, LBM, EBM, AJM, WJM – **Principle**, working, limitations and applications.

UNIT -V

RAPID PROTOTYPING: Working Principles, Methods, Stereo Lithography, Laser Sintering, Fused Deposition Method, Applications and Limitations, Rapid tooling, Techniques of rapidmanufacturing

TEXT BOOKS:

1. **Manufacturing** Engineering and Technology *I* Kalpakijian / Adisson Wesley, 1995.
2. **Process** and Materials of Manufacturing / R. A. Lindburg / 1th edition, PHI 1990.

REFERENCES:

1. **Microelectronic** packaging handbook / Rao. R. Thummala and Eugene, J. Rymaszewski / Van Nostrand Renihold,
2. **MEMS** & Micro Systems Design and manufacture / Tai — Run Hsu / TMGH

I Year I Semester	L	P	C
	3	0	3
24CC1E04 :: MECHATRONICS (Professional Elective - II)			

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, PN 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, micro processors 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, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

TEXT BOOKS:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.

REFERENCES:

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
3. Mechatronics System Design / Devdas shetty/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

I Year I Semester	L	P	C
	3	0	3
24CC1E05 :: INDUSTRIAL ROBOTICS (Professional Elective - II)			

COURSE OUTCOMES: Students will be able to

CO1: Summarize principles of Automation, Classification and Control systems of industrial Robots. [K2]
CO2: Apply various motion analysis principles to solve problems involving Manipulator Kinematics. [K4]
CO3: Apply Jacobian and Lagrangian principles to solve manipulator Dynamics Problems. [K3]
CO4: Summarize different types of Robot Programming Methods and robot languages. [K2]
CO5: Design of robot cell and robot applications in various fields [K3].

UNIT-I:
Introduction: Automation and Robotics, Robot anatomy configuration, motions joint motion and notation, work volume, robot drive system, control system and dynamic performance, precision of movement.
Control System and Components: basic concept and modals controllers control system analysis, robot actuators and feedback components (sensors): Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics, Power Transmission Systems.

UNIT-II:
Motion Analysis and Control: Manipulator kinematics, position representation Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, Differential Kinematics, Jacobian Formulation, problems, manipulator path control: Slew, Joint Interpolated & Straight line motions, trajectory planning: Joint space scheme,Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

UNIT-III:
Robot Dynamics: Lagrange – Euler & Newton - Euler formulations, problems on two link planar manipulators, configuration of robot controller.
End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.
Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog todigital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT-IV:
Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINGNAL AND DELAY commands, Branching capabilities and Limitations.
Robot Languages: Textual robot languages, Generation, Robot language structures, Elements and functions.

UNIT-V:
Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot cell,Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller.
Robot Applications: Material transfer, Machine loading/unloading. Processing operations, Assembly and Inspection, Future Applications.

TEXT BOOKS:
1. Introduction to Robotics Mechanics & Control by John J. Craig, Pearson
2. Industrial robotics by Mikell P. Groover, McGraw Hill.

REFERENCE BOOKS:

1. Industrial robotics by Mikell P. Groover, McGraw Hill
2. Robotics by K.S.Fu, McGraw Hill.
3. Introduction to Robotics Mechanics & Control by John J. Craig, Pearson
4. Robot Analysis by Lung Wen Tsai, John Wiley & Sons
5. Robot Analysis and Control by Asada H. and J. E. Slotin, Wiley, New York

I Year II Semester	L	P	C
	3	0	3
24CC1E06 :: SIMULATION OFMANUFACTURING SYSTEMS (Professional Elective - II)			

UNIT-I

Introduction to System and simulation: Concept of system and elements of system, Discrete and continuous system, Models of system and Principles of modeling and simulation, Monte carlo simulation, Types of simulation, Steps in simulation model, Advantages, limitations and applications of simulation, Applications of simulation in **manufacturing** system

UNIT-II

Review of statistics and probability: Types of discrete and continuous probability distributions such as Geometric, Poisson, Uniform, Geometric distribution with examples, Normal, Exponential distribution with examples.

