Courses of Study

(Detailed Course Contents)

Post-graduate & Integrated Programmes

(2024-2025)

Shri Mata Vaishno Devi University

Kakryal, Katra 182320 Jammu & Kashmir

VISION

Establishment of a Scientific & Technical University of Excellence to nurture young and talented human resources for the service of Indian Society & world at large and preserving the integrity and sanctity of human values.

MISSION

The mission of the University is the pursuit of Education, Scholarship and Research at the highest International level of excellence.

OBJECTIVES

- Provide education and training of excellent quality, both at undergraduate and postgraduate level.
- Ensure that the University achieves and maintains an international standing in both teaching and research
- Promote study and research in new and emerging areas and encourage academic interaction of the faculty and the students at national and international levels.
- Encourage close collaboration with industry and facilitate the application of research for commercial use and for the benefit of society.

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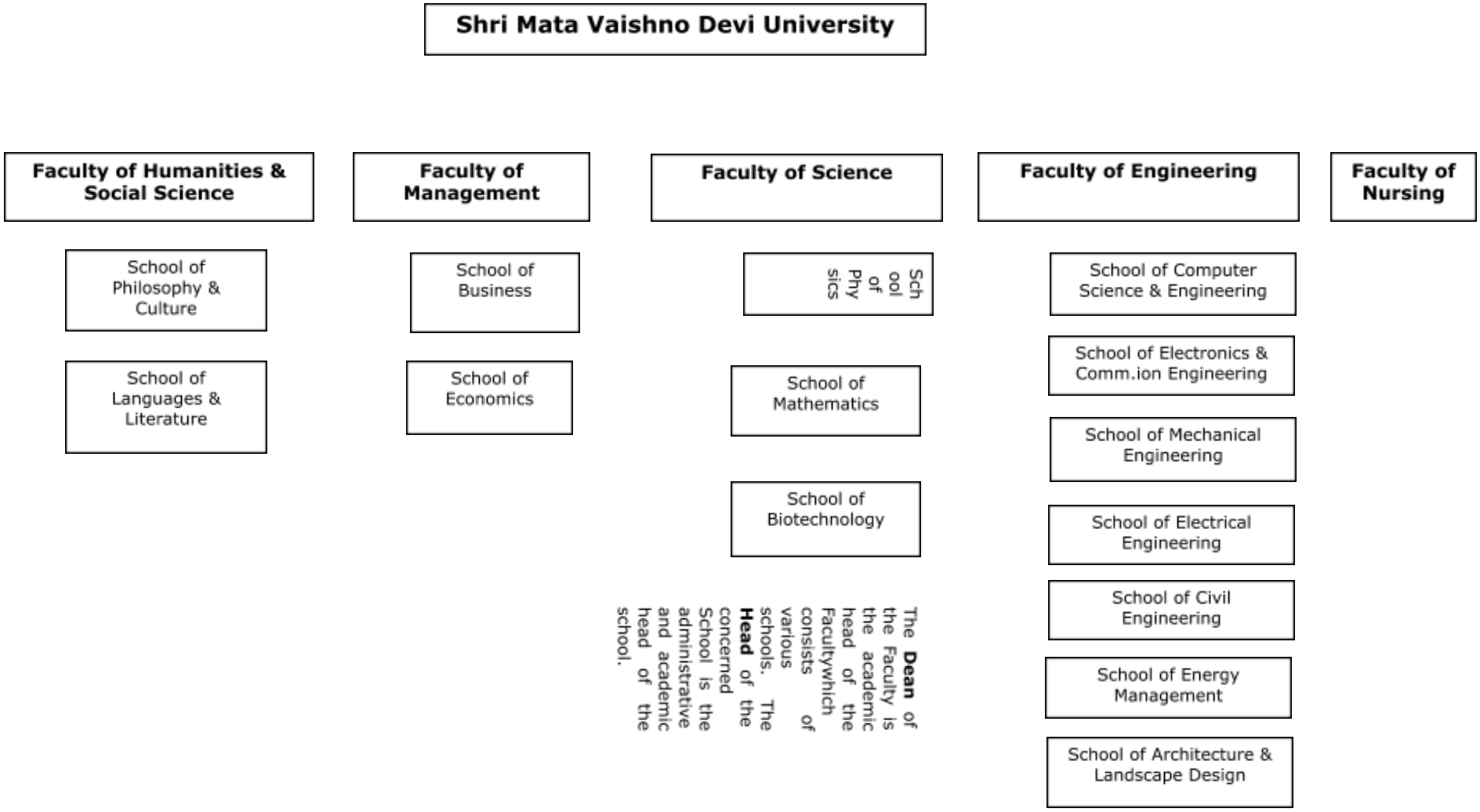
CONTENTS

Academic Structure of the University



1.0 Introduction

Shri Mata Vaishno Devi University (SMVDU) has adopted the Indian Institutes of Technology (IIT) pattern of teaching and examination system in its endeavor to attain academic excellence. The University is offering graduate and postgraduate programs since 2004. The university also offers programs leading to award of PhD degree. The programs being offered from the academic session 2013-14 are mentioned below.

2.0 Programs of study

The following programs of study are being offered by the university in the academic session 2013-14.

Undergraduate Programs

1. Bachelor of Technology in Computer Science & Engineering
2. Bachelor of Technology in Electronics & Communication Engineering
3. Bachelor of Technology in Mechanical Engineering
4. Bachelor of Technology in Industrial Biotechnology
5. Bachelor of Architecture

Post-graduate Programs

1. Master of Business Administration
2. Master of Technology (Manufacturing & Automation)
3. Master of Technology (Computer Science & Engineering)
4. Master of Technology (Electronics & Communication Engineering)
5. Master of Technology (Energy Management) (Part-Time Program)
6. Master of Arts (Philosophy)
7. Master of Arts (English)
8. Master of Sciences (Mathematics)
9. Master of Sciences (Physics)
10. Master of Sciences (Biotechnology)

PhD Programmes

3.0 Academic System, Rules & Regulations

Details of

Programme of Study

&

Syllabus of Courses

Offered by

School of Mechanical Engineering (M.Tech)

Vision of the School

Mission of the School

Details of Programs Offered

Details of Minor & Interdisciplinary Specialization Offered (if any)

Pedagogy

Infrastructure

Course Structure of
M. Tech (Mechanical Engineering) programme
M. Tech in Mechanical Engineering
with specialization in Smart Manufacturing
Two Year Full Time Degree
(Entry Batch 2024 Onwards)

Semester I **First Year**

S. No	Course Type	Course code	Course Title	L	T	P	Credit
1	Core -I	MEL DC 601	Automation in Manufacturing Systems	3	0	0	3
2	Core-II	MEL DC 603	Design for Manufacturing	3	0	0	3
	Core-III	MEL DC 605	Materials Selection Strategies	3	0	0	3
3	Program Elective-I	MEL DE 601	Modeling and Simulation of Manufacturing Systems	3	0	0	3
		MEL DE 603	Kinematics and Dynamics Of Robots				
		MEL DE 605	Introduction to ML & AI				
		MEL DE 607	Planning and control of Manufacturing Systems				
		MEL DE 609	Applied Operation Research				
4	Core	MEP DC 601	Industrial Automation Lab	0	0	2	2
5	Core	MEP DC 603	Computer Aided Manufacturing lab	0	0	2	2
6	Core	MEL DC 607	Research Methodology	3	1	0	4
7	Audit		Audit -1	2	0	0	NC
Total Credit							20

