Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A++' Grade by NAAC with a score of 3.6)

Hingna Road, Wanadongri, Nagpur – 441 110

Master of Technology

SoE & Syllabus 2025

(Department of Mechanical Engineering)

M.Tech in Automation & Robotics

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M.TECH. SCHEME OF EXAMINATION 2025

Department of Mechanical Engineering

SoE No. 25AR101

M.Tech in Automation & Robotics

Sl. No.	Sem	Course Code	Course Title	T/P	Contact Hours				Credits	% Weightage		ESE Duration Hrs.
					L	T	P	Hrs.		TA	ESE	
I SEMESTER												
1	1	25AR101	Robot Kinematics and Dynamics	T	3	0	0	3	3	20	80	3
2	1	25AR102	**Lab :** Robot Kinematics and Dynamics	**P**	0	0	2	2	1	60	40	
3	1	25AR103	Industrial Automation	T	3	0	0	3	3	20	80	3
4	1	25AR104	Automatic Control System	T	3	0	0	3	3	20	80	3
5	1	25AR105	Computer Aided Design	T	3	0	0	3	3	20	80	3
6	1	25AR106	**Lab :** Computer Aided Design	**P**	0	0	2	2	1	60	40	
7	1		**Professional Elective-I**	T	3	0	0	3	3	20	80	3
8	1		**Professional Elective- II**	T	3	0	0	3	3	20	80	3
				Total	**18**	**0**	**4**	**22**	**20**			

List of Professional Electives-I

1	1	25AR111	**PE-I :** Actuators and Drives
2	1	25AR112	**PE-I :** Machine Learning
3	1	25AR113	**PE-I :** Digital Image Processing and Machine vision

List of Professional Elective- II

1	1	25AR121	**PE-II :** Industry 4.0
2	1	25AR122	**PE-II :** Sensor's Applications in Manufacturing
3	1	25AR123	**PE-II :** Microprocessors and Micro- Controllers

II SEMESTER												
1	2	25AR201	Robotics: Advanced Concepts and Analysis	T	3	0	0	3	3	20	80	3
2	2	25AR202	**Lab :** Robotics: Advanced Concepts and Analysis	**P**	0	0	2	2	1	60	40	
3	2	25AR203	Mechatronics System: Design And Analysis	T	3	0	0	3	3	20	80	3
4	2	25AR204	**Lab :** Mechatronics System: Design and Analysis	**P**	0	0	2	2	1	60	40	
5	2	25AR205	Aerial Robotics	T	3	0	0	3	3	20	80	3
6	2	25AR206	**Lab :** Aerial Robotics	P	0	0	2	2	1	60	40	
7	2	25AR207	Minor Project	P	0	0	2	2	2	100		
8	2		**Professional Elective-III**	T	3	0	0	3	3	20	80	3
9	2		**Professional Elective-IV**	T	3	0	0	3	3	20	80	3
				Total	**15**	**0**	**8**	**23**	**20**			

List of Professional Electives-III

1	2	25AR211	**PE-III :** Artificial Intelligence in Automation
2	2	25AR212	**PE-III :** Modeling and Simulation of Mechatronic systems
3	2	25AR213	**PE-III :** Advanced Manufacturing Techniques and Applications

List of Professional Elective- IV

1	2	25AR221	**PE-IV :** Industrial IOT
2	2	25AR222	**PE-IV :** Additive Manufacturing
3	2	25AR223	**PE-IV :** Product Design and Development

III SEMESTER												
1	3	25AR301	Project Phase -I	P	0	0	20	20	10	100		
				Total	**0**	**0**	**20**	**20**	**10**			
IV SEMESTER												
1	4	25AR401	Project Phase-II	P	0	0	36	36	18	60	40	
				Total	**0**	**0**	**36**	**36**	**18**			
				GRAND TOTAL	**33**	**0**	**68**	**101**	**68**			

		June, 2025	1.00
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for AY 2025-26 Onwards

I SEMESTER

25AR101 : Robot Kinematics and Dynamics

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Describe the fundamental concept of robot kinematics and dynamics. 2. Apply the basic concepts of robot kinematics and dynamics for solution of problems on planar and spatial robotic system. 3. Evaluate the robot through the kinematic (velocity and acceleration) and dynamic (torque and inertia) analysis. 4. Analyze robotic manipulator 5. Evaluate the dynamic variables of industrial manipulator

Unit I: Introduction to robotics	**(7 Hrs.)**
Evolution of robots and robotics, Laws of robotics, Progressive advancement in robots, Robot anatomy: links, joint and joint notation scheme, degree of freedom, arm configuration, wrist configuration, End-effector and Grippers, Classification of robot, Human arm characteristics, Design and control issues, Manipulation and control, Sensors and vision, Programming robot, Future aspect.	
Unit II: Coordinate Frames, Mapping and Transformations	**(6 Hrs.)**
Coordinate frames: Mapping, Mapping between rotated frames, Mapping between translated frames, Mapping between rotated and translated frames. Description of object in space. Transformation of vectors: Rotation of vector, translation of vector, combined rotation and translation of vectors, composite transformation, inverting a homogeneous transform. Fundamental Rotation matrix: Principal axis rotation, fixed angle representation, Euler angle representation, Equivalent angle axis representation.	
Unit III: Direct/Forward kinematics modeling	**(7 Hrs.)**
Mechanical Structure and notation, Description of links and joints, Kinematic modeling of manipulator, Denavit-hartenberg notation, Kinematic relationship between adjacent links, Manipulator transformation matrix.	
Unit IV: Inverse kinematic modeling	**(6 Hrs.)**
Manipulator workspace, Solvability of inverse kinematic model: existence of solution, multiple solution, Solution technique, closed form solution.	
Unit V: Manipulator differential motion and statics	**(7 Hrs.)**
Linear and angular velocity of rigid body, relationship between transformation matrix and angular velocity, mapping velocity vector, velocity propagation along links, Manipulator Jacobian, Jacobian inverse, Jacobian singularity, static analysis, trajectory planning.	
Unit VI: Dynamic modeling	**(6 Hrs.)**
Lagrangian Mechanics, Dynamic modeling of two degree of freedom manipulator, Langrange-EulerFormulation, Newton-Euler formulation, Comparison of Langrange-Euler Formulation and Newtion- Euler formulation, Inverse dynamics.	
Total Lecture	**39 Hours**

