DEPARTMENT OF MECHANICAL ENGINEERING
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING
INDUS UNIVERSITY

M.TECH (CAD/CAM), SEMESTER –I TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2016

Sr. No.	Sub. Code	Name of the subject	CREDIT	Teaching scheme (per week)				Examination Scheme					Total Marks
								Theory			Practical		
								MID	CIE	END SEM	CIE	END SEM	
				Th.	Tut.	Pr.	Total (hr)	Th	Th	Th	Pr.	Pr.	
1	CC101	Advanced Machine Design	04	03	02	00	05	30	10	60	00	00	100
2	CC102	Advanced Computer Aided Design	04	03	00	02	05	30	10	60	40	60	200
3	CC103	Advanced Computer Aided Process Planning	04	03	02	00	05	30	10	60	00	00	100
4	CC104	Product Design & Life Cycle Management	04	03	02	00	05	30	10	60	00	00	100
5	CC105	Advanced Computer Integrated Manufacturing	04	03	00	02	05	30	10	60	40	60	200
6	CC106	Mechanical Behavior of Engineering Material (EL-I)	04	03	02	00	05	30	10	60	00	00	100
7	CC107	Automation in Production System (EL-I)											
8	CC108	Mechatronics (EL-I)											
9	CC109	Soft Computing Laboratory	02	00	00	04	04	00	00	00	40	60	100
		TOTAL	**26**	**18**	**08**	**08**	**34**	**180**	**60**	**360**	**120**	**180**	**900**

DEPARTMENT OF MECHANICAL ENGINEERING
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

INDUS UNIVERSITY

M.TECH (CAD/CAM), SEMESTER –II TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2016														
Sr. No.	**Sub. Code**	**Name of the subject**	**CREDIT**	**Teaching scheme (per week)**				**Examination Scheme**						
								Theory			**Practical**		**Total Marks**
								MID	**CIE**	**END SEM**	**CIE**	**END SEM**	
				Th.	**Tut.**	**Pr.**	**Total (hr)**	**Th.**	**Th.**	**Th.**	**Pr.**	**Pr.**	
1	CC210	Advanced Kinematics and Dynamics of Machines	04	03	02	00	05	30	10	60	00	00	100
2	CC211	Finite Element Method	04	03	00	02	05	30	10	60	40	60	200
3	CC212	Robotics & Artificial Intelligence	04	03	00	02	05	30	10	60	40	60	200
4	CC213	Engineering Optimization	04	03	02	00	05	30	10	60	00	00	100
5	CC214	Flexible Manufacturing System	04	03	02	00	05	30	10	60	00	00	100
6	CC215	Rapid Prototyping (DE-II)	04	03	02	00	05	30	10	60	00	00	100
7	CC216	Computerized Reliability & Maintenance Engineering (DE-II)											
8	CC217	Composite Materials (DE-II)											
		TOTAL	**24**	**18**	**08**	**04**	**30**	**180**	**60**	**360**	**80**	**120**	**800**

DEPARTMENT OF MECHANICAL ENGINEERING
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING
INDUS UNIVERSITY

M.TECH (CAD/CAM), SEMESTER –III TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017														
Sr. No.	Sub. Code	Name of the subject	CREDIT	Teaching scheme (per week)				Examination Scheme					Total Marks
								Theory			Practical		
								MID	CIE	END SEM	CIE	END SEM	
				Th.	Tut.	Pr.	Total (hr)	Th.	Th.	Th.	Pr.	Pr.	
1	CC0301	Dissertation Phase - I	20	00	00	40	40	00	00	00	150	150	300
		TOTAL	**20**	**00**	**00**	**40**	**40**	**00**	**00**	**00**	**150**	**150**	**300**

INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING
INDUS UNIVERSITY

M.TECH (CAD/CAM), SEMESTER –IV TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017														
Sr. No.	**Sub. Code**	**Name of the subject**	**CREDIT**	**Teaching scheme (per week)**				**Examination Scheme**					**Total Marks**
								Theory			**Practical**		
								MID	**CIE**	**END SEM**	**CIE**	**END SEM**	
				Th.	**Tut.**	**Pr.**	**Total (hr)**	**Th.**	**Th.**	**Th.**	**Pr.**	**Pr.**	
1	CC0401	Dissertation Phase - II	20	00	00	40	40	00	00	00	150	150	300
TOTAL			**20**	**00**	**00**	**40**	**40**	**00**	**00**	**00**	**150**	**150**	**300**

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

Department of Mechanical Engineering, IITE,

Indus University

1st Semester

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

Subject: Advanced Machine Design								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC101**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course Objective

This course enables the student to identify failure modes and evolve design by analysis methodology. Design against fatigue failure is given explicit attention.

Course Outcome

This course enriches the student with state of the art design methodology namely design by analysis and damage tolerant design.

Content

UNIT-I **[12]**

Introduction:

Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples.

Fatigue of Materials

Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods, Fatigue design criteria, Fatigue testing, Test methods and standard test specimens,

UNIT-II **[12]**

Design for Fatigue:

S-N curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress

effects, Different factors influencing S-N behavior, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using SN approach.

Fatigue from Variable Amplitude Loading:

Spectrum loads and cumulative damage, Damage quantification and the concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach

UNIT-III **[08]**

Fracture Mechanics:

Introduction, Modes of fracture failure – Brittle & Ductile, Griffith theory of brittle fracture, LEFM concepts, Crack tip plastic zone, Fracture toughness, Fatigue crack growth, Mean stress effects, Crack growth life estimation.