UNIT-III

Random numbers: Need for RNs, Technique for Random number generation such as Mid product method, Mid square method, and Linear congruential method with examples

Test for Random numbers: Uniformity - Chi square test or Kolmogorov Smirnov test, Independency- Auto correlation test

Random Variate generation: Technique for Random variate generation such as Inverse transforms technique or Rejection method

UNIT-IV

Analysis of simulation data: Input data analysis, Verification and validation of simulation models, Output data analysis

Simulation languages: History of simulation languages, Comparison and selection of simulationlanguages

Design and evaluation of simulation experiments: Development and analysis of simulation models using simulation language with different manufacturing systems

UNIT-V

Queueing models: An introduction, M/M/1 and M/M/m Models with examples, Open Queueing and Closed queueing network with examples

Markov chain models and others: Discrete time markov chain with examples, Continues time markov chain with examples, stochastic process in manufacturing, Game theory

TEXT BOOKS:

1.J.**Banks**, J.S. Carson, B. L. Nelson and D.M. Nicol, ―Discrete Event System Simulation‖, PHI, New Delhi, 2009.

2.A.M. Law and W.D.Kelton, –Simulation Modeling and Analysis‖, Tata McGraw Hill Ltd, New Delhi, 2008.

3.N. Viswanadham and Y. Narahari, "Performance Modeling of Automated ManufacturingSystems", PHI, New Delhi, 2007

I Year I Semester	L	P	C
	0	4	2
24CC1L01 :: ADVANCED COMPUTER AIDED DESIGN LAB			

COURSE OUTCOMES: Students will be able to

CO1: Perform the modelling of 2D and 3D trusses and predict the deflection and stress distributions. [K4]
CO2: Carryout the modelling of different beams and predict the stress distributions and deflections in the span. [K4]
CO3: Perform the finite element analysis in a plate and predict the maximum stress and strain in plane stress condition. [K4]
CO4: Perform the finite element analysis in a cylinder in axisymmetric condition and predict the stress distributions and deflections.[K4]
CO5: Carryout the modelling of different beams and predict the natural frequency using FEA.

Note: Conduct any Ten exercises from the list given below:

1. Two- dimensional drawing using CAD software.
2. Three-dimensional drawing using CAD software.
3. Various Dimensioning and tolerancing techniques on typical products using CAD software.
4. Assembly and animation of simple assemblies like screw jack, bolt-nut mechanism, etc.
5. Truss analysis using FEA software.
6. Beam analysis using FEA software.
7. Frame analysis using FEA software.
    1. Buckling analysis
    2. Fracture analysis
    3. Analysis of laminated composites
    4. Modal Analysis
    5. Harmonic analysis
    6. Spectrum analysis
    7. Transient structural analysis
    8. Transient Thermal Analysis
    9. Couple-field analysis using FEA software.
    10. Rigid Body Dynamic Analysis

Software to be used: Any FEA software like Ansys, Hypermesh, NASTRAN etc.

I Year I Semester	L	P	C
	0	4	2
24CC1L02 :: COMPUTER AIDED MANUFACTURING LAB (Lab - II)			

List of Experiments:

1. CNC programs for turning- 4 exercises
2. CNC programs for milling- 4 exercises
3. Robot programming- Lead through programming using teach product, forward kinematics, inverse kinematics, trajectory planning.

I Year II Semester	L	P	C
	3	0	3
24CC2T01 :: ADVANCED FINITE ELEMENT METHODS			

COURSE OUTCOMES: Student will be able to

CO1: Apply direct stiffness, Rayleigh-Ritz, Galerkin method to solve engineering problems and outline the requirements for convergence.

CO2: Analyze linear 1D problems like bars and trusses;

CO3: Analyze 2D structural problems using CST element, solving 1Dheat conduction and convection heat transfer problems

CO4: Generating Isoperimetric formulation and solving numerical integration problems

CO5: Evaluate the Eigenvalues and Eigenvectors for stepped bar and beam, explain nonlinear geometric and material non linearity**.**

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 and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

UNIT – II

ONE-DIMENSIONAL ELEMENTS: Bar, trusses, beams and frames, displacements, stresses and temperature effects.

UNIT – III

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

UNIT – IV

ISOPARAMETRIC FORMULATION: Concepts, sub parametric, super parametric elements, numerical integration, Requirements for convergence, hrefinement and p-refinement, complete and incomplete interpolation functions, Pascal's triangle, Patch test.

UNIT – V

Finite elements in Structural Analysis: Static and dynamic analysis, eigen value problems, and their solution methods, case studies using commercial finite element packages.