Semester II **First Year**

S. No	Course Type	Course code	Course Title	L	T	P	Credit
1.	Core-IV	MEL DC 602	Mechatronics for Advance Manufacturing	3	0	0	3
2.	Core-V	MEL DC 604	Additive Manufacturing	3	0	0	3
3.	Program Elective-II	MEL DE 602	Computer Integrated Manufacturing Systems	3	0	0	3
		MEL DE 604	MEMS & NEMS				
		MEL DE 606	Applied AI for Manufacturing				
		MEL DE 608	Design for Internet of Things				
		MEL DE 610	Smart Maintenance				
4.	Program Elective-III	MEL DE 612	Sustainable Manufacturing	3	0	0	3
		MEL DE 614	Human Machine Interfaces for Manufacturing				
		MEL DE 616	Industrial IoT and Cloud Computing				
		MEL DE 618	Cyber-Physical Systems for Manufacturing				
		MEL DE 620	Data Analytics for Manufacturing				
		MEL DE 622	Supply Chain Management				
5.	Core	MEP DC 602	Mechatronics for Advance manufacturing Lab	0	0	4	2
6.	Core	MEP DC 604	Additive Manufacturing Lab	0	0	4	2
11.	Core	MED PR 602	Mini Project	0	0	8	4
12.	Audit		Audit 2	2	0	0	NC

Total Credit	20

Audit 1 & 2

1. Constitution of India
2. Presentation skills and technical writing
3. Disaster Management
4. Discourse of Human Virtues

Semester III **Second Year**

S. No	Course Type	Course code	Course Title	L	T	P	Credit
3.	Dissertation	MED PR 701	Dissertation Phase-I/Internship	0	0	40	20
Total Credit							**20**

Semester IV **Second Year**

S. No	Course Type	Course code	Course Title	L	T	P	Credit
3.	Dissertation	MED PR 702	Dissertation Phase-II/Internship	0	0	40	20
Total Credit							**20**

List of Departmental/School Core Courses (DCC)

S. No	Course Code	Course Title	L	T	S/P	Credit
1	CSL DEXXX		3	1	0	4
2	CSP DEXXX		3	1	0	4

List of Departmental/School Core Electives (DEC)

S. No	Course Code	Course Title	L	T	S/P	Credit
1	CSE DEXXX		3	1	0	4
2	CSE DEXXX		3	1	0	4

List of Basic Science Courses Offered by School (BSC)

S. No	Course Code	Course Title	L	T	S/P	Credit
1	CSL BSXXX		3	1	0	4
2	CSP BSXXX		3	1	0	4

List of Engineering Science Courses Offered by School (ESC)

S. No	Course Code	Course Title	L	T	S/P	Credit
1	CSL ESXXX		3	1	0	4
2	CSP ESXXX		3	1	0	4

List of General Elective Courses Offered by School (GEC)

S. No	Course Code	Course Title	L	T	S/P	Credit
1	CSE GEXXX		3	1	0	4
2	CSE GEXXX		3	1	0	4

List of Ability Enhancement Courses Offered by School (AEC)

S. No	Course Code	Course Title	L	T	S/P	Credit
1	CSL AEXXX		3	1	0	4
2	CSL AEXXX		3	1	0	4

List of Skill Enhancement Courses Offered by School (SEC)

S. No	Course Code	Course Title	L	T	S/P	Credit
1	CSL SEXXX		3	1	0	4
2	CSL SEXXX		3	1	0	4

List of Value Addition Courses Offered by School (VAC)

S. No	Course Code	Course Title	L	T	S/P	Credit

1	CSL VAXXX		3	1	0	4
2	CSL VAXXX		3	1	0	4

List of Vocational Courses Offered by School (VOC)

S. No	Course Code	Course Title	L	T	S/P	Credit
1	CSL VOXXX		3	1	0	4
2	CSP VOXXX		3	1	0	4

Template for Detailed Syllabus for Various Courses
(Use the most appropriate Template for the course)
(Some courses like NSS, NCC may not require Approx. contact hours in the Table Below)
Template –I

Semester – 1- Sr No. 1 Core I

Course Code : **MEL DC 601**
Course Title : **Automation in Manufacturing Systems**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Engineering Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Fundamentals of Manufacturing: Production system facilities, Manufacturing support systems, Automation in Production systems, Automation Principles and Strategies, Manufacturing operations, Product, production, relationship.	
2	Construction elements for automation, Automated work piece handling, working principles and techniques for feeding arrangement, transfer mechanism, etc., Assembly automation, Automated packaging, Automated inspection, etc.	
3	Industrial Control: Industrial Control systems, Sensors, Actuators and other control systems, Discrete controls using PLC & PLC. Power Hydraulics and pneumatics: Concepts, features and parameters governing the section of various components necessary for building the elements, Circuit Design and Analysis, Industrial Application of fluid power and pneumatic systems, electro-hydraulic Servo system, Fluid logic control, MPL, Fluidics logic control.	
4	PLC: Introduction, Micro PLC, Programming a PLC, Logic functions, input & output modules, PLC processors, PLC instructors, Documenting a PLC system, Timer and counter Instructions, comparison & data handling instructions, sequencing instructions, mask data representation, typical PLC programming, exercises for industrial applications.	
5	Data acquisition system, Evolution of SCADA, Communication Technologies, Monitoring and Supervisory Functions.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Performance Modelling of Automated Manufacturing systems, Vishwanandham, PHI	
2	Fluid Power system, by Goodwin, Mc Graw Hills Press Ltd.	
3	Principles and applications of PLC by Webb, Mc Milan	
4	Principles of CIM, By Vajpayee, PHI	
5	Automated Production system and CIM, by Michael P. Grover, Pearson Education,Asia	
6	Fluid Power with application 6 Th edition, by Anthony Esposito, PHI	
7	Mechatronics, by W, Bolton, Longman, Anderson Wiseley/li	
8	Stuart A.Boyer, "SCADA: 'Supervisory control and Data Acquisition', 4th Edition, ISA, 2010.	
Reference Books		

1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Understand the fundamentals of automation technologies used in manufacturing processes.	CO1
2	Apply principles of robotics and control systems to automate manufacturing tasks.	CO2
3	Evaluate the role of sensors and actuators in automated manufacturing systems.	CO3
4	Design and implement automated manufacturing systems using software tools like PLC programming and HMI (Human Machine Interface) design	CO4

Semester – 1- Sr No. 2 Core II

Course Code : MEL DC 603
Course Title : Design for Manufacturing
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction: Need Identification and Problem Definition. Concepts of Design for Manufacturing (DFM); Role of DFM in product specification and standardization, Concept Generation and Evaluation, Embodiment Design	
2	Selection of Materials and Shapes: Properties of Engineering Materials, Selection of Materials, Selection of shapes, Co-selection of materials and shapes, Case studies,	
3	Selection of Manufacturing Processes: Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Co-selection of Materials and Processes, Case studies.	
4	Design for Assembly: Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case Studies.	
5	Design for Reliability and Quality: Failure Mode and Effect Analysis, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	M FAshby and K Johnson, Materials and Design - the art and science of material selection in product design,Butterworth-Heinemann, 2003.	
2	G Dieter,Engineering Design - a materials and processing approach, McGraw Hill, NY, 2000.	
3	M FAshby, Material Selection in Mechanical Design,Butterworth-Heinemann, 1999.	
4	G Boothroyd,P Dewhurst and W Knight,Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.	
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	Identify product specification and standardization.	CO1
2	Select material, shape, and manufacturing process.	CO2
3	Provide robust design in terms of quality and reliability.	CO3
4	Optimize the design.	CO4