UNIT-IV **[14]**

Design for Creep:

Introduction, Deformation mechanism, Larson – Miller parameter in accordance to creep design

Surface Failure:

Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength

Reference Books:

1. Robert L. Norton , “Machine Design”, Pearson Education India, 2000
2. John, V. Harvey, “Pressure Vessel Design: Nuclear and Chemical Applications”, Affiliated East West Press Pvt. Ltd., 1969
3. Prashant Kumar, “Elements of Fracture Mechanics”, Wheeler Publishing, New Delhi-1999
4. V. Rammurti, “Computer Aided Mechanical Design and Analysis”, Tata Mc Graw Hill-1992
5. L. S. Srinath, “Advanced Solid Mechanics”, Tata McGraw-Hill, 2002

6. Burr and Cheatham**,** “Mechanical analysis & Design”, Prentice Hall, 1995

Subject: Advanced Computer Aided Design								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC102**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	30/60	30/60	20/40	20/40	200

Course objective

1. To understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication.
2. To impart the 2D and 3D modeling skills to the students.
3. To develop understanding of how CAD technology can be used in the design process.

Course outcomes:

1. Students will be able to design different parts of mechanical equipments.
2. Able to describe the principles of Computer Aided Designing systems and the concepts of Geometric modeling, solid modeling, and feature-based design modeling.

Content

UNIT-I **[07]**

Computer Graphics:

Windowing and Clipping algorithms, Bresenham's circle and ellipse generating algorithms, Three Dimensional geometric transformations, multiple transformations.

UNIT-II **[11]**

Geometric Modeling:

Dimensions of models, Types, Wire frame modeling, Solid modeling, Parametric representation of analytic curves-Line, Circle, Ellipse, parabola, hyperbola, conics. Parametric representation of Synthetic curves- Hermite cubic curves, Bezier curves, B-spline curves, rational curves. Curve manipulations-displaying, evaluating points on curves, Blending, segmentation, Trimming, Intersection.

UNIT-III **[10]**

Surface models, surface entities, Parametric representation of analytic surfaces-planed and ruled surfaces, Surface of revolution, Tabulated cylinder, Parametric representation of synthetic surfaces-Hermite bicubic, Bezier and B-spline surfaces, Coons surface, offset surface, Triangular patches, sculptured surface, Rational parametric surface. Surface Manipulations-Displaying, evaluating points & curves on surfaces, segmentation, Trimming, Intersection, Projection.

Surfaces & solids – model, entities, representations, fundamentals of surface and solid modeling, B-rep, constructive solid geometry (CSG), analytical modeling, sweep.

UNIT-IV **[14]**

Assembly and Modeling Software Standards:

Introduction, assembly modeling-Parts modeling and representation, Hierarchical relationships, Mating conditions. Inference of position from mating conditions. Representation schemes- Graph structure, Location graph, Virtual link, generation of assembly sequences-Precedence diagram, Liaison-Sequence analysis, Precedence graph, Assembly analysis programs.

Graphics Standards:

Graphics database structure and handling, Operating features, Symbols, micros. Editing facility, Data selection, Graphic transformation, Plotting. Graphic standards-GKS and CORE, GKS-3D and PHIGS, IGES, Other graphic standards.

Reference Books:

1. D Hearn & M P Baker, "Computer Graphics", Prentice Hall

2. Ibrahim Zeid & R Sivasubramanian, ". CAD/CAM Theory and Practice", Tata McGraw-Hill
3. W.M. Neumann and F Robert, "Principles of Computer Graphics", McGraw-Hill Co., Singapore
4. J Rooney & P Steadman, "Principles of CAD", Longman Higher Education
5. H P Groover and E W Zimmers, "CAD/CAM", Prentice Hall
6. Rodger Burden, "PDM: Product data Management", Resource Publishing

Advanced Computer Aided Design Laboratory

List of Experiments/Practical

Sr. No.	Practical/ Experiment title
1	Computer program for scan converting a line using Bresenham's algorithm.
2	Computer program for scan converting a circle using Bresenham's algorithm.
3	Computer program for 2D rotation of rectangle
4	Computer program for 3D transformations of a parallelepiped find the transformed coordinates of eight corners of the parallelepiped.
5	Computer program for solving a quadratic equation ax^2+ b*x + c for five sets of coefficients a, b, c stored in a data file.
6	Use Booleans operations for displaying 2D & 3D models. Use CADian software.

Subject: Advanced Computer Aided Process Planning								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC103**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course Objectives:

1. To understand what is process planning and ACAPP,
2. To know the various steps involved in ACAPP,
3. To classify the various methods of ACAPP, and
4. To understand the feature recognition in ACAPP.
5. To understand the various coding systems.
6. To understand the modulus structure.

Course Outcomes:

1. Use of design principles and develop conceptual and engineering design of any components.
2. Ability to integrate the parts design with assembly and ability to prepare manufacturing drawings.
3. Students will able to understand how to generate the report by using Process Planning.

Content

UNIT-I **[08]**

Introduction:

The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology

UNIT-II **[12]**

Part Design Representation

Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input / output devices - topology - Geometric transformation - Perspective transformation - Data structure – Geometric modeling for process planning - GT coding - The Optiz system - The MICLASS system.