TEXT BOOK:

1. Finite element methods by Chandrubatla & Belagondu.

REFERENCES:

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

I Year II Semester	L	P	C
	3	0	3
24CC2T02 :: ADDITIVE MANUFACTURING TECHNOLOGIES			

UNIT–I:

Introduction: Prototyping fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies.

UNIT–II:

Liquid-based AM Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Poly jet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case studies. Micro fabrication.

Solid-based AM Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT–III:

Powder Based AM Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three-dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Electron Beam Melting (EBM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT–IV:

AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques.

AM Software's: Need for AM software, Features of various AM software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, Mesh Lab.

UNIT–V:

AM Applications: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Web Based Rapid Prototyping Systems

TEXT BOOK:

1. Rapid prototyping: Principles and Applications by Chua C.K., Leong K.F. and LIM C.S, World Scientific publications, Third Edition, 2010.

REFERENCE BOOKS:

1. Rapid Manufacturing by D.T. Pham and S.S. Dimov, Springer, 2001.
2. Wholers Report 2000 by Terry Wohlers, Wohlers Associates, 2000.
3. Rapid Prototyping & Engineering Applications by Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.

I Year II Semester	L	P	C
	3	0	3
24CC2E07 :: INTELLIGENT MANUFACTURING SYSTEMS (ELECTIVE- III)			

COURSE OUTCOMES: Students are able to

CO1: Assess the performance of manufacturing systems manufacturing and enterprise integration (K4)
CO2: Develop a systematic approach for design and implementation of manufacturing systems (K3)
CO3: Categorize the Biological and Artificial Neuron (K4)
CO4: Design and planning manufacturing systems (K6)
CO5: Identification of method of technologies (K1)

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

UNIT II
Components of Knowledge Based Systems - Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

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

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

UNIT V
Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation -Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

REFERENCES
1. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.
2. Artificial Neural Networks/ Yagna Narayana/PHI/2006
3..Automation,ProductionSystemsandCIM/GrooverM.P./PHI/2007
4. Neural networks: A comprehensive foundation/ Simon Hhaykin/ PHI.
5. Artificial neural networks/ B.Vegnanarayana/PHI
6. Neural networks in Computer intelligence/ Li Min Fu/ TMH/2003
7. Neural networks/ James A Freeman David M S kapura/ Pearson education/2004
8. Introduction to Artificial Neural Systems/Jacek M. Zurada/JAICO Publishing House Ed. 2006.

I Year II Semester	L	P	C
	3	0	3
24CC2E08 :: OPTIMIZATION AND RELIABILITY (ELECTIVE- III)			

COURSE OUTCOMES: Students are able to

CO1: Estimating the likely reliability of new designs, and for analyzing reliability data.

CO2: Train personnel in specific maintenance skills.

CO3: Advise on the acquisition, installation and operation of machinery.

CO4: Ensure environmental protection.

CO5: Understand the various applications of optimization.

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT – IV

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

UNIT V

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

TEXT BOOKS:

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers

REFERENCES:

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

I Year II Semester	L	P	C
	3	0	3
24CC2E09 :: FRACTURE MECHANICS (ELECTIVE- III)			

UNIT-I

Introduction: Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile **behaviour**. Fracture in brittle and ductile materials – characteristics of fracture surfaces; inter- granular and intra-granular failure, cleavage and micro-ductility, growth of fatigue cracks, The ductile/brittle fracture transition temperature for notched and unnotched components. Fracture at elevated temperature.

UNIT-II

Griffiths analysis: Concept of energy release rate, G, and fracture energy, R. Modification for ductile materials, loading conditions. Concept of R curves.

Linear Elastic Fracture Mechanics, (LEFM). Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, stress intensity factor and the material parameter the critical stress intensity factor, crack tip plasticity, effect of thickness on fracture toughness.

UNIT-III

Elastic-Plastic Fracture Mechanics; (EPFM). The definition of alternative failure prediction parameters, Crack Tip Opening Displacement, and the J integral. Measurementof parameters and examples of use.

UNIT-IV

Fatigue: definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, mean stress R ratio, strain and load control. S-N curves. Goodmans rule and Miners rule. Micromechanisms of fatigue damage, fatigue limits and initiation and propagation control, leading to a consideration of factors enhancing fatigue resistance. Total life and damage tolerant approaches to life prediction.