Textbooks:	
1.	John J. Craig, Introduction to Robotics Mechanics and Control, Second Edition, Addison Wesly Longman Inc. International Student edition, 2014.
2.	R. K. Mittal and I J Nagrath, Robotics and Control, McGraw Hill Education (India) Private Limited, 2017
3.	Peter McKinnon , Robotics: Everything You Need to Know about Robotics from Beginner to Expert., CreateSpace Independent Publishing Platform, 2016

Reference Books:	
1.	Robotics and Control: Fundamental Algorithms in MATLAB® (Springer Tracts in Advanced Robotics, 141) 1st ed. 2022 Edition
2.	Laura Menini (Author), Corrado Possieri , Antonio Tornambè , Algebraic Geometry for Robotics and Control Theory, World Scientific Publishing Europe Ltd, September 28, 2021
3.	R. N Jazar, Theory of Applied Robotics : Kinematics, Dynamics, and Control, Springer; 2nd Ed. 2010.

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/playlist?list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_
2.	https://www.youtube.com/playlist?list=PLyqSpQzTE6M_XM9cvjLLO_Azt1FkgPhpH

I SEMESTER

25AR102 : Lab. : ROBOT KINEMATICS AND DYNAMICS

Course Outcomes
Upon successful completion of the course the students will be able to
1. Describe the fundamental concept of robot kinematics and dynamics.
2. Apply the basic concepts of robot kinematics for solution of problems on planar and spatial robotic system.
3. Simulate the robot through the kinematic (velocity and acceleration) and dynamic analysis.
4. Analyze jointed arm robotic manipulator analytically and graphically.
5. Evaluate the dynamic variables of industrial manipulator

Minimum Eight Practical's to be performed from the list as below

SN	**Experiments based on**
1	Solve direct kinematics of a PUMA 560 robotic arm for the given joint variables and simulate the robot remotely to identify the end-effector trajectory
2	Determine the joint variables of a PUMA 560 robotic arm for a given Cartesian trajectory and compare with simulation
3	Forward kinematic analysis of a 2R planar robot and 6 DoF robots
4	Inverse kinematic analysis of a 2R planar robot and 6 DoF robots
5	Generate workspace of planar robots
6	Generate workspace of spatial robots
7	Generate a 3D model of a robot based on DH parameters
8	Forward dynamic analysis of a 2R planar robot
9	Inverse dynamic analysis of a 2R planar robot
10	Program for loading and unloading operations on 6 DoF Articulated robot
11	Program for palletizing application on 6 DoF Articulated robot
12.	Program for conveyor belt application on SCARA robot
13.	Program for deburring and assembly application on SCARA robot

Web-links and software's:
1. ROBCAD
2. RoboAnalyzer (IIT Delhi)
3. RT Toolbox (Mitsubishi Robots)
4. Robotics System Toolbox (MATLAB)

I SEMESTER

25AR103 : INDUSTRIAL AUTOMATION

Course Outcomes :

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

1. Describe the fundamental concepts of Automation in Production and Material Handling Systems.(L2)
1. Summarizes the knowledge in Hydraulic and Pneumatic Systems used in Automated Manufacturing System.(L2)
2. Summarizes the knowledge in Automated Manufacturing System, Cellular & Flexible Manufacturing System and evaluate the balanced line for Automated Manufacturing System.(L2, L3)
3. Determine the properties of surface like centroid, moment of inertia, etc. for planar surfaces and mass moment of inertia for rigid body. Summarizes the knowledge in Inspection & Quality Control and apply the basic concepts for solution of problems on quality control. .(L2, L3)

Unit I: Introduction:	**(6 Hrs.)**

Introduction , Automation In Production System, Manual Labor in production systems Principles and Strategies of Automation, Basic Elements of An Automated System, Levels of Automation, production concepts and mathematical models.

Material Handling: Introduction to Material Handling, Material Handling Equipment's, Principles and Design Consideration in material handling, Material Transport Equipment, Automated Storage systems. **CO 1**

Unit II: Hydraulic and Pneumatic Systems:	**(7 Hrs.)**

Basic Hydraulic Systems. Hydraulic Circuit Design and Analysis-Introduction, Control of A Single-Acting Hydraulic Cylinder Circuit, Control of a Double Acting Hydraulic Cylinder Circuit, Regenerative Cylinder Circuit.