UNIT-III **[08]**

Process Engineering And Process Planning:

Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, Al

UNIT-IV **[14]**

Computer Aided Process Planning Systems:

Logical Design of a Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

An Integrated Process Planning Systems:

Totally integrated process planning systems - An Overview - Modulus structure - Data Structure, operation - Report Generation, Expert process planning

Reference Books:

1. Gideon Halevi and Roland D. Weill, "Principles of Process Planning ", A logical approach, Chapman & Hall, 1995.
2. TienChien Chang, Richard A.Wysk, "An Introduction to automated process planning systems ", Prentice Hall, 1985.
3. Chang, T.C., "An Expert Process Planning System ", Prentice Hall, 1985.
4. Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing ", John Wiley & Sons, 1996.

5. Rao, “Computer Aided Manufacturing ", Tata McGraw Hill Publishing Co., 2000.

Subject: Product Design & Life Cycle Management								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC104**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course objective:

1. To study about scope of product development and design engineering.
2. To study about life cycle management.
3. To study about product design consideration.

Course outcomes

1. Able to predict success of product in life cycle.
2. Able to perform effective and strategic business management in product life cycle management.

Content

UNIT-I **[08]**

Introduction:

Nature and scope of product engineering - creative thinking and organizing for product innovation, criteria for product success in life cycle of a product, Characteristics of successful product development, Design and development of products, duration and cost of product development, challenges of product development.

UNIT-II **[12]**

Modelling and simulation:

Modeling and simulation - The role of models in product design, Mathematical modeling, and Simulation relations - weighted property index.

Material selection:

Material selection - problems of material selection-performance characteristics of materials - the materials - selection process-economics of materials-cost versus performance relations.

UNIT-III **[08]**

Design considerations:

Functional and production design-form design-influence on basic design, Mechanical loading and material on form design - form design of gray castings, malleable iron castings, aluminium castings, pressure die castings, plastic moldings, welded fabrications, forging and manufacture by machining methods. Influence of space, size, weight, etc. on form design, Aesthetic and ergonomic considerations

UNIT-IV **[14]**

Product life cycle management:

Concept, Product life cycle, Design for disposal, Design for repair, Design sense, approaches, applications

Reference Books:

1. Jones J.C., "Design Methods", Interscience, 1970.
2. Dieter, G.E., "Engineering Design", McGraw Hill, 1983.
3. Robert Matouseek, "Engineering Design", Blackie & Sons Ltd., 1963.
4. Niebel, B.W. & Draper, A.B., "Product Design and Process Engineering, McGraw Hill, 1974.
5. Harry Peck, "Designing for Manufacturing", Sir Issac Pitman and Sons Ltd., 1973.
6. Wade, Or., "Tolerance Control in Design and Manufacture", Industrial Press, Inc.
7. Arthur E. Mudge, "Value Engineering: A Systematic Approach", Mc GrawHill

Subject: Advanced Computer Integrated Manufacturing								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC105**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	30/60	30/60	20/40	20/40	200

Content

UNIT-I **[08]**

Introduction:

Introduction to CIM Concepts & Scope of CIM, Nature & Type of Manufacturing System, Evolution, Benefits of CIM, Role of Manufacturing Engineers, CIM Wheel.

Group Technology And Computer Aided Production Management:

History Of Group Technology – role of G.T in CAD/CAM Integration – part families-classification and coding – DCLASS and MCLASS and OPTIZ coding systems – facility design using G.T – benefits of G.T – cellular manufacturing.

Process planning: role of process planning in CAD/CAM. PPC fundamentals, Problems with traditional PPC approaches to computer aided process planning – variant approach and generative approaches –., Use of Computer in PPC, MRPI, MRPII, CAGC etc. CAPP and CMPP systems

UNIT-II **[12]**

Constructional Features of CNC Machines:

CNC Machine building, structural details, guide ways –Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion –

,open loop and closed loop control, - Spindle Cooling System.

Tooling And Work Holding Devices:

Introduction to cutting tool materials – HSS, Carbides, Ceramics, CBN, PCD, classification of inserts, tooling system for CNC Machining center and Turning center, Automatic Tool changers, work holding devices for rotating and fixed work parts, Automatic Pallet changer, economics of CNC, maintenance of CNC machines. Feedback devices

UNIT-III **[08]**

Part Programming For CNC Machines:

Numerical Controls, Types, Evolution of Controllers, Components of NC/CNC System, Specification of CNC System. Classification of NC/CNC Machines, Transducers Used, Salient Features, Tape, Tape Codes and Tape Readers Used in NC Machines, Constructional Details of CNC Machines, Axis Designation, NC/CNC Tooling. Fundamentals of Manual Part Programming, Types of Format, Word Address Format, Manual Part Programming for Drilling, Lathe and Milling Machine Operations, Subroutines, Do Loops, Canned Cycles and Parametric Sub Routines. Automated Programmed Tools Language- Its Types of Statement, Command and Programming

UNIT-IV **[14]**

Networking and Communication in CIM:

Concepts, functions in CIM systems, CIM networking, hardware & software, protocols and standards used. Data exchange format, evolution- features of various interfaces GKS, IGES, DXF, PDES, STEP etc. Communication modes, Data base management, system and their architecture.