Semester – 1- Sr No. 2 Core III

Course Code : MEL DC 605
Course Title : Material Selection Strategies
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Engineering Materials and their properties	
2	Introduction to Materials Selection Software	
3	Material property charts	
4	Strategy for Materials Selection	
5	Materials Selection involving multiple constraints and / or conflicting objectives	
6	Hybrid Materials	
7	Bio-inspired Materials	
8	Material processes and process Selection.	
9	The Material Life-Cycle and Environment-friendly Selection.	
10	Failure analysis and materials Selection for Durability	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Ashby, M. F. Materials Selection in Mechanical Design, 4th ed. Burlington: Elsevier, 2011. Print.	
2	Farag, M. M. Materials and Process Selection for Engineering Design, 3rd ed. Boca Raton: CRC Press, 2013, Print.	
3	Ashby, M. F., Hugh Shercliff, and David Cebon. Materials: Engineering, Science.	
4	Processing and Design, 4th ed. Kidlington, Oxford, United Kingdom: Butterworth Heinemann, 2019. Print.	
5	Raman, A. Materials Selection and Applications in Mechanical Engineering. New York: Industrial Press, 2007. Print.	
6	Dieter, G. E. Mechanical Metallurgy, 3rd ed. New York: McGraw-Hill, 1986. Print	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Able to understand the basic knowledge of materials and their characterization	CO1
2	Able to understand the requirement of materials in terms of basic characterization	CO2
3	Able to understand how to select the material for a particular job/parts/machine	CO3
4	Able to select sustainable material for a particular job/parts/machine	CO4

Semester –I - Sr No. 3 Programe elective - I

Course Code : MEL DE 601
Course Title : Modeling and Simulation of Manufacturing Systems
L-T-P/S=Credits :
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Chapter I: Introduction to Modeling: Concept of System, Understand the manufacturing systems, Continuous and Discrete System, Understand the basic concept of mathematical model, Types of Models, Understand the deterministic as well as stochastic mathematical model, develop the mathematical model for a given manufacturing systems, analyze the complexity of mathematical model	
2	Chapter II: Introduction to Simulation: Discrete, Continuous, Normal, Poisson and Empirical Distributions, Out Put Data Analysis for a Single System, Steps in Simulation Study, Comparing Alternative System Configuration Statistical Procedures for Comparing Real World Observations with Simulation Out Put Data, Generations of Arriving Processes, Verification and Validation of Simulation Models	
3	Chapter III: Different types of simulation: Generation of random number, Motnte Carlo Simulation, Queing Models and Its Applications in and Inventory Models, Different types of simulation for stochastic systesm	
4	Chapter IV: Simulation of Manufacturing and Material Handling Systems: Understand the basic MATLAB, for and while loops in MATLAB, different functions of MATLAB, Case Studies on Simulation Packages	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Dynamic modelling and control of Engineering Systems, by Bohdan T. Kulakowski, John F. Gardner, and J. Lowen Shearer	
2	System Modeling & Simulation, by V P Singh.	
3	Modelling & Simulation of Systems Using Matlab & Simulink, by Devendra K Chaturvedi.	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Acquire basic knowledge of modelling and simulation.	CO1
2	Apply their knowledge for making mathematical model of manufacturing systems.	CO2
3	Able to analyze the complexity of mathematical model	CO3
4	Able to perform the simulation the mathematical model of manufacturing systems.	CO4

Semester –I - Sr No. 3 Programe elective - I

Course Code : MEL DE 603
Course Title : KINEMATICS AND DYNAMICS OF ROBOTS
L-T-P/S=Credits :
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction, position and orientation of objects, objects coordinate frame Rotation matrix, Euler angles Roll, pitch and yaw angles coordinate Transformations, Joint variables and position of end effector, Dot and cross products, coordinate frames, Rotations, Homogeneous coordinates.	
2	DIRECT KINEMATICS: Link coordinates D-H Representation, The ARM equation. Direct kinematic analysis for Four axis, SCARA Robot and three, five and six axis Articulated Robots.	
3	INVERSE KINEMATICS: The inverse kinematics problem, General properties of solutions. Tool configuration, Inverse kinematics of four axis SCARA robot and three and five axis, Articulated robot.	
4	WORKSPACE ANALYSIS AND TRACJECTORY PLANNING: Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique - continuous path motion, Interpolated motion, straight line motion and Cartesian space teclmique in trajectory planning.	
5	MANIPULATOR DYNAMICS: Introduction, Lagrange's equation kinetic and potential energy. Link inertia Tensor, link Jacobian Manipulator inertia tensor. Gravity, Generalized forces, Lagrange-Euler Dynamic model, Dynamic model of a Two-axis planar robot, Newton Euler formulation, Lagrange Euler formulation, problems	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009.	
2	Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.	
3	P.A. Janaki Raman, Robotics and Image Processing An Introduction, Tata Me Graw Hill Publishing company Ltd., 1995.	
4	Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.	
5	Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993	
6	Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, MIT Press., 2003.	
7	John J. Craig, Introduction to Robotics Mechanics and Control, Third Edition, Pearson, 2008.	

8	Bijay K. Ghosh, Ning Xi, T.J. Tam, Control in Robtics and Automation Sensor - Based integration, Academic Press, 1999	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	To control both the position and orientation of the tool in the three dimensional space.	CO1
2	The relationship between the joint variables and the position and the orientation of the tool.	CO2
3	Planning trajectories for the tool to follow on order to perform meaningful tasks.	CO3
4	To precisely control the high speed motion of the system.	CO4

Semester –I - Sr No. 3 Programe elective - I

Course Code : MEL DE 605
Course Title : Introduction to ML and AI
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to AI & ML History of AI, Comparison of AI with Data Science, Need of AI in Mechanical Engineering, Introduction to Machine Learning. Basics: Reasoning, problem solving, Knowledge representation, Planning, Learning, Perception, Motion and manipulation. Approaches to AI: Cybernetics and brain simulation, Symbolic, Sub-symbolic, Statistical. Approaches to ML: Supervised learning, Unsupervised learning, Reinforcement learning.	
2	Feature Extraction and Selection Feature extraction: Statistical features, Principal Component Analysis. Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in Mechanical Engineering.	
3	Classification & Regression Classification: Decision tree, Random forest, Naive Bayes, Support vector machine. Regression: Logistic Regression, Support Vector Regression. Regression trees: Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in Mechanical Engineering.	
4	Development of ML Model Problem identification: classification, clustering, regression, ranking. Steps in ML modeling, Data Collection, Data pre-processing, Model Selection, Model training (Training, Testing, K-fold Cross Validation), Model evaluation (understanding and interpretation of confusion matrix, Accuracy, Precision, Recall, True positive, false positive etc.), Hyper parameter Tuning, Predictions.	
5	Reinforced and Deep Learning Characteristics of reinforced learning; Algorithms: Value Based, Policy Based, Model Based; Positive vs Negative Reinforced Learning; Models: Markov Decision Process, Q Learning. Characteristics of Deep Learning, Artificial Neural Network, Convolution Neural Network. Application of Reinforced and Deep Learning in Mechanical Engineering.	
6	Applications Human Machine Interaction, Predictive Maintenance and Health Management, Fault Detection, Dynamic System Order Reduction, Image based part classification, Process Optimization, Material Inspection, Tuning of control algorithms.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.	
2	B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020.	
3	Parag Kulkarni and Prachi Joshi, “Artificial Intelligence – Building Intelligent Systems”,	

	PHI learning Pvt. Ltd., ISBN – 978-81-203-5046-5, 2015	
4	Stuart Russell and Peter Norvig (1995), “Artificial Intelligence: A Modern Approach,” Third edition, Pearson, 2003.	

Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	DEMONSTRATE fundamentals of artificial intelligence and machine learning.	CO1
2	APPLY feature extraction and selection techniques.	CO2
3	PPLY machine learning algorithms for classification and regression problems.	CO3
4	DEVISE AND DEVELOP a machine learning model using various steps.	CO4
5	EXPLAIN concepts of reinforced and deep learning.	CO5
6	SIMULATE machine learning model in mechanical engineering problems.	CO6

Semester – I - Sr No. 3 Programe elective - I

Course Code : MEL DE 607
Course Title : Planning and control of Manufacturing system
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Manufacturing Systems Types of manufacturing processes, Components of manufacturing systems, Trends and challenges in modern manufacturing, .	
2	Production Planning and Control Forecasting techniques, Aggregate planning, Material requirements planning (MRP), Capacity planning, Master production scheduling (MPS).	
3	Inventory Management Inventory control models (e.g., EOQ, JIT), ABC analysis, Inventory management techniques (e.g., safety stock, reorder point), Inventory optimization	
4	Scheduling Types of scheduling problems (e.g., job shop, flow shop), Scheduling algorithms (e.g., FCFS, SPT, EDD), Advanced scheduling techniques (e.g., genetic algorithms, simulated annealing)	
5	Quality Control Statistical process control (SPC), Six Sigma methodology, Total quality management (TQM), Quality assurance techniques,	
6	Computer-Based Systems for Manufacturing Manufacturing execution systems (MES), Enterprise resource planning (ERP) systems, Advanced planning and scheduling (APS) software, Simulation tools for manufacturing systems.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	"Introduction to Materials Management" by Tony Arnold, Stephen Chapman, and Lloyd Clive.	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Understand the fundamentals of manufacturing systems and their components.	CO1

2	Learn various techniques for production planning and scheduling.	CO2
3	Explore inventory management strategies and their impact on manufacturing efficiency.	CO3
4	Understand quality control methods and their role in manufacturing systems.	CO4
5	Gain hands-on experience with computer-based tools for manufacturing optimization.	CO5

Semester – I Sr No. 3 Programe elective - I

Course Code : MEL DE 609
Course Title : Applied Operation Research
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Operational Research Definition and scope of operational research, Historical development and applications, Overview of mathematical modeling and optimization techniques	
2	Linear Programming (LP) Formulation of LP problems, Graphical solution method, Simplex method and its variants, Sensitivity analysis,	
3	Integer Programming (IP) and Mixed Integer Programming (MIP) Formulation of IP and MIP problems, Branch and bound method, Cutting plane methods, Applications in resource allocation, scheduling, and network design	
4	Nonlinear Programming (NLP) Formulation of NLP problems, Unconstrained optimization methods (e.g., gradient descent, Newton's method), Constrained optimization methods (e.g., Lagrange multipliers, penalty methods),	
5	Simulation Modeling and Analysis Monte Carlo simulation method, Random number generation and sampling techniques, Input modeling and output analysis, Applications in queuing systems, inventory management, and project management	
6	Decision Analysis Decision trees and influence diagrams, Utility theory and risk analysis, Multi-criteria decision-making techniques, Applications in investment analysis, project selection, and risk management	
7	Heuristic and Metaheuristic Optimization Overview of heuristic methods (e.g., greedy algorithms, local search), Introduction to metaheuristic algorithms (e.g., genetic algorithms, simulated annealing, particle swarm optimization), Applications in combinatorial optimization and large-scale problems	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Operations Research: An Introduction" by Hamdy A. Taha.	
Reference Books		
1		

Course Outcome

Sr	Course Outcome	CO
1	Understand the principles and techniques of operational research.	CO1
2	Learn to formulate decision-making problems as mathematical optimization models..	CO2
3	Gain proficiency in using software tools for modeling and solving optimization problems.	CO3
4	Explore the application of simulation techniques for analyzing complex systems.	CO4
5	Develop skills in decision analysis and uncertainty modeling.	CO5

Semester – I Sr No.4 Core

Course Code : MEP DC 601
Course Title : Industrial Automation Lab
L-T-P/S=Credits : 0-0-4 =2
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents Lab Experiment	Approx. Contact Hours
1	Study of Pneumatic Valves used in automation, their specifications and working principle.	
2	Study of mechanical based automation devices for Single and Double Acting Cylinder.	
3	Study of Electro-mechanical automation devices for Single and Double Acting Cylinder.	
4	To develop a Double Acting Cylinder pneumatic circuit from two different remote sources.	
5	To develop a circuit for automatic sequences operation of two double acting Cylinders for extension and retraction process	
6	To develop 'OR' Logic, 'NOR' Logic, 'AND' Logic, and 'NAND' Logic using electro-mechanical devices.	
7	To study PLC and its wiring, timer and counter applications for manufacturing systems.	
8	To study PLC ladder programming and write programs for various logic circuits using toggle and push buttons.	
9	To develop Ladder diagram programs for a single/double acting Pneumatic cylinder using solenoid valves.	
10	Design a circuit for Speed Control of hydraulic motor meter-out circuit by employing 4/3 DC valve.	
11	Design and develop PLC program for Automatic Bottle filling system in Automation Plant.	
12	Design, develop and visualize application for Traffic Light Control using PLC.	
13	Design and develop PLC program for controlling Temperature of room using temperature sensor.	
14	To interface PLC and HMI and develop screens for various automation applications.	
15	Study of SCADA in controlling and monitoring the control of both local and remote processes using standard communication protocols	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1		
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Able to draw and design an automatic operation of pneumatic and hydraulic systems.	CO1
2	Able to understand PLC and make ladder diagram programs for various automated systems	CO2
3	Able to design, develop and visualize automation systems for various industrial applications.	CO3
4	Able to understand HMI and SCADA and its applications in industrial automation	CO4

Semester – I Sr No.5 Core

Course Code : MEP DC 603
Course Title : Computer Aided Manufacturing Lab
L-T-P/S=Credits : 0-0-2 =2
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents Lab Experiment	Approx. Contact Hours
1	Study of Computer Aided Manufacturing processes used in Industry. Difference between conventional and computer aided manufacturing.	
2	Study of basic systems, parts, and their functions of Fanuc Control system in CNC Turning centre.	
3	Study of basic systems, parts, and their function of Siemens Control system in CNC Vertical Milling Centre (VMC).	
4	Study of Tools/inserts used in CNC machines and their specifications	
5	Study of G Code and M-Code used in CNC Turning and VMC.	
6	Write a basic program to perform facing and turning operations on Wood/Acrylic /MS/Al-alloy work piece of suitable size on CNC Turning centre.	
7	Write a basic program to perform step turning and contour/groove operations on Wood/Acrylic /MS/Al-alloy work piece of suitable size on CNC Turning centre.	
8	Write a basic program to perform thread cutting and parting operations on Wood/Acrylic/MS/Al-alloy work piece of suitable size on CNC Turning centre.	
9	Write a program to perform surface milling on Wood/Acrylic/MS/Al-alloy work piece using CNC VMC.	
10	Write a program to perform rectangular and circular grooves on Wood/Acrylics/MS/Al-alloy work piece using CNC VMC	
11	Write a program to perform drilling operations on Wood/Acrylic/MS/Al-alloy work piece using CNC VMC.	
12	Study of parts, and their functions of ZNC Electrical discharge machine(EDM)	
13	Calculation of material removal rate, tool wear rate and surface finishing of advanced machining process (EDM/AJM/ECM).	
14	Study of parts and their functions of Rapid Prototyping Machining and perform machining operations using soft materials	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1		
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Able to understand CNC machines subsystems and functioning of CNC turning centers and its tools/ inserts for various machining operations.	CO1
2	Able to understand CNC machines subsystems and functioning of CNC VMC and its tools/ inserts for various machining operations.	CO2
3	Able to understand parts, functions and operations and calculations of machining parameters for materials using advanced machining methods (EDM/AJM/ECM/ Rapid Prototype Machine/ Water Jet Machine).	CO3

Semester – I Sr No. 6 Core

Course Code : MEL DC 607
Course Title : Research Methodology
L-T-P/S=Credits : 3-1-0 =4
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process	
2	Problem Identification & Formulation – Research Question – Investigation Question, Research Design: Concept and Importance in Research – Features of a good research design –Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, typesand uses. Experimental Design: Concept of Independent & Dependent variables.	
3	Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept ofmeasurement. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size,Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample,Systematic Sample, Stratified Random Sample & Multi-stage sampling. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts,percentages).	
4	Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Energy Science& Engineering, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing,Plagiarism and Self-Plagiarism.Use of Encyclopedias, Research Guides, Handbook etc.	
5	Use of tools / techniques for Research: methods to search required information effectively,Reference Management Software like Mendeley, Software for paper formatting likeLaTeX/MS Office, Software for detection of Plagiarism.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition	
2	Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press	
3	Research Methodology – C.R.Kothari	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	The student will be able to identify appropriate research topics and their parameters.	CO1
2	The student will be able to organize and conduct research in a scientific manner	CO2