UNIT-V

Creep deformation: the evolution of creep damage, primary, secondary and tertiary creep. Micro-mechanisms of creep in materials and the role of diffusion. Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters. Creep-fatigueinteractions. Examples.

TEXT BOOKS:

1. T.L. Anderson, Fracture Mechanics Fundamentals and Applications, 2nd Ed. CRC press,(1995)
2. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths (1973)
3. G. E. Dieter, Mechanical Metallurgy, McGraw Hill, (1988)
4. S. Suresh, Fatigue of Materials, Cambridge University Press, (1998)

REFERENCES:

1. B. Lawn, Fracture **of** Brittle Solids, Cambridge Solid State Science Series 2nd ed1993.
2. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.
3. H.L.Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold, (1984).
4. L.B. Freund and S. Suresh, Thin Film Materials Cambridge University Press,(2003).
5. D.C. Stouffer and L.T. Dame, Inelastic Deformation of Metals, Wiley (1996)

I Year II Semester	L	P	C
	3	0	3
24CC2E10 :: PRODUCT DESIGN AND DEVELOPMENT (ELECTIVE – IV)			

UNIT I

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

UNIT II

Morphology of design. Conceptual Design: Generation, selection & embodiment of concept.Product architecture**,** Industrial design: process, need, Robust Design: Taguchi Designs & DOE, Design Optimization.

UNIT III

Design for Mfg& Assembly: Methods of designing for Manufacturing and assembly, Designs for Maintainability, Designs for Environment, Product costing, Legal factors and social issues, Engineering ethics and issues of society related to design of products. Value Engineering / Value Analysis. : Definition. Methodology, Case studies.

UNIT IV

Economic analysis: Qualitative & Quantitative. Ergonomics / Aesthetics: Gross human autonomy, Anthropometry, Man-Machine interaction, Concepts of size and texture, colour .Comfort criteria, Psychological & Physiological considerations.

UNIT V

Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design. Concurrent Engineering, Rapid prototyping, Tools for product design – Drafting / Modeling software, CAM Interface, Patents & IP Acts. Overview, Disclosure preparation.

Text Books:

1. Karl T Ulrich, Steven D Eppinger , ― Product Design & Development.‖ Tata McGrawhill New Delhi 2003.
2. David G Ullman, –The Mechanical Design Process.‖ McGrawhill Inc Singapore 1992 N J M Roozenberg , J Ekels , N F M Roozenberg ― Product Design Fundamentals and Methods .‖ John Willey & Sons 1995.
3. Kevin Otto & Kristin Wood Product Design: –Techniques in Reverse Engineering and New Product Development.‖ 1 / e 2004 , Pearson Education New Delhi. References:
4. L D Miles –Value Engineering.‖
5. Hollins B & Pugh S –Successful Product Design.‖ Butter worths London.
6. Baldwin E N &Neibel B W –Designing for Production.‖ Edwin Homewood Illinois
7. Jones J C –Design Methods.‖ Seeds of Human Futures. John Willey New York.
8. Bralla J G –Handbook of Product Design for Manufacture, McGrawhillNewYork

I Year II Semester	L	P	C
	3	0	3
24CC2E11 :: DESIGN AND MANUFACTURING OF MEMS AND MICRO SYSTEMS (ELECTIVE – IV)			

COURSE OUTCOMES: Students will be able to

CO1: Explain the concepts of MEMS, Micro systems and applications of MEMS.[K2]

CO2: Describe the various methods of microsystems design and fabrication.[K2]

CO3: Analyze the concepts of engineering mechanics for microsystems design.[K4]

CO4: Analyze the concepts of thermal and fluid flow in microsystems design.[K4]

CO5: Illustrate the materials used and manufacturing methods used for microsystems and MEMS.[K2]

UNIT I

Overview and working principles of Mems And Microsystems MEMS & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & Miniaturization, Applications of MEMS in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluids.

UNIT II

Engineering Science for Microsystems Design And Fabrication: Atomic structure of Matter, Ions and Ionization, Molecular Theory of Mater and Intermolecular Force, Doping of Semiconductors, The iffusion Process, Plasma Physics, Electrochemistry, Quantum Physics

UNIT III

Engineering Mechanics for Microsystems Design: Static Bending of thin Plates, Mechanical Vibration, Thermo mechanics Fracture Mechanics, Thin-Film Mechanics, Overview of Finite Element Stress Analysis

UNIT IV

Thermo Fluid Engineering & Microsystems Design: Overview of Basics of Fluid Mechanics in Macro and Meso scales, Basic equations in Continuum Fluid dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid Flow in Sub micrometer and Nano scale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design Mechanical Design, Mechanical Design using FEM, Design of a Silicon Die for a Micro pressure Sensor.