Rapid Prototyping:

Introduction, Methods of Rapid Prototyping (subtraction, addition), Stereo lithography, Rapid tooling, FDM, 3-D Printing, LOM and SLS

Reference Books:

1. Zeid,I., "CAD - CAM Theory and Practice ", Tata McGraw-Hill Publishing Co. Ltd., 2007.
2. Radhakrishnan, P., “Computer Numerical Control ", New Central Book Agency, 1992.
3. Rao, P.N., “CAD/CAM”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.
4. Computer Network and communications By V.K. Jain and Narija Bajaj, Cyber Tech Publications, New Delhi.
5. Computer Networks Tanenbaum Prentice Hall of India , New Delhi.
6. Singh, N., “Systems Approach to Computer-Integrated Design and Manufacturing”, Wiley India Pvt. Ltd., 2011.

Advanced Computer Integrated Manufacturing Laboratory

List of Experiments/Practical

Sr. No.	Practical/ Experiment title
1	Exercise in manual part programming of CNC lathe & Milling machines. Use of CAD/CAM software for simulation of turned and milled parts and simple surfaces.
2	Automatic NC part program generation from CAD model and post processing for machining on CNC machines.

Subject: Mechanical Behavior of Engineering Materials (DE-1)								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC106**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

COURSE OBJECTIVES:

1. To understands fundamental structure and mechanical behavior of engineering materials.
2. To understands engineering failure and structural design aspects of various materials.
3. To understands failure analysis and prevention of unexpected failure of engineering materials.
4. To understands origin of stress and strain in material and the resulting deformation/fracture response of materials.

COURSE OUTCOME:

After studying this subject students will be able to understands,

1. Various types of deformation and failure of engineering materials subjected to various static and dynamic loadings.
2. Correlate microscopic and macroscopic material behaviors.
3. Learn how to engineer the material properties to meet certain specifications.
4. Determine the safety factor for various possible failure modes and loadings.
5. Obtain hands-on-experience with standardized mechanical testing techniques and learn how to present/interpret the measurements in a formal report.

Content

UNIT-I **[08]**

Concept of stresses and strains, types of loading and temperatures encountered in energy applications, stress – strain diagram for different engineering materials,

concepts involved, theoretical estimation of parameters related to strength of engineering materials, elastic behavior of metals, ceramics and polymers

UNIT-II **[12]**

Hydrodynamic and deviatoric stress, octahedral stress, yield criteria, yield surface, distortion of yield surface, true stress and strain, strain hardening, Ramberg-Osgood equations, plastic deformation of energy materials

UNIT-III **[08]**

Uni-axial and bi axial tension test, Bridgemann conception, Bauschinger effect, torsion test, bend test, strain hardening, power law approximations, isotropic, kinematic and combined hardening models, temperature dependence of flow stress, deformation theory of plasticity.

UNIT-IV **[14]**

Fracture in metals, ceramics and polymers, different types, fracture mechanics – KIC, elastic plastic fracture mechanics, JIC, ASTM standards of measurement. Design for fatigue, effect of environment, effect of microstructure on KIC and JIC, their importance in the design of metals, ceramic & polymers, S – N curves, life cycle prediction.

Time dependent deformation, different stages of creep, stress rupture, creep mechanism, creep under multi axial loading, design of creep resistant alloys, high temperature deformation of ceramics and polymers, visco- elasticity, rheological models, Maxwell and Voigt models

Reference Books:

1. Willium D Callister Jr, "Fundamental of Material Science of Engg,", John willey & sons
2. George E Dieter, "Mechanical Metallurgy", Mcgraw Hill, 1988
3. Domimique Frances, "Mechanical Behavior of Materials", Springer, 2012
4. W F Hosford, "Mechanical Behavior of Material, Cambridge University Press, 2005

Subject: Automation in Production System (DE-1)								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC107**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course Objectives and Outcomes:

Content

UNIT-I **[08]**

Introduction:

Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools, Mechanical feeding and tool changing and machine tool transfer.

Automated flow lines:

Methods of work part transport, Mechanical buffer storage control function, design and fabrication consideration

UNIT-II **[12]**

Analysis of Automated flow lines:

General terminology and analysis of transfer lines without and without buffer storage, partial automation, implementation of automated flow lines.

Assembly system and line balancing:

Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT-III **[08]**

Automated material handling:

Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems. Automated storage systems, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT-IV **[14]**

Adaptive control systems:

Introduction, adaptive control with optimization, Adaptive control with constraints, Application of A.C. in Machining operations. Use of various parameters such as cutting force, Temperatures, vibration and acoustic emission.

Business process Re-engineering:

Introduction to BPE logistics, ERP, Software configuration of BPE, concurrent Engineering, Techniques of Rapid Proto typing.

Reference Books:

1. M.P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", PHI
2. Yoram Coreom, "Computer control of Manufacturing Systems", Mcgraw Hill, 1983
3. Radhakrishnan., "CAD / CAM/ CIM", New Age International Publishers, 2/e, 2000
4. W. Buekinsham, "Automation", PHI Publications, 2004

Subject: Mechatronics (DE-1)								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC108**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course Objectives and Outcomes:

Content

UNIT-I **[08]**

Introduction:

Mechatronics, Measurement Systems, Basic Electrical Elements, Kerchoeff's Law, Voltage And Current Sources and Meters, Thevenin and Norton Equivalent Circuits, Alternating Current Circuit Analysis, Power in Electrical Circuits, Transformer, Impendence Matching, Grounding and Electrical Interference.

UNIT-II **[12]**

Semiconductor Electronics:

Introduction, Semiconductor Physics as the Basis for Understanding Electronic Devices, Junction Diode, Bipolar Junction Transistor, and Field Effect Transistors.