Basic Pneumatic systems, Types of Cylinders-Single acting Cylinder-Double acting Cylinder, Direction Control Valves-Valve position, Shuttle Valve, Basic Pneumatic Circuits-Control of Single acting Cylinder Circuit-Control of Double acting circuit, Impulse operation-Pilot operation of single acting and Double acting cylinder.

CO 2

Unit III: Manufacturing Systems:	**(6 Hrs.)**

Introduction to Manufacturing systems, Components of Manufacturing systems, Classification scheme for Manufacturing systems ,Simple problems using Mathematic models of production performance, single station manufacturing cells, fundamentals of manual assembly lines, automated production lines

CO 3.

Unit IV: Automated Production Lines and Assembly systems:	**(6 Hrs.)**
Fundamentals of Automated Production Lines, Applications Of Automated production lines, System configurations, Work Part Transfer Mechanisms, Storage Buffers, Power Transmission Systems-Gears, Power Screws(Linear Guideways), Other Transmissions Systems such as chains and ropes. **CO 3**	
Unit V: Cellular Manufacturing and Flexible Manufacturing Systems	**(7 Hrs.)**
Introduction, Part Families, Manufacturing Cells, Cellular Manufacturing, Part classification and coding, Production Flow Analysis, Group Technology and its applications. Introduction to FMS, FMS Industrial Applications and its benefits, FMS Components **Industry 4.0, digitization**. **CO 3**	
Unit VI: Inspection and Quality control:	**(6 Hrs.)**
Introduction, Inspection, Specifying limits of variability, dimensions and tolerances, selection of gauging equipment, gauge control, quality control and quality assurance, statistical quality control, total quality management, six sigma, quality standards, Simple numerical problems**. CO 4**	
Total Lecture	**39 Hours**

Textbooks:	
1.	Automation, Production Systems and Computer Integrated Manufacturing-M. P. Groover, Pearson Education. Third edition/Fifth edition, 2009..
2.	Zimmers & Groover., CAD/CAM , Fifth edition (2008), Pearson Education India
3.	Koren y., Computer Control of Manufacturing Systems, Mcgraw Hill, 2005

Reference Books:	
1.	Fluid Power with Applications-Anthony Esposito, Peason, Sixth Addition.
2.	Pneumatic Systems, Principles and Maintenance-SR Majumdar, 2011 Edition.
3.	Computer Based Industrial Control-Krishna Kant, EEE-PHI,2nd edition,2010
4.	An Introduction to Automated Process Planning Systems-Tiess Chiu Chang & Richard A. Wysk.
5.	N.V. RAGHAVENDRA, Engineering Metrology and Measurements , Oxford University Press YMCA Library Building, 1 Jai Singh Road, New Delhi 110001, India

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/e-copies%20of%20books/2.Mechanical%20Engineering/
2	http://103.152.199.179/YCCE/e-copies%20of%20books/2.Mechanical%20Engineering/
3	http://103.152.199.179/YCCE/e-copies%20of%20books/2.Mechanical%20Engineering/

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/112/103/112103293/
2.	https://archive.nptel.ac.in/courses/108/105/108105088/
3.	https://onlinecourses.nptel.ac.in/noc21_mg92/preview

I SEMESTER

25AR104 : Automatic Control System

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Describe the mathematical representation of various control system and determine the transfer function of mechanical and electrical system. 2. Evaluate the performance of control system using time response analysis and frequency response analysis. 3. Analyse the working of various control system on the basis of stability. 4. Design and analysis of control system on the basis of performance.

Unit I: Control System and Transfer Function	**(7 Hrs.)**
Motivation for control, Types of control, Transfer function, Block diagram and signal flow graph method, Review of differential equations, impulse response and Laplace transformations, Introduction to state equations.	
Unit II: Mathematical Modelling	**(6 Hrs.)**
Mathematical Modeling: - Representation of control components: Mechanical, electrical components. Analogues system	
Unit III: Time Domain Analysis	**(7 Hrs.)**
Interpretation of poles and zeros of transfer functions. Time domain response of second order system. Command tracking and system type. Rough/Hurwitz test.	
Unit IV: Frequency Domain Analysis	**(6 Hrs.)**
Frequency response and frequency domain methods. Nyquist stability test. Bode plots. Phase and gain margins. Bode phase formula.	
Unit V: Control System Design	**(7 Hrs.)**
Applications of Root locus, Sensitivity of roots of characteristics equation, Tool for design and analysis of control systems, Case studies using mat lab on Bode, Nyquist and Root locus.	
Unit VI: Control System Analysis	**(6 Hrs.)**
Robustness. Uncertainty and performance weights. Robust stability test. Robust performance test. Loop shaping necessary and sufficient conditions. Bode integral formula.	
Total Lecture	**39 Hours**

Textbooks:	
1.	Feedback Control of Dynamical Systems, 5th Edition, Franklin, Powell, and Enami-Naeini, Addison-Wesley, 2006
2.	Control Systems Engineering –I.J .Nagrath, M.Gopal, 5thEdition; New age International (P) Ltd, Publishers.

Reference Books:	
1.	Katsuhiko Ogata, Modern Control Engineering, Prentice Hall Publication, 2020.

I SEMESTER
25AR105 : Computer Aided Design

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Describe the fundamental concepts of CAD tools. 2. Apply the basic concepts of 2D and 3D transformation for solving engineering problems. 3. Analyze the importance of computer graphics for plotting curves. 4. Evaluate the use of different data exchange formats as per the applications.