UNIT V

Materials For MEMS & Microsystems And Their Fabrication: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon Compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, chemical and physical vapor deposition, Etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process

REFERENCES

1. MEMs & Microsystems: Design & Manufacture/ Tai-Ran Hsu/Tata Mc-Graw Hill., ed./2002
2. An Introduction to Micro electromechanical Systems Engineering/ Maluf, M./ Artech House, Boston, 2000
3. Micro robots and Micromechanical Systems/ Trimmer, W.S.N/ Sensors & Actuators, vol19, no.1989.
4. Applied Partial Differential Equations/ Trim, D.W/ PWS-Kent Publishing/ Boston 1990.
5. Fundamentals of Micro fabrication. Madou, M/ CRC Press, Boca Raton, 1997.

I Year II Semester	L	P	C
	3	0	3
24CC2E12 :: ADVANCES IN NANO TECHNOLOGY (ELECTIVE – IV)			

COURSE OUTCOMES: Students can able to
CO1: Understand the fundamentals of nano technology
CO2: Understand various approaches for nanomaterial synthesis.
CO3: Aware of various morphological techniques
CO4: Understand the fundamentals of Metal and semiconductor nanoparticles
CO5: Understand the importance of carbon based nanomaterials.

UNIT-I
Introduction Size and shape dependence of material properties at the nanoscale, why is small good, limits to smallness, scaling relations, can nano-Robots walk and nanoplanes fly, Nanoscale elements in conventional technologies, Mechanics at nanoscale, Enhancement of mechanical properties with decreasing size, Nano electromechanical systems, nanomachines, Nanofluidics, filtration, sorting, Molecular motors.

UNIT-II
Top-down and bottom-up nanofabrication, The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, Electron beam lithography, Soft lithography: Nanoimprinting and microcontact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

UNIT-III
Imaging/characterization of nanostructures, General considerations for imaging, scanning probe techniques: SEM, STM, AFM, 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 C 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)
2. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy,and Heflin, Kluwer Academic Publishers (2004).

REFERENCES:
1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003)
2. Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing (2006).

I Year II Semester	L	P	C
	0	4	2
24CC2L01 :: SIMULATION OF MANUFACTURING SYSTEMS LAB			

1. Writing of manual part programming using ISO codes for turning and milling operations, Use of tool radius compensation and canned cycles, Check the program for syntax errors, lists errors and locations, show the tool path through graphical simulation using EXSL-WIN or other CAM Packages.
2. Modelling of simple machine parts (Turning and Milling) and generating machine codes using standard NX CAM or other CAM Packages
3. Creating and simulating a process flow and optimizing the layout, calculation of various times related to manufacturing systems in an industry using any of the product planning and control packages like Delmia, Robostudio etc.

I Year II Semester	L	P	C
	0	4	2
24CC2L02 :: MATERIAL CHARECTERIZATION LAB			

List of Experiments

1. Preparation and study of the Microstructure of pure metal

2 Preparation and study of the Microstructure of Mild Steel

3 Rockwell Hardness Tests

4 Tension Test

5. Study on Characterization techniques of Nanomaterials

6. Compression Nanomaterials: Synthesis and Applications

II Year I Semester	L	P	C
	3	0	3
24CC3E13 :: NON DESTRUCTIVE EVALUATION (ELECTIVE – V)			

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

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 2 Training for NDT : E. A. Gingel, Prometheus Press,
3. ASTM Standards, Vol 3.01, Metals and alloys

II Year I Semester	L	P	C
	3	0	3
24CC3E14 :: COMPUTER GRAPHICS (ELECTIVE – V)			

COURSE OUTCOMES: Students can able to
CO1: Explain the, computer input devices, hard copy devices. [K2]
CO2: Apply mathematical principles in Line drawing algorithms [K3]
CO3: Explain Polygon clipping, character clipping, 3D- clipping. [K2]
CO4: Summarize the principles of Cartesian and homogeneous coordinate systems[K3]
CO5: Explain about algorithms, shading algorithm, Comparison of shading algorithms[K2]

UNIT - I
Introduction to computer graphics: Color CRT raster scan monitors, plasma display & liquid crystal display monitors, computer input devices, hard copy devices.