UNIT-III **[08]**

Microcontroller Programming and Interfacing:

Microprocessor and Microcomputers, Microcontrollers, The PIC16F84 Microcontroller, Programming a PIC, Pic Basic Pro, Using Interrupts, Interfacing Common PIC Peripherals, Interfacing to the PIC,

Data Acquisition:

Introduction, Quantizing Theory, Analog-to-Digital Conversion, Digital-to-Analog (D/A) Conversion,

UNIT-IV **[14]**

Sensors:

Introduction, Position and Speed Measurement, Stress and Strain Measurement, Temperature Measurement Vibration and Acceleration Measurement, Pressure and Flow Measurement, Semiconductor sensors and Micro electromechanical Devices.

Actuators:

Introduction, Electromagnetic Principles, Solenoids and Relays, Electric Motors, DC Motors, Stepper Motors, Selecting a Motor, Hydraulics, Pneumatics,

Text Books:

1. Introduction to Mechatronics and Measurement Systems – David G. Alciatore, Michael B. Histand, TMH Publication.
2. Mechatronics – Principles, Concepts and Applications – Dan Necsulescu, Published by Pearson Education (Singapore)

Reference Books:

1. Mechanical Measurements– Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, Pearson Education.
2. Mechatronics -Principles, Concepts and Applications – Nitaigour Premchand Mahalik, Tata McGraw-Hill Publication.

Subject: Soft Computing Laboratory								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC109**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
0	0	4	2	0	30/60	0	20/40	100

Course Objectives and Outcomes:

Content

List of Experiments/Practical

Sr. No.	Practical/ Experiment title
1	MATLAB Basics
2	MATLAB for Mechanical Engineering problems
3	Neural Network based problems
4	Fuzzy Systems based problems
5	Genetic Algorithm based problems

Department of Mechanical Engineering, IITE,

Indus University

2nd Semester

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

Subject: Advance Kinematics and Dynamics of Machines								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC210**			**Semester: II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course objective

1. To study about computer aided design for four bar and slider crank mechanism.
2. To study about synthesis of mechanism.
3. To study of free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi degree of freedom linear and non- linear systems.
4. To study about experimental methods in vibration analysis.

Course outcomes

After successful completion of the course, student will be able to

1. Principles of kinematic synthesis, analysis and dynamics to planer mechanisms.
2. Formulate the mathematical models of real life engineering systems for vibration study.
3. Interpret the vibratory responses of multi degree of freedom systems and continuous system through experiments.
4. Ability to obtain linear mathematical models of real life engineering systems
5. Ability to use Lagrange's equations for linear and nonlinear vibratory systems

Content

UNIT-I **[08]**

Fundamentals and synthesis:

Degrees of Freedom, Determining Degree of Freedom, Synthesis, Paradoxes, Isomers,

Linkage Transformation, Dimensional Synthesis, Coupler Curves, Position Analysis.

UNIT-II **[12]**

Computer Aided Analysis and Synthesis of Mechanisms:

Computer Aided Analysis for Four Bar Mechanism, Computer Aided Analysis For Slider Crank Mechanism, Synthesis of Mechanisms: Function generation, Path generation and Body guidance.

UNIT-III **[08]**

Vibration:

Introduction to Single degree freedom systems, Duhamel's Integral, Impulse Response function, Virtual work, Lagrange's equation, Single degree freedom forced vibration with elastically coupled viscous dampers, Transient Vibration, Free vibration of spring-coupled system, Mass coupled system, Vibration of two degree freedom system, Forced vibration of spring-coupled system, Mass coupled system, Nonlinear stiffness, Vibration Absorber, Vibration Isolation, Introduction to continuous systems, linear vibration of bar, lateral vibration of string, transverse vibrations of the beam and torsional vibration of shaft, Orthogonality of eigenvectors.

UNIT-IV **[14]**

Experimental Methods in Vibration Analysis:

Vibration instruments, Vibration exciters Measuring Devices, Analysers, signal processing; modal parameter identification; vibration trouble-shooting and diagnosis; time-domain and frequency-domain vibration analysis.

Text Books:

1. Robert L Norton, Design of Machinery, McGraw-Hill Publishing.
2. Theory of Machines by S.S. Rattan, Tata McGraw Hill Companies
3. Mechanical Vibrations, S. S.Rao, Pearson Eduction.

Reference Books:

1. Theory of Machines by R.K. Bansal, S Chand

2. Theory of Machines and Mechanisms by Shigley, Pennock and Uicker, Oxford University Press.
3. Mechanical Vibrations S. Graham Kelly and Shashidar K.Kudari, , McGraw-Hill Publishing
4. Engineering Vibration Inman D J Pearson Education.
5. Modal Testing: Theory and Practice Ewins D.J John Wiley.
6. Principles of Vibrations Control A.K. Mallik, Affiliated East-West Press Pvt. Ltd.

Subject: Finite Element Method								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC211**			**Semester: II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	30/60	30/60	20/40	20/40	200

Course Objectives

1. To present the Finite element method (FEM) as a numerical method for engineering analysis of continua and structures
2. To present Finite element formulation using variational and weighted residual approaches
3. To present Finite elements for the analysis of bars & trusses, beams & frames, plane stress & plane strain problems and 3-D solids, for thermal and dynamics problems.