Unit I: CAD Tools	**(6 Hrs.)**
Definition of CAD Tools, Types of system, CAD/CAM system evaluation Criteria, functional areas of CAD, Modelling and viewing, efficient use of CAD software	
Unit II:	**(7Hrs.)**
Role of Computer Graphics in CAD, Fundamentals of 2D graphics, Menu design and Graphical User Interfaces (GUI), Customisation and Parametric representation, Line Generation using Bresenham's and DDA algorithms for line, circle and ellipse	
Unit III:	**(7 Hrs.)**
Two dimensional geometric and co-ordinate transformations like scaling, translation, rotation reflection, shear. Concept of homogeneous representation and concatenated transformations, Inverse transformations.	
Unit IV:	**(6 Hrs.)**
Three dimensional geometric and co-ordinate transformations, Orthographic and Perspective projection, Types of mathematical representation of curves, wire frame models, wire frame entities	
Unit V:	**(7 Hrs.)**
Geometric modeling techniques, Wireframe modeling, Surface Modeling and Solid Modeling, B-Rep, CSG and Hybrid modellers	
Unit VI:	**(6 Hrs.)**
Evaluation of data-exchange formats, IGES data representations and structure, STEP architecture, applications	
Total Lecture	**39 Hours**

Textbooks:	
1.	CAD/CAM, theory & practice: Ibrahim Zeid
2.	Procedural elements for computer graphics: D Rogers
3.	Computer Graphics: D Hearn &M.P.Baker

Reference Books:	
1.	Computer Graphics: S Harrington.
2.	Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
3.	Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi,2000

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1	
2	
3	

MOOCs Links and additional reading, learning, video material	
1.	
2.	
3.	

I SEMESTER

25AR106 : Lab Computer Aided Design

Course Outcomes
Upon successful completion of the course the students will be able to
1. Describe the fundamental concepts of statics and dynamics.
2. Apply the basic concepts of applied mechanics for solution of problems on planar force system.
3. Determine the properties of surface like centroid, moment of inertia, etc. for planar surfaces and mass moment of inertia for rigid body.
4. Analyze pin jointed truss frame structure and beam structure analytically and graphically.
5. Evaluate the dynamic variables of kinetics of particles and simple lifting machine

Minimum Eight Practical's to be performed from the list as below

SN	**Experiments based on**
1	To find determine the support reactions of a Simply Supported Beam experimentally and analytically.
2	To determine the forces in the members of a Jib Crane Apparatus experimentally and graphically.
3	To determine the coefficient of friction between two surfaces of different material on Plane Friction Apparatus.
4	To determine the coefficient of friction of Coil Friction Apparatus.
5	To determine the forces in members of a Shear Leg Apparatus experimentally and manually.
6	To determine the mass moment of inertia of a fly wheel using Fly Wheel Apparatus
7	To determine efficiency and law of machine of Differential Axel & Wheel machine.
8	To determine efficiency and Law of machine of Single Purchase Crab machine.
9	To determine efficiency and Law of machine of Double Purchase Crab machine.
10	To verify law of polygonal of forces using Law of Polygon Apparatus.
11	To find support reactions of a simply supported beam using graphical method and hand calculation.
12.	To find the forces in the member of truss using graphical method and hand calculation.
13.	To find (1) Principle moment of inertia and (2) Moment of inertia and product of inertia about any inclined axis for a composite figure using Mohr's circle and hand calculation,

I SEMESTER

25AR111 : PE-1 Actuators and Drives

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Demonstrate the fundamental concepts of various drive mechanism for robotics. 2. Model the dc and ac drive systems. 3. Analyze various hydraulic and pneumatic drives used in robotics. 4. Examine the different feedback control methods for dynamic conditions.

Unit I: Introduction to Robot Drives and Actuators	**(7 Hrs.)**
Introduction, drives and actuators, classification of actuator systems, open loop control, closed loop control with feedback, functions and classification of drive systems, chain and linkages, lead screw, ball screws, belt drives, gear drives, precision gear boxes, harmonic drives, speed reducers, classification of grippers.	
Unit II: Electric Drives	**(6 Hrs.)**
Introduction, classification, AC motors, DC motors, stepper motors, types of stepper motors, half step mode operation, micro step mode, linear actuators, direct drive actuators.	
Unit III: Pneumatic Drives	**(7 Hrs.)**
Introduction, advantages and disadvantages, components of pneumatic control drives, linear pistons, rotary pistons, flow control valves, pneumatic proportional controller, applications.	
Unit IV: Hydraulic Drives	**(6 Hrs.)**
Introduction, advantages and disadvantages, components of hydraulic control drives, piston and transfer valves, hydraulic circuit with control amplifiers,	
Unit V: Feedback methods for the control of dynamic systems	**(7 Hrs.)**
modelling, characteristics and performance of feedback systems, stability, root locus and frequency response methods and computer simulation	
Unit VI: Servo Systems	**(6 Hrs.)**
Introduction, arrangement of actuators in robots, fundamentals of control techniques, modelling of robot servos, error response, steady state errors in robot servos, feedback and feed forward compensations, hydraulic position servo, computer controlled servo systems, selection of robot drives.	
Total Lecture	**39 Hours**

Textbooks:	
1.	Knapczyk, J. (2014). Basics of Robotics: Theory and Components of Manipulators and Robots. Austria: Springer Vienna.
2.	De Silva, C. W. (2015). Sensors and Actuators: Engineering System Instrumentation, Second Edition. United States: CRC Press.
3.	Pawlak, A. M. (2017). Sensors and Actuators in Mechatronics: Design and Applications. United Kingdom: CRC Press.
4	Ida, N. (2014). Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction. United Kingdom: Institution of Engineering and Technology.
5	Actuators: Basics and Applications. (2004). Germany: Springer.