3	The student will be able to write a research report, thesis, and research proposal (grants)	CO3

Semester – II- Sr No. 1 Core -IV

Course Code : MEL DC 602
Course Title : Mechatronics for Advance Manufacturing
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Basic Electronics & Computation:** Binary System, Boolean Algebra, Logic Gates, Digital Circuit Technologies, Rtl/Dtl/Dctl/Ttl/Mos/Cmos/Ecl, Analysis of Basic Circuits in these Families, Internal Architecture of Programmable Logic Devices, Combinational Design, Sequential Circuits, Flip-Flops, Counters, Shift Registers, Memory System - RAM ,ROM, EPROM. EEPROM, PAL, PLDS, PGAS. Hard Disk Drive Assembly, IC and their Characteristics	
2	**Components of a Mechatronic System**: Sensors:-Electric Position Sensors, Pneumatic Position Sensors, Comparison Between Different Position Sensors, Level Switches, Pressure Switches, Temperature Switches. Actuators:-Hydraulic, Pneumatic and Electric Actuators. Controllers:-Micro Controller and Microprocessor, PLC Mechanical Component:- Kinematic Chains, Cams, Gears Trains, Ratchet and Pawl, Belt And Chain Drives, Bearings, Ball Screws.	
3	**Signal Conditioning & Data Presentation System:** D-A and A-D Converters, Operational Amplifier; Protection, Filtering, Digital Signals, Multiplexers, Pulse Modulation, Data Acquisition, Digital Signal Processing; Pulse Modulation; Data Presentation Systems –Displays; Data Presentation Elements; Magnetic Recording; Data Acquisition Systems; Testing & Calibration, Interfacing D-A and A-D Converters.	
4	**Mechatronics Product Design:** Mechantronics Design Approach, Possible Mechatronics Design Solutions for Timed Switch, Wind Screen Wiper Motion, Bath Room Scale, Pick & Place Robot, Automatic Camera, Engine Management System & Bar Code Recorder. Software and Hardware Principles and Tools to Build Mechatronics System.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	1. Mechatronics by W. Bolton, Published by Addition Wesley.	
2	Mechatronics System Design – Devdas Shetty and Richard A. Kolx Brooks/ Cole 1997.	
3	Introduction to Mechatronics and Measuring System : david G. Alciation and Michael B. Hist and Tata McGraw Hill.	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Acquire basic knowledge of electrical and mechanical components.	CO1
2	Apply knowledge of signal and systems for developing control systems.	CO2
3	Able to develop automatic manufacturing systems	CO3

Semester – II- Sr No. 2 Core V

Course Code : MEL DC 604
Course Title : Additive Manufacturing
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction To Conceptual Design And CAD Introduction to Design Theories, develop a concept, implement a concept, creative methods for design, Introduction to CAD, CAD input devices, CAD output devices, CAD Software, Display Visualization Aids, and Requirements of Geometric Modelling, Transformations of Geometry, Developing algorithms/computer codes for transformations.	
2	Design Of Curves Hermite Cubic segments, Curve Trimming and Blending, Bezier segments, Bezier- subdivision, Degree elevation, Composite Bezier, Bspline, Properties of basic functions, Continuity, NURBS, Developing algorithms/computer codes for curves. Design Of Surfaces: Surface entities, surface representation, surface analysis, design of analytical and synthetic surfaces, Developing algorithms/computer codes for surfaces.	
3	Design Of Solids Solid entities, Boolean operations, B-rep of Solid Modeling, CSG approach of solid modeling, Advanced modelingmethods. CAD Data Exchange Formats and Applications: CAD Data exchange formats, Finite element analysis, 3D digitizing: Reengineering, Additive Manufacturing	
4	AM Data Formats Tessellated Models, STL Format, STL File Problems, STL File Manipulation and Repair Algorithms, AMF files, 3MF, XML, Meta Data, PLY, STEP for AM Application Protocols (AP).	
5	AM Data Processing: Part Orientation and Support Structure Generation, Model Slicing and Contour Data Organization, Direct and Adaptive Slicing, Hatching Strategies and Tool Path Generation. Modelling Of AM Process: Surface Roughness due to Staircase Effect, Part Build-time, Fabrication Cost, Optimal Orientation, Quantification of Building Inaccuracy and Part Stability.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Anupam Saxena, Birendra Sahay, “Computer Aided Engineering Design”, Springer, 2005.	
2	Patri K. Venuvinod and Weiyin Ma, “Rapid Prototyping: Laser-based and Other Technologies”, Springer, 2004.	
3	L. Lu, J. Y. H. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”, Springer, 2001.	

4	Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015.	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Apply conceptual design and geometric transformation techniques in CAD	CO1
2	Develop mathematical models to represent curves, surfaces and solids	CO2
3	Identify STL file problems and apply repair algorithms systems.	CO3
4	Determine part orientation for minimum build time and part errors	CO4
5	Modelling of AM Process for optimum part quality	CO5

Semester – II- Sr No. 3 Program Elective II

Course Code : MEL DE 602
Course Title : Computer Integrated Manufacturing systems
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to CIMS and MSME: Overview of manufacturing systems, Evolution and significance of CIMS, Role of computers in manufacturing, Integration of design, production planning, and control, Basics of microfabrication techniques, MEMS materials and processes, Applications of MEMS in various industries	
2	Manufacturing Automation and Integration: Industrial robotics and automation, Flexible manufacturing systems (FMS), Just-In-Time (JIT) manufacturing, Integration of CAD, CAM, and CNC with manufacturing automation. Case studies and applications of CIM systems in various industries.Integration of MEMS sensors and actuators with CIM systems for real-time monitoring and control.MEMS sensors and actuators: Accelerometers, gyroscopes, pressure sensors, and microvalves.	
3	Applications and Future Trends of CIMS and MSME: Current and emerging applications of CIMS and MEMS in consumer electronics, healthcare, automotive, and aerospace industries, Future trends and challenges in MEMS technology, Integration of MEMS with other systems such as IoT and wearable devices.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Automation, Production System and Computer Integrated Manufacturing, by Mikell P. Grover, Prentice Hall of India Pvt Ltd	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Understand the evolution and significance of Computer Integrated Manufacturing Systems (CIMS) and Microelectromechanical Systems (MEMS) in modern manufacturing.	CO1
2	Develop skills in integrating design, production planning, and control within manufacturing systems	CO2
3	Gain proficiency in manufacturing automation, including robotics and flexible manufacturing systems.	CO3
4	Evaluate current and emerging applications of CIMS and MEMS across industries, and anticipate future trends and challenges.	CO4

Semester – II- Sr No. 3 Program Elective II

Course Code : MEL DE 604
Course Title : MEMS AND NEMS
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Have a concept on the scope and recent development of the science and technology of micro- and nano-systems;	
2	Gain the physical knowledge underlying the operation principles and design of micro- and nano-systems;	
3	Learn some typical or potentially applicable micro- and nano-systems at the frontier of the development of the field	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Marc Madou, "Fundamentals of Micro fabrication", CRC press 1997.	
2	Stephen D. Senturia, "Micro system Design", Kluwer Academic Publishers,2001	
Reference Books		
1	Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill, 2002.	
2	Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006	

Course Outcome

Sr	Course Outcome	CO
1	Ability to understand the operation of micro devices, micro systems and their applications	CO1
2	CO2: Ability to design the micro devices, micro systems using the MEMS fabrication process.	CO2
3	CO3: Gain a knowledge of basic approaches for various sensor design	CO3
4	CO4: Gain a knowledge of basic approaches for various actuator design	CO4
5	Develop experience on micro/nano systems for photonics.	CO5
6	Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.	CO6