Course Outcomes

On completion of the course the student will be

1. Knowledgeable about the FEM as a numerical method for the solution of solid mechanics, structural mechanics and thermal problems
2. Developing skills required to use a commercial FEA software

Content

UNIT-I **[08]**

Basic concepts, History of FEM, approximate method vs exact solutions, Comparison of FEM with exact solutions, General procedure for FEM. Stress and equilibrium, strain – displacement relations, stress strain relations, potential energy approach, Element shapes, nodes, nodal unknowns, coordinate systems, shape functions. Variational methods, weighted residual techniques, weak formulation

UNIT-II **[12]**

Introduction, finite element modeling, coordinates and shape functions, the potential energy approach, element stiffness matrix, derivation of body and traction forces for 1-D FEM, assembly of global stiffness matrix and load vector, treatment of boundary conditions, basics of quadratic shape functions, temperature effects, numerical.

UNIT-III **[08]**

Trusses:

Introduction, Plane trusses, 2D and 3D trusses, derivation of stiffness matrix**,** numerical examples

2-D FEM using CST:

Introduction, finite element modeling, CST: Isoperimetric representation, potential energy approach, element stiffness, force terms, numerical examples

Isoparametric formulation, element types, numerical integration, error analysis, Extension to multi-dimensional problems

UNIT-IV **[14]**

Dynamic analysis using finite elements:

Introduction, equation of motion using Lagrange's approach, consistent and lumped mass matrices, form of finite element equations for vibration problems, some properties of Eigen pairs, solution of Eigen value problems, transient vibration analysis.

Nonlinear analysis using finite elements:

Introduction, classifications of nonlinearities.

Reference Books:

1. T. Chandrupatla and A. G. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall Inc., 2002
2. Rao S S, "The Finite Element Method in Engineering" Butterworth-Heinemann, 2010
3. J. N. Reddy, "Introduction to the Finite Element Method", McGraw-Hill Education, 2005

4. Fish & Belytschko., "A First Course in Finite Elements", Wiley, 2007
5. Zienkiewicz & Taylor, "The Finite Element Method", 5/e, Butterworth-Heinemann, 2000
6. Thompson, "Introduction to the FEM: Theory, Programming and Applications".

Finite Element Method Laboratory

List of Experiments/Practical

Sr. No.	Practical/ Experiment title
1	To find deflection and stresses in one dimensional bar problem and validate with analytical method.
2	To find deflection and stresses in cantilever beam problem and validate with analytical method.
3	To find temperature distribution and heat transfer in one dimensional bar problem and validate with analytical method.
4	To find frequency and mode shapes of Fixed-Fixed beam and validate with analytical method.
5	To study two dimensional structural problem using FE software.
6	To study two dimensional axis symmetric problem using FE software.
7	To study three dimensional structural problem using FE software.

Subject: Robotics & Artificial Intelligence								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC212**			**Semester: II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	30/60	30/60	20/40	20/40	200

Course Objective

1. To be familiar with the automation and brief history of robot and applications.
2. To give the student familiarities with the kinematics of robots.
3. To give knowledge about robot end effectors and their design.
4. To learn Practical application of Artificial intelligence in day today life.
5. To give knowledge about Genetic algorithms, Neural network & its practical applications.

Course Outcomes

1. Students will be equipped with the automation and brief history of robot and applications.
2. Students will be familiarized with the kinematic motions of robot.
3. Students will have good knowledge about robot end effectors and their design concepts.
4. Students will be equipped with the Programming methods & various Languages of robots.
5. Students will be equipped with the concepts of Artificial intelligence

Content

UNIT-I **[08]**

Introduction to robotics:

Evolution of robots and robotics, laws of robotics, progressive advancements in robots, Robot anatomy, human arm characteristics, Coordinate frames, description of object in

space, transformation of vectors, inverting a homogeneous transform, fundamental rotation matrices.

UNIT-II **[12]**

Direct & Inverse kinematic model:

Mechanical structure and notations, description of links and joints, kinematic modeling of the manipulator, Denavit – Hartenberg notation, kinematic relationship between adjacent links, manipulator transformation matrix, Manipulator workspace, solvability of inverse kinematic model, solution techniques, closed form solutions.

UNIT-III **[08]**

Manipulator differential motion and statics:

Linear and angular velocity of a rigid body, relationship between transformation matrix and angular velocity, mapping velocity vector, velocity propagation along links, manipulator Jacobian, Jacobian inverse and singularities, static analysis, Lagrangian mechanics, 2- DOF manipulator dynamic model, L – E formulation and N – E formulation and comparison of both the formulation methods, inverse dynamics.

UNIT-IV **[14]**

Introduction to Artificial Intelligence (AI):

The AI problems, the underlying assumption, what is an AI technique? The level of the model, criteria for success, Defining the problem as a state space search, production systems, problem characteristics, production system characteristics, issues in the design of search problems. Heuristic search techniques: Generate and test, hill climbing, best first search, problem reduction, constraint satisfaction, Means – Ends analysis.

Artificial Neural Networks, Fuzzy Logic & Genetic Algorithm:

Introduction, historical note, biological and artificial neurons, multilayer perception, modeling the problem, types of data involved, training, issues in ANN, applications of ANN in robotics, Introduction to fuzzy sets, classical sets, properties of classical sets and their operations, properties of fuzzy sets and their operations, classical vs fuzzy relations, introduction to fuzzy logic, fuzzy control and its applications in robotics,

Introduction to GA, genetic search, genetic programming, applications in robotics.