Reference Books:	
1.	Agrawal, S. K., Kinzel, G. L., Waldron, K. J. (2016). Kinematics, Dynamics, and Design of Machinery. United Kingdom: Wiley.
2.	Norton, R. L. (2014). Machine Design: An Integrated Approach. United Kingdom: Prentice Hall.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=QIPJYTeEc_s&t=1s
2.	https://www.youtube.com/watch?v=0pgGn4CkDTM

I SEMESTER

25AR112 - PE-1 MACHINE LEARNING

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Describe the fundamental concepts of Artificial Intelligence. 2. Apply the basic concepts of Planning and Reasoning required for machine learning. 3. Evaluate the performance of supervised and unsupervised learning required for machines 4. Adapting the knowledge of Natural Language Processing and its applications

Unit I: Introduction to Artificial Intelligence	**(7 Hrs.)**
History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. Solving problems by searching, informed search and exploration, constraint satisfaction problems, knowledge and reasoning, knowledge representation, first order logic.	
Unit II: Planning	**(6 Hrs.)**
Introduction, planning with forward and backward state space search, partial order planning, planning graphs, planning with propositional logic, planning and acting in real world.	
Unit III: Reasoning	**(7 Hrs.)**
Introduction, uncertainty, probabilistic reasoning, filtering and prediction, Hidden Markov models, Kalman filters, Dynamic Bayesian Networks, Speech recognition, making decisions.	
Unit IV: Supervised Learning	**(6 Hrs.)**
Introduction to machine learning, learning input- output functions, types of learning, performance evaluation, noise. Decision trees and inductive bias, geometry and nearest neighbours, logistic regression, binary classification.	
Unit V: Unsupervised Learning	**(7 Hrs.)**
Introduction, curse of dimensionality, dimensionality Reduction, PCA, clustering, K-means, expectation maximization algorithm, hierarchical clustering, applications in robotics.	
Unit VI: Language	**(6 Hrs.)**
Natural Language Processing and its applications	
Total Lecture	**39 Hours**

Textbooks:	
1.	Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India,2016..
2.	Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems",. Harlow: AddisonWesley,2002
3.	Michalski, Carbonell, Tom Mitchell, 'Machine Learning', Springer, 2014.
4.	Rogers, S., Girolami, M. (2016). A First Course in Machine Learning, Second Edition. United Kingdom: CRC Press.

Reference Books:	
1.	Huimin Lu, Xing Lu, "Artificial Intelligence and Robotics", Springer, 2017.
2.	David MacKay, 'Information Theory, Inference and Learning Algorithms', Cambridge, 2003
3.	David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-https://drive.google.com/drive/u/3/folders/1dqGoTKVRXcUHwNpBBNgSNmGk6DqfLiCY

MOOCs Links and additional reading, learning, video material	
1.	https://www.mygreatlearning.com/blog/what-is-machine-learning/
2.	https://www.zdnet.com/article/what-is-machine-learning-everything-you-need-to-know/
3.	https://onlinecourses.nptel.ac.in/noc23_cs18/preview

I SEMESTER

25AR113 : PE1 Digital Image Processing and Machine Vision

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Express the basic knowledge of Image Formation and Coordinate Transformations 2. Implement the knowledge of Image Processing. 3. Explain the Segmentation and Shape Clustering related to image processing 4. Implement the ideas related Machine Learning techniques in Vision 5. Execute the Object Modeling and Recognition Fundamental matrix

Unit I: Introduction	**(7 Hrs.)**
Image Formation and Coordinate Transformations, Camera Matrix, Motion/Stereo Pin-hole model, Human eye, cognitive aspects of colour, 3D space; illumination; Sampling and Quantization, Coordinate transformations and camera parameters	
Unit II: Image Processing	**(6 Hrs.)**
Image Processing - Noise Removal, Blurring, Edge Detection: Canny – Gaussian, Gabor, Texture Edges, Curvature, Corner Detection. Motion Estimation: Horn-Schunk Optical Flow Formulation, Euler-Lagrange formulation: Calculus of variations theory. Structure Recovery from Motion.	
Unit III: Segmentation	**(7 Hrs.)**
Segmentation - Concept of Figure vs. Ground, Watershed, Change Detection, Background Subtraction, Texture Segmentation, Gaussian Mixture Models - Applications in Color and Motion based Image Segmentation, Background Modeling and Shape Clustering.	
Unit IV: Machine Learning techniques	**(6 Hrs.)**
Machine Learning techniques in Vision, Bayesian Classification, Maximum Likelihood Methods, Neural Networks; Non-parametric models; Manifold estimation, Support Vector Machines; Temporal sequence learning.	
Unit V: Object Tracking	**(7 Hrs.)**
Introduction to Object Tracking - Exhaustive vs. Stochastic Search Shapes, Contours, and Appearance Models. Mean-shift tracking; Contour-based models.	
Unit VI: Object Modeling	**(6 Hrs.)**
Object Modeling and Recognition Fundamental matrix and Epipolar geometry, Adaboost approaches: Face Detection and Recognition, Large Datasets; Attention models. Applications: Surveillance, Object detection etc..	
Total Lecture	**39 Hours**