UNIT - II
Raster scan graphics: Line drawing algorithms – DDA & Bresenham algorithms, circle generation, general function rasterization, displaying lines, characters and polygons. Filling algorithms: polygon filling, edge fill algorithm, seed fill algorithm, fundamentals of antialiasing and half toning.

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

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

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

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

II Year I Semester	L	P	C
	3	0	3
24CC3E15 :: QUALITY ENGINEERING INMANUFACTURING (ELECTIVE-V)			

UNIT - I

QUALITY VALUE AND ENGINEERING: An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances.(N-type,S- type and L-type)

UNIT II

TOLERANCE DESIGN AND TOLERANCING: Functional limits, tolerance design for N- type. L-type and S-type characteristics, tolerance allocation fbr multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

UNIT – III

ANALYSIS OF VARIANCE (ANOVA): Introduction to ANOVA, Need for ANOVA, NO- way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT - IV

ORTHOGONAL ARRAYS: Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

UNIT - V

SIX SIGMA AND THE TECHNICAL SYSTEM: Six sigma DMAIC methodology, tools for process improvement, six sigma in services and small organizations, statistical foundations, statistical methodology.

TEXT BOOK:

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill/ Intl. II Edition,1995.

REFERENCES:

1. Quality Engineering in Production systems by G. Taguchi, A. Elsayed et al, McGraw Hill Intl.Pub 1989.
2. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi *I* Prentice Hall Pvt.Ltd. New Delhi

II Year I Semester	L	P	C
	3	0	3
24CM3O01 :: BUSINESS ANALYTICS (OPEN ELECTIVES)			

UNIT I

BUSINESS ANALYTICS: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II

TRENDINESS AND REGRESSION ANALYSIS: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT III

ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS: Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV

FORECASTING TECHNIQUES: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Model Curriculum of Engineering & Technology PG Courses Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V

DECISION ANALYSIS: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT VI

RECENT TRENDS IN: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

REFERENCE:

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

II Year I Semester	L	P	C
	3	0	3
24CC3O02 :: INDUSTRIAL SAFETY (OPEN ELECTIVES)			

UNIT-I

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

UNIT-II

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

UNIT-III

WEAR AND CORROSION AND THEIR PREVENTION: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV

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

UNIT-V

PERIODIC AND PREVENTIVE MAINTENANCE: Periodic inspection-concept and need, egreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

REFERENCE:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

II Year I Semester	L	P	C
	3	0	3
24CC3O03 :: OPERATIONS RESEARCH (OPEN ELECTIVES)			

UNIT 1
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT 2
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT 3
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT 4
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT 5
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

REFERENCES:
1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

II Year I Semester	L	P	C
	3	0	3

24MB3O04 :: COST MANAGEMENT OF ENGINEERING PROJECTS (OPEN ELECTIVES)

UNIT- I

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decisionmaking; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT- II

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre-project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with
significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT- III

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing,Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning,Enterprise Resource Planning, Total Quality Management and Theory of constraints.

UNIT- IV

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT- V

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TEXT BOOKS/ REFERENCE BOOKS:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

II Year I Semester	L	P	C
	3	0	3
24CC3O05 :: COMPOSITE MATERIALS (OPEN ELECTIVES)			

UNIT–I:

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

UNIT – II

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III

MANUFACTURING OF METAL MATRIX COMPOSITES: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV

MANUFACTURING OF POLYMER MATRIX COMPOSITES: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V

STRENGTH: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximumstrain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

II Year I Semester	L	P	C
	3	0	3
24PE3O06 :: WASTE TO ENERGY (OPEN ELECTIVES)			

UNIT-I

INTRODUCTION TO ENERGY FROM WASTE: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT-II

BIOMASS PYROLYSIS: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III

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

UNIT-IV

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

UNIT-V

BIOGAS: Properties of biogas (Calorific value and composition) - Biogas plant technology and status Bio energy system - Design and constructional features - Biomass resources and their classification Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass sification pyrolysis and liquefaction - biochemical conversion - anaerobic digestion Types of biogas Plants Applications - Alcohol production from biomass - Bio diesel production Urban waste to energy conversion - Biomass energy programme in India.

REFERENCES:

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