Reference Books:

1. R K Mittal and I J Nagrath, "Robotics and Control", Tata McGraw-Hill publication.
2. John. J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson education
3. E. Rich, K. Knight and S. B. Nair, "Artificial Intelligence", Tata McGraw-Hill publication
4. Amit Konar, "Artificial Intelligence and Soft Computing: Behavioral and Cognitive modeling of the human brain", CRC Press
5. Zilouchian and M. Jamshidi, "Intelligent control systems using soft computing methodologies", CRC Press

Robotics & Artificial Intelligence Laboratory

List of Experiments/Practical

Sr. No.	Practical/ Experiment title
1	Study of 6- axis Robotic arm.
2	Experiment of prismatic motion on 6- axis Robotic arm.
3	Experiment revolute motion on 6- axis Robotic arm.
4	Pick & place Experiment on Robotic arm.
5	Experiment on frame assignment.
6	Experiment on 3D rotation.
7	Experiment on Design of simple fuzzy washing machine that can decide the speed of its motor based on the dirt level, type and weight of the cloth.

Subject: Engineering Optimization								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC213**			**Semester: II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course Objectives and Outcomes:

Content

UNIT-I **[08]**

Introduction:

Historical background, engineering applications, statement of an optimization problem, classification of optimization problems, Johnson's method of optimization

UNIT-II **[12]**

Classical optimization techniques:

Introduction, single variable optimization, multivariable optimization with no constraints, multivariable optimization with equality constraints: solution by direct substitution and solution by the method of Lagrange multipliers, multivariable optimization with inequality constraints: Kuhn-Tucker conditions and constraint qualification

UNIT-III **[08]**

Linear programming: Graphical method, simplex method,

Nonlinear programming – One dimensional minimization methods:

Introduction, classification, unimodal function, (i) Elimination methods: unrestricted search, exhaustive search, Fibonacci method, golden section method, comparison of

elimination methods. (ii) Interpolation methods: quadratic interpolation method, direct root methods such as Newton method, Quasi-Newton method and Secant method.

UNIT-IV **[14]**

Concept of Optimization based Stochastic Programming: Probability fundamentals, Linear and Non-linear programming

Optimization Techniques : Genetic algorithms, Neural-Network-Based Optimization, Optimization of fuzzy systems

Reference Books:

1. Kalyanmoy Deb, "Optimization for Engineering Design", Prentice Hall of India
2. S.S. Rao, "Engineering Optimization", New Age International
3. E.J. Haug and J.S. Arora, "Applied Optimal Design", Wiley, New York
4. G.V. Reklaites, A. Ravindran and K.M, Rogsdeth, "Optimization", Wiley, New York

Subject: Flexible Manufacturing System								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC214**			**Semester: II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course Objectives and Outcomes:

Content

UNIT-I **[08]**

Flexible Manufacturing System:

Concept of Group technology, composite part families - classification and coding, the FMS concept-transfer systems - head changing FMS, Production flow analysis, Planning issues: Components of FMS, Types of flexibility, tradeoffs, Computer control and functions, Planning, scheduling and control of FMS, Scheduling and knowledge based scheduling.

UNIT-II **[12]**

FMS computer hardware and software, General structure and requirements, PLCs, FMS installation and implementation, Acceptance testing, Computer Software, Simulation and Database of FMS: System issues, Types of software, Specification and selection, Trends, Application of simulation, Software, Manufacturing data systems, Data flow, CAD/CAM considerations, Planning FMS database.

UNIT-III **[08]**

Turning and Machining Centers:

Introduction, Types ,Construction and Operation Performed on Turning enter,

Automated Features and Capabilities of Turning Centers, General Advantages and Disadvantages of Vertical and Horizontal Machining Centers, Pallet and Part Loading and Programming Options in Machining Centers, Automated features and capabilities of a Machining Centers

UNIT-IV **[14]**

Automated Material Movement and Storage System:

Introduction, Types of AGV and Their principle of working, Advantages, Limitation and General AGV Guide path, Robots, Benefits of using Industrial Robots, Basic components and benefits of Automated Storage and Retrieval Systems, Conveyors and Pallet Flotation System, Queuing Carrousels and Automatic Work Changers, Coolant and Chip Disposal and Recovery system.

FMS Installation and Implementation

Reference Books:

1. Flexible Manufacturing System H. K. Shivanand, M. M. Benal, V. Koti, New Age Pub.
2. Automation, Production Systems and Computer Integrated Manufacturing, Groover M.P, Prentice Hall of India.
3. Approach to Computer Integrated Design and Manufacturing Nanua Singh, John Wiley and Sons, 1998.
4. Flexible Manufacturing Cells and Systems Luggen -

Subject: Rapid Prototyping (DE-2)								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC215**			**Semester: II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course Objectives and Outcomes:

Content

UNIT-I **[08]**

Introduction:

Historical Development, Fundamentals of RP, Advantages of RP, Classification of RP, RP Process: Process chain, 3D modeling, data conversion and transmission, checking and preparing, building, post processing.

UNIT-II **[12]**

Liquid Based RP System:

3D systems' SLA, Cubital's SGC, Sony's SCS, Other similar commercial RP systems, micro fabrication.

UNIT-III **[08]**

Solid Based RP System:

Helisys' LOM, Stratasys' FDM, 3D systems MJM, Other similar commercial RP systems.