Textbooks:	
1.	D. Forsyth and J. Ponce, Computer Vision: A Modern Approach, 2nd Edition, Prentice Hall 2011.
2.	Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2011

Reference Books:	
1.	E.R. Davies, Machine Vision, Theory Algorithms Practicalities, Elsevier, 2005.
2.	Richard O. Duda, Peter E. Hart, and David G. Stork, Pattern Classification, 2nd ed., Wiley Asia, 2002.
3.	Richard Szeliski, Computer Vision: Algorithms and Applications, Springer; 2011.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-https://drive.google.com/drive/u/3/folders/1dqGoTKVRXcUHwNpBBNgSNmGk6DqfLiCY

MOOCs Links and additional reading, learning, video material	
1.	https://youtu.be/aj2d1_wcauU
2.	https://youtu.be/xUCsfKA8bi0
3.	https://youtu.be/TElCCwnX6SU

I SEMESTER

25AR121 : PE-II: Industry 4.0

Course Outcomes :
Upon successful completion of the course the students will be able to: **1.** This course is designed to offer learners an introduction to Industry 4.0 and its applications. **2.** .Learners will gain deep insights into how smartness is being harnessed from data. **3.** Learners will understand what needs to be done in order to overcome the challenges. **4.** To familiarize in Industry 4.0 in healthcare services.

Unit I	**(7 Hrs.)**
Introduction to Industry 4.0- The Various Industrial Revolutions, Digitalization and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation, Future of Works and Skills for Workers in the Industry 4.0 Era.	
Unit II	**(6 Hrs.)**
Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics.	
Unit III	**(7 Hrs.)**
Technologies for enabling Industry 4.0 - Cyber Physical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Mobile Computing, Cyber Security.	
Unit IV	**(6 Hrs.)**
3D printing technologies, selection of material and equipment, develop a product using 3D printing in Industry 4.0 environment	
Unit V	**(7 Hrs.)**
Industry 4.0 in healthcare services, innovation & prototyping, strategies for competing in an industry 4.0 world, IoT platforms and their architecture, Digital Twins: uses and applications, IIoT case studies.	
Unit VI	**(6 Hrs.)**
Introduction to social innovation and industry 4.0 its types, design for industry 4.0 and social innovation, societal impact analysis, and relevant case studies.	
Total Lecture	**39 Hours**

Textbooks:	
1.	Industry 4.0: The Industrial Internet of Things Paperback – 1 January 2019, Alasdair Gilchrist, APRESS.
2.	Introduction To Industrial Internet Of Things And Industry 4.0, Sudip Misra, Chandana Roy, Anandarup Mukherjee by CRC Press (Taylor & Francis Group)
3.	New Industry 4.0 Advances in Industrial IoT and Visual Computing for Manufacturing Processes, MDPI

Reference Books:	
1.	Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
2.	J. Chanchaichujit, A.Tan, Meng, F., Eaimkhong, S. "Healthcare 4.0 Next Generation Processes with the Latest Technologies", Palgrave Pivot, 2019.
3.	Handbook Industry 4.0, Law, Technology Society, Springer
4.	Handbook Industry 4.0, Diego Galar Pascual, Uday Kumar, CRC Press (Taylor & Francis Group)
5.	Sustainable Logistic and Production in Industry 4.0, by Katarzyna Grzybowska, Anjali Awasthi, Rapinder Sawhney, Springer.
6.	Industrial Applications of Machine Learning, CRC Press
7.	Industry 4.0 for SMEs Challenges, Opportunities and Requirements, Dominik T. Matt · Vladimír Modrák · Helmut Zsifkovits, Palgrave Macmillan Pub

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/NPTEL%20VIDEOS%20PHASE%20I%20%20-%20PART3/Mechanical%20Engineering/Manufacturing%20Processes%20II/
2	http://103.152.199.179/YCCE/yccelibrary.html
3	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/EAT/

MOOCs Links and additional reading, learning, video material	
1.	https://onlinecourses.nptel.ac.in/noc20_cs69/preview
2.	https://onlinecourses.nptel.ac.in/noc23_me71/preview

I SEMESTER

25AR122 : PE-II: Sensor's Applications in Manufacturing

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Express the basic knowledge of sensors and transducers 2. Implement the knowledge of Sensors for mechanical systems or mechanical sensors. 3. Explain the Thermal sensors and Magnetic Sensors for testing 4. Implement the ideas related Electrical sensors for testing

Unit I: Introduction	**(7 Hrs.)**
Introduction to sensors and transducers .Need for sensors in the modern world. Different fields of sensors based on the stimuli - various schematics for active and passive sensors. Static and dynamic characteristics of sensors - zero, I and II order sensors – Response to impulse, step, ramp and sinusoidal inputs. Environmental factors and reliability of sensors.	
Unit II: Sensors for mechanical systems	**(6 Hrs.)**
Sensors for mechanical systems or mechanical sensors - Displacement - acceleration and force - flow of fluids - level indicators - pressure in fluids - stress in solids. Typical sensors - wire and film strain gauges, anemometers, piezo electric and magnetostrictive accelerometers, potentio metric sensors, LVDT	
Unit III: Thermal sensors	**(7 Hrs.)**
Thermal sensors – temperature – temperature difference – heat quantity. Thermometers for different situation – thermocouples thermistors – color pyrometry. Optical sensors: light intensity – wavelength and color – light dependent resistors, photodiode, photo transistor, CCD, CMOS sensors. Radiation detectors: radiation intensity, particle counter – Gieger Muller courter (gas based), Hallide radiation detectors.	
Unit IV: Magnetic sensors	**(6 Hrs.)**
Magnetic sensors: magnetic field, magnetic flux density – magneto resistors, Hall sensors, super conduction squids. Acoustic or sonic sensors: Intensity of sound, frequency of sound in various media, various forms of microphones, piezo electric sensors.	
Unit V: Electrical sensors	**(7 Hrs.)**
Electrical sensors: conventional volt and ammeters, high current sensors, (current transformers), high voltage sensors, High power sensors. High frequency sensors like microwave frequency sensors, wavelength measuring sensors. MEMs and MEM based sensors	
Unit VI:	**(6 Hrs.)**
Relevant Case studies	
Total Lecture	**39 Hours**