Semester – II Sr No. 3 Program Elevtive -II

Course Code : MEL DE 606
Course Title : Applied AI for Manufacturing
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Application of Machine Learning to Industrial Planning and Decision Making, Special Purpose Resource Design in Planning to Make More Efficient Plans;	
2	Geometric Reasoning Using a Feature Algebra, Backward Assembly Planning Symmetry Groups in Solid Model-Based Assembly Planning, An Expert System Approach for Economic Evaluation of Machining Operation Planning, Interactive Problem Solving for Production Planning	
3	An Abstraction-Based Search and Learning Approach for Effective Scheduling, ADDYMS: Architecture for Distributed Dynamic Manufacturing Scheduling, An Architecture for Real-Time Distributed Scheduling, Exploiting Local Flexibility During Execution of Pre-computed Schedules An Architecture for Integrating Enterprise Automation;	
4	An Intelligent Agent Framework for Enterprise Integration; Teamwork Among Intelligent Agents: Framework and Case Study in Robotic Service Symbolic Representation and Planning for Robot Control Systems in Manufacturing	
5	Integrated Software System for Intelligent Manufacturing; Enterprise Management Network Architecture: A Tool for Manufacturing Enterprise Integration; Design and Manufacturing: Integration through Quality Introduction to Digital Twin and Cyber-Physical Manufacturing Systems.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Fazel Famili (Editor), Dana S. Nau (Editor), Steven H. Kim (Editor); Artificial Intelligence Applications in Manufacturing, AAAI Press.	
2	Ellen Friedman, Ted Dunning, AI and Analytics in Production; O'Reilly Media, Inc., 2018 (ISBN: 9781492044116)	
3	Çağlayan Arkan, The Future Computed: AI and Manufacturing; Global Lead, Manufacturing and Resources Industry, Microsoft, 2019.	
4	A. Fazel Famili (Editor), Dana S. Nau (Editor), Steven H. Kim (Editor); Artificial Intelligence Applications in Manufacturing, AAAI Press	
5	Ellen Friedman, Ted Dunning, AI and Analytics in Production; O'Reilly Media, Inc., 2018 (ISBN: 9781492044116)	
6	Çağlayan Arkan, The Future Computed: AI and Manufacturing; Global Lead, Manufacturing and Resources Industry, Microsoft, 2019.	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Understand the capability of AI for production planning and decision making.	CO1
2	Understand the fundamental concepts of manufacturing scheduling and role of robot control system in manufacturing.	CO2
3	Realize application of Machine Learning to Industrial Planning and Decision Making	CO3
4	Develop a practical understanding of effective scheduling	CO4
5	Develop Integrated Software System for Intelligent Manufacturing and Planning for Robot Control Systems in Manufacturing	CO5

Semester – II- Sr No. 3 Program Elevtive II

Course Code : MEL DE 608
Course Title : Design for internet of Things
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Internet of Things (IoT) Design Overview of Internet of Things (IoT) concepts, evolution, and significance, Understanding the design principles and methodologies for IoT systems, Analysis of IoT architecture, including edge computing, fog computing, and cloud integration, Exploration of IoT communication protocols and standards	
2	Manufacturing Automation and Integration: IoT Device Design and Prototyping Design considerations for IoT devices: Size, power consumption, connectivity, and sensor integration.Prototyping techniques for IoT devices using development boards (e.g., Arduino, Raspberry Pi) and sensor kits.Introduction to PCB design for IoT devices and integration of wireless communication modules.Hands-on exercises and projects to develop IoT device prototypes.	
3	IoT Data Analytics and Visualization Understanding data collection, storage, and processing in IoT systems. Introduction to data analytics techniques for IoT data, including descriptive, diagnostic, predictive, and prescriptive analytics. Visualization techniques for representing IoT data and insights.Case studies and projects on IoT data analytics and visualization.	
4	Integration of IoT devices with cloud platforms and other backend systems, Design considerations for scalable and secure IoT deployments.Introduction to IoT deployment tools and platforms.Evaluation of real-world IoT deployment case studies and best practices. plications.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Wiley Publications	
2	Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications	
3	Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014.	
4	J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Learn the fundamental design principles and methodologies for developing IoT systems	CO1
2	Gain a comprehensive understanding of Internet of Things (IoT) concepts, evolution, and significance.	CO2
3	Understand data collection, storage, and processing in IoT systems	CO3
4	Understand design considerations for scalable and secure IoT deployments.	CO4
5	Develop critical thinking skills by evaluating real-world IoT deployment case studies and best practices.	CO5
6	Analyze the challenges and opportunities associated with designing and deploying IoT systems in various domains.	CO6

Semester – II- Sr No. 3 Program Elevtive II

Course Code : **MEL DE 610**
Course Title : **Smart Maintenance**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Engineering Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Machinery Maintenance**: Maintenance strategies: Reactive, Preventive, Predictive and CMMS, Benefits of planned maintenance, Bath tub curve, Failure Modes Effects and Criticality Analysis (FMECA).	06
2	**Fault Tracing**: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive,and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Electrical motors.	06
3	**Machine Health Monitoring:** Condition Based Maintenance, Signature Analysis, Oil Analysis, Vibration, Noise and Thermal Signatures, On Line & Off Line Techniques, Instrumentation & Equipment Used in Machine Health Monitoring, Signal Processing, Data Acquisition and Analysis, Application of Intelligent Systems.	08
4	**Maintenance data life-cycle management**: Data acquisition, data storage, data preprocessing, data visualization and applications. New data-driven technologies in maintenance	08
5	**Smart Maintenance**: Importance of Smart Maintenance, Four Pillars of Smart Maintenance: Data-Driven Decision-Making (DDD), Human Capital Resources (HCR), Internal Integration and External Integration. Technologies Involved in Smart Maintenance such as Digital Twins, Augmented Reality and Virtual Reality etc.	12

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	. R. Keith Mobley, Maintenance Fundamentals, Elsevier,	2011
2	Cornelius Scheffer and Paresh Girdhar, "Practical Machinery Vibration Analysis and Predictive Maintenance", Elsevier,	2004, 1st Edition.
3	A. R. Mohanty, Machinery Condition Monitoring: Principles and Practices, CRC Press, Taylor & Francis,	1st Edition, 2017.
4	R. C. Mishra & K. Pathak, Maintenance Engineering and Management	
5	Anthony Kelly, Maintenance Planning & control, East-West Pvt. Ltd.	
6	Jon Bokrantz, Smart Maintenance: Maintenance in Digitalized Manufacturing, published by Department of Industrial and Materials Science, Chalmers University of Technology	2019
7	Bolton W., Mechatronics, Pearson Education,	6th Edition, 2015.
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO

1	Able to understand the types of maintenance management strategies used in Industries	CO1
2	Able to detect, assess and analyses different types of defects in industrial machinery	CO2
3	Able to plan and implement condition based Maintenance in industry	CO3
4	Able to understand and implement Maintenance data management system	CO4
5	Able to understand smart maintenance and associate technologies in smart factory	CO5