UNIT-IV **[14]**

Powder Based RP Systems:

DTM's selective laser sintering (SLS), MIT's 3D printing (3DP), BPM Technology's

ballistic particle manufacturing (BPM)

Rapid Prototyping Data formats:

STL format, STL file problem, Consequences of building a valid and invalid tessellated model, STL file repair, newly proposed formats.

Text Books:

1. Rapid Prototyping: Principles and Applications - Chua Chee Kai, Leong Kah Fai, Lim Chu-Sing, World Scientific Pub Co.
2. Rapid Manufacturing – D.T. Pham and S. S. Dimov, Springer Publication.

Reference Books:

1. Rapid Prototyping : Theory and Practice - Ali Kamrani, Emad Abouel Nasr (Editors), Springer Publication
2. Rapid Prototyping: Principles and Applications- Rafiq I. Noorani, Wiley.
3. Rapid Prototyping -- Andreas Gebhardt, Hanser Gardner Publications

Subject: Computerized Reliability & Maintenance Engineering (DE-2)								
Program: M. Tech. (CAD/CAM)				Subject Code: CC216			Semester: II	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	2	0	4	30/60	0	20/40	0	100

Course Objectives and Outcomes:

Content

UNIT-I **[08]**

Generalized Reliability and Maintenance Engineering: Reliability:

Introduction, Static and dynamic reliability, Reliability testing and management, Reliability and human engineering, Maintenance – Introduction, Type of maintenance, Maintenance planning, Maintenance strategy – Selection, formulation and characteristics, Design principles for optimizing maintenance model, Computer Aided Maintenance.

UNIT-II **[12]**

Statistical Methods in Reliability:

Statistical concepts of probability distributions, Methods for single sample (maximum likelihood estimation, goodness of fit, etc.), Conditional probability and its use in the analysis of dependent failures, Regression models for data, Proportional hazards modeling, Bayesian approach, Model for system reliability, Monte carlo simulation, Solution through computer programming for any one statistical analysis

UNIT-III **[08]**

Modeling and Analysis of Reliability and Maintenance Practices:

Organization and management of reliability data. Data banks and data storage and retrieval system Calculation of reliability parameters like; MTTF, MTBF MTTR etc from failure Data, Reliability in terms of hazard rate and failure density, Constant hazard model, Linearly increasing hazard and the Weibull Model, Reliability and availability function, A r – out – of – n – structure, Calculation of reliability from FMEA and FTA

UNIT-IV **[14]**

Software Reliability:

Software reliability concept, Software life cycle, Historical software reliability techniques, Current trends and problems and possible future directions, Software reliability models – Static and dynamic models, Reliability Growth Modeling with Covariates, When to stop testing software, Capabilities and comparisons of commercially available reliability and maintenance software, Software based case study

Advancement in Reliability and Maintenance:

Condition monitoring - WDM, SPM, Reliability Centered Maintenance, Maintenance Information System, TPM and Kaizan, Computerized Maintenance Management System, Use of heuristic approach in Reliability and Maintenance Engineering, Industrial case studies

Reference Books:

1. R. C. Mishra, Reliability and Maintenance Engineering, New Age International Publication
2. L.S. Srinath, Concepts of Reliability Engg., Affiliated East-Wast Press (P) Ltd., 1985
3. B.S. Dhillion, C. Singh, Engineering Reliability, John Wiley & Sons, 1980.
4. M.L. Shooman, Probabilistic, Reliability, McGraw-Hill Book Co., 1968
5. Charles Ebeling, An Introduction to Reliability and Maintenability Engineering
6. Michael R. Lyu, Software Reliability Engineering - A Roadmap
7. Hoang Pham, Handbook of Reliability Engineering, Springer
8. ASM Handbook Volume - 11, Failure Analysis and Prevention

Subject: Composite Materials (DE-2)								
Program: M. Tech. (CAD/CAM)				**Subject Code: CC217**			**Semester: II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	30/60	0	20/40	0	100

Course Objectives and Outcomes:

Content

UNIT-I **[08]**

Basic concepts and characteristics:

Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.

Reinforcements:

Fibers- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Metal matrix and ceramic composites.

UNIT-II **[12]**

Micromechanics:

Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

UNIT-III **[08]**

Manufacturing methods:

Autoclave, tape production, bag moulding process, filament winding, hand layup,sprayup techniques, pultrusion, RTM.

UNIT-IV **[14]**

Coordinate transformations:

Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

Elastic behavior of unidirectional composites:

Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

Text Books:

1. Mechanics of Composite Materials – R. M. Jones, McGraw Hill Company, New York
2. Analysis and performance of fibre Composites – B. D. Agrawal and L. J. Broutman, Wiley – Inderscience, New York.

Reference Books:

1. Analysis of Laminated Composite Structures – L. R. Calcote, Van Nostrand Rainfold, New York, 1969.
2. Engineering Mechanics of Composite Materials – Isaac, M. Daniel, Oxford University Press.

Department of Mechanical Engineering, IITE,

Indus University

3rd Semester

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

Subject**: Dissertation Phase I**								
Program: **M-TECH CAD/CAM**				Subject Code: CC0301			Semester**: III**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
0	0	40	20	00	150	00	150	300

Department of Mechanical Engineering, IITE,

Indus University

4th Semester

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

Subject**: Dissertation Phase II**								
Program: **M-TECH CAD/CAM**				Subject Code: CC0401			Semester**: IV**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
0	0	40	20	00	150	00	150	300