Textbooks:	
1.	Doebelin, "Measurement Systems: Application and Design", McGraw Hill Kogakusha Ltd.
2.	Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim "Microsensors, MEMS and Smart Devices", New York: Wiley, 2001.
3.	Henry Bolte, "Sensors – A Comprehensive Sensors", John Wiley.
4.	. Jocob Fraden," Handbook of Modern Sensors, Physics, Designs, and Applications", Springer.

Reference Books:	
1.	Manabendra Bhuyan," Intelligent Instrumentation Principles and Applications", CRC Press
2.	Randy Frank," Understanding Smart Sensors", Second edition, Artech House.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-https://drive.google.com/drive/u/3/folders/1dqGoTKVRXcUHwNpBBNgSNmGk6DqfLiCY

MOOCs Links and additional reading, learning, video material	
1.	https://youtu.be/U2XepZNbWi8
2.	https://youtu.be/sCTgZv33tuA

I SEMESTER

25AR123 : PE-II: Microprocessors and Micro- Controllers

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Express the basic knowledge of Microprocessors 2. Implement the knowledge of ARM Instruction Set. 3. Explain the Internet of Things 4. Implement the ideas related AVR Microcontroller, Assembly language Programming

Unit I: Introduction	**(7 Hrs.)**
Introduction to Microprocessors, RISC and ARM design Philosophy, ARM Processor Fundamentals, registers, Current Program Status Register, Pipeline, Interrupts and Vector Table, Architecture Revisions, ARM Processor Families	
Unit II: ARM Instruction Set	**(6 Hrs.)**
Data processing instruction, branch instructions, load store instructions, software interrupt instructions, program status register instructions, loading constants, conditional executions, efficient C programming for ARM processor.	
Unit III: Introduction to Internet of Things	**(7 Hrs.)**
IoT Definitions, IoT Frameworks, Internet of things application examples, Identification of IoT, Objects and Services, Structural Aspects of the IoT Key, Iot Technologies. IoT Protocols: Application protocols-MQTT, LORA, CoAP, Infrastructure Protocols-WiFi, Bluetooth, Zigbee, RFIP, Wireless sensor networks.	
Unit IV: AVR Microcontroller	**(6 Hrs.)**
Overview of AVR family, AVR Microcontroller architecture, Register, AVR status register, ROM space and other hardware modules. ATmega8 pin configuration and pin functions.	
Unit V: AVR Assembly Language Programming	**(7 Hrs.)**
Addressing modes of AVR, Data transfer, Arithmetic, Logic and Compare, Rotate and Shift, Branch and Call instructions. AVR data types and assembler directives, AVR assembly language programs and I/O port programming	
Unit VI: Peripheral Interfacing	**(6 Hrs.)**
LED and Keyboard Interfacing, ADC, DAC and IR sensor interfacing, Stepper Motor Interfacing, DC motor control.	
Total Lecture	**39 Hours**

Textbooks:	
1.	"Advanced Microprocessors and IBM PC Assembly Language Programming"-K. UdayaKumar & B.S. Umashankar , TMH, 1stedition,
2.	"The AVR Microcontroller and Embedded Systems Using Assembly and C",By Muhammad Ali Mazidi, SarmadNaimi and SepehrNaimi, Pearson Education
3.	. "Programming and Customizing the AVR Microcontroller", By DhananjayGadre, McGraw Hill Education 3. AVR ATmega32 data sheet

Reference Books:	
1.	Vijay Madisetti, "Internet of Things A Hands-On-Approach", ArshdeepBahga, 2014
2.	Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies,

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-https://drive.google.com/drive/u/3/folders/1dqGoTKVRXcUHwNpBBNgSNmGk6DqfLiCY

MOOCs Links and additional reading, learning, video material	
1.	https://youtu.be/dcNk0urQsQM
2.	https://youtu.be/JwCTkm43CxQ
3.	https://onlinecourses.nptel.ac.in/noc22_ee12/preview

II SEMESTER

25AR201 : Robotics: Advanced Concepts and Analysis

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Describe the fundamental concepts of robot programming. 2. Apply the basic concepts of robot kinematics and dynamics for robot simulation 3. Apply knowledge of sensors and actuators for designing robots for different environments 4. Analyze various motion types and associated instructions for robot prograaming 5. Evaluate the robot control modes and efficient path planning