Semester – II- Sr No. 4 Program Elevtive III

Course Code : **MEL DE 612**
Course Title : **Sustainable Manufacturing**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Engineering Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction to Sustainable Manufacturing** Overview of sustainable manufacturing: Concepts, principles, and significance.Environmental impacts of manufacturing processes: Energy consumption, resource depletion, and waste generation.Sustainable manufacturing practices: Resource efficiency, waste reduction, and pollution prevention.Regulatory frameworks and sustainability standards in manufacturing. Introduction to the environmental issues pertaining to the manufacturing sector – pressure to reduce costs – processes that minimize negative environmental impacts – environmental legislation and energy costs – acceptable practice in society – adoption of low carbon technologies – need to reduce the carbon footprint of manufacturing operations.	
2	**Sustainable Materials and Processes** Selection criteria for sustainable materials: Renewable resources, recycled content, and eco-friendly alternatives.Sustainable manufacturing processes: green chemistry, eco-design, and life cycle assessment (LCA).Sustainable supply chain management: Supplier evaluation, green procurement, and logistics optimization.Case studies of sustainable materials and processes in manufacturing industries. Cost and income based approaches, demand estimation methods – expressed and revealed preference, choice modeling – Multi-criteria analysis- Stakeholder analysis – Environmental accounting at sector and national levels.	
3	**Energy Efficiency and Renewable Energy in Manufacturing** Energy management strategies for sustainable manufacturing: Energy audits, efficiency improvements, and demand-side management.Integration of renewable energy sources in manufacturing: Solar, wind, hydro, and biomass energy.Energy-efficient technologies and best practices in industrial processes.Economic and environmental benefits of energy efficiency and renewable energy adoption. Challenges in logistics and supply chain – developing the right supply chain strategy for the products – need to align the supply network around the strategy – Tools that can be used systematically to identify areas for improvement in supply chains – Specific challenges and new thinking in the plan, source and delivering of subprocesses.	
4	**Sustainable Manufacturing Systems and Circular Economy** Design for sustainability in manufacturing systems: Lean manufacturing, Six Sigma, and total quality management (TQM) principles.Circular economy principles and their application in manufacturing: Reuse, remanufacturing, recycling, and closed-loop supply chains.Sustainable product design and extended producer responsibility (EPR).Case studies of companies implementing sustainable manufacturing systems and circular economy practices.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Atkinson G, Dietz S, Neumayer E, "Handbook of sustainable manufacturing" Edward Elgar Publishing limited, 2007	
2	Rodick, D, "Industrial Development for the 21 st century: Sustainable development perspectives" UN New York,2007	
3	Seliger, G, "Sustainable Manufacturing: Shaping Global Value Creation", Springer,2012	
4	Dornfeld, David., "Green Manufacturing", Springer-Verlag, New York,2012	
5	Davim, J.P.(2010), "Sustainable Manufacturing", John Wiley & Sons,2010	
6	Gupta, S.M. and Lambert, A.J.D., "Environment Conscious Manufacturing", CRC Press,2008.	
7	Douglas C.Montgomery, "Design and Analysis of Experiments", 5th Edition, John Wiley & Sons, 2012.	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Demonstrate a comprehensive understanding of sustainable manufacturing principles, practices, and regulations.	CO1
2	Apply sustainable material selection criteria and eco-design principles to minimize environmental impacts in manufacturing processes.	CO2
3	Implement energy management strategies and integrate renewable energy sources to improve energy efficiency in manufacturing.	CO3
4	Analyze and optimize manufacturing systems for resource efficiency, waste reduction, and pollution prevention.	CO4
5	Develop innovative solutions for sustainable product design and circular economy implementation in manufacturing.	CO5
6	Evaluate the economic, environmental, and social implications of sustainable manufacturing practices and propose strategies for continuous improvement.	CO6

Semester – II- Sr No. 4 Program Elevtive III

Course Code : **MEL DE 614**
Course Title : **Human Machine Interface for Manufacturing**
L-T-P/S=Credits : **3-0-0 =3**
Course Category : **Engineering Science Course**
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction to Human Machine Interfaces (HMIs)** Overview of HMIs: Definition, importance, and evolution in manufacturing.Principles of human-centered design: User experienc, usability, and ergonomics.Types of HMIs in manufacturing: Touchscreens, graphical user interfaces (GUIs), and augmented reality (AR).Case studies illustrating the impact of effective HMIs on manufacturing efficiency and operator performance.	
2	Manufacturing Automation and Integration: HMI Design and Development HMI design principles and guidelines: Information architecture, visual design, and interaction patterns.Tools and techniques for HMI prototyping and development: Interface design software, rapid prototyping methods, and usability testing.Integration of sensors and actuators with HMIs for real-time data visualization and control.Industry best practices for designing intuitive and efficient HMIs in manufacturing environments.	
3	Emerging HMI technologies: Natural language processing (NLP), gesture recognition, and haptic feedback.Integration of artificial intelligence (AI) and machine learning (ML) algorithms in HMIs for predictive maintenance and decision support.Human-robot collaboration (HRC) interfaces: Design considerations and safety standards.Case studies showcasing innovative applications of advanced HMI technologies in smart manufacturing.	
4	**HMI Deployment and Optimization** Deployment strategies for HMIs in manufacturing: System integration, scalability, and compatibility with existing infrastructure.Optimization techniques for improving HMI performance: Response time optimization, interface customization, and user feedback analysis.Maintenance and troubleshooting of HMIs: Diagnostic tools, remote monitoring, and software updates.Evaluation methodologies for assessing the effectiveness and usability of HMIs in manufacturing settings.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Human-Machine Interface Technology Advancements and ApplicationsEdited By Ravichander Janapati, Usha Desai, Shrirang Ambaji Kulkarni, Shubham Tayal	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Master the principles of Human Machine Interfaces (HMIs) and their applications in manufacturing.	CO1
2	Design intuitive and efficient HMIs using human-centered design principles and advanced technologies	CO2

3	Develop HMIs that enhance operator performance, productivity, and safety in manufacturing environments.	CO3
4	Implement HMIs integrated with sensors, actuators, and artificial intelligence for real-time data visualization and control.	CO4
5	Deploy and optimize HMIs for seamless integration into manufacturing systems,	CO5

Semester – II- Sr No. 4 Program Elevtive III

Course Code : MEL DE 616
Course Title : Industrial IoT and Cloud Computing
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Introduction to Internet of Things (IoT) Design Overview of Internet of Things (IoT) concepts, evolution, and significance, Understanding the design principles and methodologies for IoT systems, Analysis of IoT architecture, including edge computing, fog computing, and cloud integration, Exploration of IoT communication protocols and standards	
2	IIoT Technologies and Applications IIoT platforms and frameworks: Selection criteria, features, and capabilities.IIoT security and privacy considerations: Authentication, authorization, and data encryption.IIoT applications in manufacturing: Predictive maintenance, asset tracking, quality control, and process optimization.Case studies and industry examples demonstrating successful IIoT implementations.	
3	Cloud Computing Fundamentals Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications. Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages	
4	Cloud Computing in Manufacturing Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services. Cloud-based manufacturing systems: Data storage, processing, and analytics.Integration of IIoT with cloud computing: Data ingestion, stream processing, and batch processing.Benefits and challenges of cloud computing adoption in manufacturing.Security, privacy, and compliance considerations in cloud-based manufacturing environments.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	R. Anandan. The Industrial Internet of Things (IIoT): Intelligent Analytics for Predictive Maintenance. 2022 Scrivener Publishing LLC.	
2	Gautam Shroff, “Enterprise Cloud Computing Technology Architecture Applications”, Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010. 7 SRM-M.Tech Cloud Computing 2015 – 16	
3	Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach” McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.	
4	Dimitris N. Chorafas, “Cloud Computing Strategies” CRC Press; 1 edition [ISBN: 1439834539],2010.	

Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Understand IIoT's importance in manufacturing and its architecture, communication protocols, and sensor integration	CO1
2	Learn cloud computing concepts, deployment models, infrastructure components, and development tools relevant to manufacturing environments.	CO2
3	Understand cloud-based manufacturing systems, integration with IIoT.	CO3
4	Development tools and technologies applicable to manufacturing	CO4

Semester – II- Sr No. 4 Program Elevtive III

Course Code : MEL DE 618
Course Title : Cyber Physical Systems for Manufacturing
L-T-P/S=Credits :
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Cyber-Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS, CPS HW platforms like Processors, Sensors, Actuators, CPS Network, CPS SW stack RTOS, Scheduling Real Time control tasks.	
2	Principles of Automated Control Design: Dynamical Systems and Stability, Controller Design Techniques, Stability Analysis: CLFs, MLFs, stability under slow switching, Performance under Packet drop and Noise.	
3	CPS: From features to software components, Mapping software components to ECUs, CPS Performance Analysis : effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion. Formal Methods for Safety Assurance of Cyber-Physical Systems: Advanced Automata based modelling and analysis: Basic introduction and examples ,Timed and Hybrid Automata, Definition of trajectories, Bounded Model checking	
4	Hybrid Automata Modelling: Flowpipe construction using Flowstar, SpaceX and Phaver tools, CPS SW Verification: Frama-C, CBMC, Secure Deployment of CPS: Attack models, Secure Task mapping and Partitioning, State estimation for attack detection, Automotive	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	E. A. Lee and S. A. Seshia, “Introduction to Embedded Systems: A Cyber-Physical Systems Approach”, 2011.	
2	R. Alur, “Principles of Cyber-Physical Systems,” MIT Press, 2015.	
3	T. D. Lewis “Network Science: Theory and Applications”, Wiley, 2009.	
4	P. Tabuada, “Verification and control of hybrid systems: a symbolic approach”, Springer-Verlag 2009.	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Define embedded systems and cyber-physical systems (CPS) and give examples	CO1
2	Understand various modeling formalisms for CPS, such as hybrid automata, state-space methods, etc.	CO2
3	Understand CPS security and safety aspects	CO3

4	Understand the basics of CPS implementation	CO4

Semester – II- Sr No. 4 Program Elevtive III

Course Code : MEL DE 620
Course Title : Data Analytics for Manufacturing
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction: Data Analytics - Types –** Phases - Quality and Quantity of data – Measurement – Exploratory data analysis - Decision Intelligence. Collection of data, filtration of data, analysis of data, finding trend of data, taking decision on that basis.	
2	**Big Data: Big Data and Cloud technologies** - Introduction to HADOOP: Big Data, Apache Hadoop, Map Reduce - Data Serialization - Data Extraction - Stacking Data - Dealing with data.	
3	Visualization: Introduction to data visualization – Data visualization options – Filters – Dashboard development tools – Creating an interface.	
4	**Analytics and Machine Learning: Machine learning** – Modeling Process – Training model – Validating model – Predicting new observations –Supervised learning algorithms – Unsupervised learning algorithms..	
5	Ethics and Recent Trends: Data Science Ethics – Doing good data science – Owners of the data - Valuing **different aspects of privacy - Getting informed consent** - The Five Cs – Diversity – Inclusion – Future Trends.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Introducing Data Science, Manning Publications Co., 1st edition, 2016.	
2	Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer, 1st edition, 2013.	
3	Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley.	
4	D J Patil, Hilary Mason, Mike Loukides, Ethics and Data Science, O' Reilly,	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Acquire basic knowledge how to handle the data in manufacturing domain.	CO1
2	Develop the mathematical model on the basis of data	CO2
3	Apply their knowledge for taking decision on manufacturing systems.	CO3

Semester – II- Sr No. 4 Program Elevtive III

Course Code : MEL DE 622
Course Title : Supply Chain Management
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	**Introduction:** Role of supply chain management in Economy and Organization- Introduction to SCM, Evolution, Key concepts, Decisions and Importance of SCM. Supply chain strategy and Performance Measures- Competitive supply chain strategies, CRM strategy, Supplier relationship strategy- Performance Measures (Financial, Productivity, Quality and cycle time).	
2	**Supply Chain Drivers and Design**: Supply chain drives- Introduction, Facilities, Inventory, Transportation and Information. Supply chain design- Network design and operation models.	
3	**Transportation, Planning, and Managing Inventory in Supply Chain Network:** Sourcing and Transportation- Role of sourcing, Supplier selection and contracts, Procurement process, Role of Transportation, Design options for transportation network. Planning and Managing Inventories-Introduction, cycle/safety/seasonal stock, Inventory for short life cycle products, Multi echelon inventory.	
4	**Information technology and Innovations in SCM:** Information Technology in SCM- Role of IT, E-business and future trends. Supply chain innovations- Introduction, Supply chain integration, Restructuring, Agile supply chains.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Designing and Managing the Supply Chain: David Simchi-Levi, Philip Kaminsky, Edith Simchi – Levi, Ravi Shankar, Mc Graw Hill Education, 2008	
2	Supply chain management text and cases: Janat Shah, Pearson Education, 2009.	
3	Supply chain management strategy, planning and operation, Sunil Chopra, Peter Meindl, PHI	
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Understand the importance and role of supply chain management.	CO1
2	Design optimize supply chain network model.	CO2
3	Design optimize logistic model foe supply chain network.	CO3
4	Use of AI in Supply chain management	CO4

Semester – II- Sr No. 5 Program core

Course Code : MEP DC 602
Course Title : Mechatronics for Advance Manufacturing Lab
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents / List of Experiments:	Approx. Contact Hours
1	Addition-Subtraction-Multiplication-Division-SortingCode conversion using 8085 Assembly language programming	
2	Stepper motor interface with 8051 Microcontroller kit	
3	Traffic light interface with 8051 microcontroller kit	
4	Speed Control Of Dc Drives Using PID Controller Interfacing Unit	
5	Design and Testing of Pneumatic Circuits to Control the Speed of the Cylinder By Meter In And Meter Out Valve Circuit	
6	Design and Testing of Pneumatic Circuits Operation of double acting cylinder with AND & OR logic circuit	
7	Design and Testing of Electro-Pneumatic Circuits Operation of single and double acting cylinder using single solenoid valve	
8	Actuation of single acting cylinder with ON and OFF Delay timer using PLC	
9	Modelling And Analysis Of Basic Hydraulic Systems Using Lab View	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1		
2		
3		
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	Acquire basic knowledge in mechatronics.	CO1
2	Able to apply concept of basic mechatronics	CO2
3	Able to design PLC for automatic systems	CO3

Semester – II- Sr No. 6 Program core

Course Code : MEP DC 604
Course Title : Additive Manufacturing Lab
L-T-P/S=Credits : 3-0-0 =3
Course Category : Engineering Science Course
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any) :

Detailed Syllabus

Sr	Contents / List of Experiments:	Approx. Contact Hours
1	Experiment 1: To Design and Print a Mechanical Component Using FDM 3D Printing ● Create a CAD model of a mechanical component. ● Use a basic FDM 3D printer to print the designed component. ● Analyze the accuracy and quality of the printed part.	
2	Experiment 2: Investigation of Printing Parameters and Material Options ● Study and optimize various printing parameters (layer height, print speed, temperature, infill patterns). ● Evaluate different material options (PLA, ABS, PETG, etc.) for 3D printing. ● Compare the effects of these parameters and materials on print quality and mechanical properties	
3	Experiment 3: Analysis of Mechanical Properties of 3D Printed Parts ● Perform mechanical testing (tensile, compression, impact) on 3D printed parts. ● Analyze the data to understand the mechanical behavior of different materials and print settings.	
4	Experiment 4: Identification and Mitigation of Common Defects in 3D Printed Parts ● Study common defects such as warping, layer separation, and surface roughness. ● Develop and implement strategies to minimize or eliminate these defects.	
5	Experiment 5: Evaluation of Post-Processing Techniques for 3D Printed Parts ● Explore various post-processing methods such as sanding, painting, vapor smoothing, and annealing. ● Assess the impact of these techniques on the surface finish, dimensional accuracy, and mechanical properties of 3D printed parts.	
6	Experiment 6: Investigation of Recycled Materials in 3D Printing ● Explore the feasibility and performance of using recycled materials for 3D printing. ● Evaluate the mechanical properties and environmental benefits of printed parts made from recycled materials.	
7	Experiment 7: Design and Print a Functional Part for Real-Time Applications Identify a real-world problem or application requiring a functional part. ● Design and print the part using suitable materials and optimized print settings. ● Test and validate the performance of the printed part in its intended application.	

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1		
2		

3		
Reference Books		
1		
2		

Course Outcome

Sr	Course Outcome	CO
1	To describe and differentiate between various additive manufacturing technologies	CO1
2	To gain practical experience in operating 3D printers	CO2
3	To design parts in CAD softwares specifically for additive manufacturing	CO3

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