Unit I: Introduction to Robot Programming	**(7 Hrs.)**
Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation- Interlock commands Operating mode of robot, Jogging-Types, Robot specifications- Motion commands. end effectors and sensors commands.	
Unit II: VAL Language	**(7 Hrs.)**
Robot Languages-Classifications, Structures- VAL language commands motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications. ROS and its applications	
Unit III: Practical Study of Virtual Robot	**(8 Hrs.)**
Robot cycle time analysis-Multiple robot and machine Interference-Process Chart-Simple problems- Virtual robotics, Robot studio online software- Introduction, Jogging, components, work planning, program modules, input and output signals-Singularities-Collision Detection-Repeatability.	
Unit IV: Sensors and Actuators	**(7 Hrs.)**
Sensors, sensor integration, Actuators (electrical)- DC motors, BLDC servo motors, Control – PWM, joint motion control, feedback control, Computed torque control	
Unit V: Perception, Localization and mapping	**(7 Hrs.)**
Probabilistic robotics, Path planning, BFS; DFS; Dijkstra; A-star; D-star; Voronoi; Potential Field; Hybrid approaches, Simultaneous Localization and Mapping, Introduction to Reinforcement Learning	
Unit VI: Control Modes, Intelligent Robotic Systems and Types of Robots	**(8 Hrs.)**
Control Concepts: Discontinuous - Continuous - Composite Control Modes, Intelligent Robotic Systems. Locomotion: Introduction - Key issues for locomotion - Types of Robots: Legged Mobile Robots - Wheeled Mobile Robots - Driving Robots - Omnidirectional Robots - Balancing Robots - Walking Robots - Autonomous Planes - Autonomous Vessels & Underwater Vehicles.	
Total Lecture	**44 Hours**

Textbooks:	
1.	Danny Staple, Learn Robotics Programming- Build and Control Autonomous Robots Using Raspberry Pi3 and 11011, Packt publishing 2018
2.	Cameron Hughes, Tracey Hughes, Robot Programming -A Guide to Controlling Autonomous Robots, Pearson Education, 2016.
3.	Dinesh Tavasalkar, Hands-On Robotics Programming with C++ -Leverage Raspberry Pi 3 and C++ Libraries to Build Intelligent Robotics Applications, Packt publishing 2019.
4.	R.K. Mittal & I.J. Nagrath, "Robotics & Control" T MH-2007
5.	Lynch. K.M, Park. F. C., Modern Robotics-Mechanics, Planning and Control, Cambridge University Press, 2017
6.	Mastering ROS for Robotics Programming Design, Build, and Simulate Complex Robots Using the Robot Operating System, 2nd Edition By Lentin Joseph, Jonathan Cacace · 2018

Reference Books:	
1.	J. Norberto Piers, Industrial Robots Programming - Building Applications for the Factories of the Future, S er,2007.
2.	Bernardo Ronquillo Japon Hands-On ROS for Robotics Programming- Program Highly Autonomous and A1-capable Mobile Robots Powered by ROS, Packt Publishing. 2020
3.	Saeed. B. Niku, Introduction to Robotics: Analysis, Control, Applications, 2nd Edition, Wiley. 2010
4.	K.S Fu, R.C. Gonzalez, C.S.G. Lee, Robotics, McGraw Hill, 2008
5.	Richard D, Klafter, Thomason A Chmiel Owski, Michel Nagin "Robotics Engg-an Integrated Approach" PHI 2005

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/playlist?list=PLgMDNELGJ1CZT9pdEEkDylXFPLdcqxn0t
2.	https://www.youtube.com/playlist?list=PLLy_2iUCG87AjAXKbNMiKJZ2T9vvGpMB0

I SEMESTER

25AR202 : Lab. Robotics: Advanced Concepts and Analysis

Course Outcomes
Upon successful completion of the course the students will be able to
1. Apply the basic concepts of robot kinematics and dynamics for robot simulation
2. Simulate the robot in different environments
3. Analyze various motion types and associated instructions
4. Evaluate the robot programming and its virtual simulation in the robot simulation software

Minimum Eight Practical's to be performed from the list as below

SN	**Experiments based on**
1	Creation of new Robot Station using the RobotStudio from Empty Station
2	Creation of the Virtual Controller from Layout
3	Simulation of jogging the Robot in joint move or linear mode from Freehand function
4	Creation of target using two methods: a) Teach target and b) Create Target
5	Model and simulate the gripper
6	Model and simulate the pick and place assignments
7	Write a Rapid programming language code
8	Simulation of Robot Environment
9	Simulation of Robot Features
10	Simulation of Robot Motion Control
11	Simulation of Robot program for different operations

Web-links and software's:

1. ABB RobotStudio
2. ROBCAD
3. Cyberbotics: Robotics simulation with Webots
4. Robotics System Toolbox (MATLAB)

II SEMESTER

25AR203 : Mechatronics System: Design And Analysis

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Summarize the key elements of mechatronic system and applications. 2. Demonstrate the application of various sensors in mechatronics system. 3. Interpret the role of various motors and their control mechatronic systems. 4. Illustrate the internal hardware structure of Mechatronic Systems and its applications in different domains.

Unit-I : Introduction to Mechatronics Systems,	**(7 Hrs.)**
Definition of Mechatronics, Classification and Description of Mechatronic using Graphical and Block Diagram Method, Multi-disciplinary scenario, origins. Evolution of Mechatronics, Mechatronics key elements, Mechatronics design process, Need for mechatronics in industries, Objectives, advantages and disadvantages of mechatronics.	
Unit-II **Sensors and Transducers:**	**(6 Hrs.)**
Introduction to Sensors and Transducers: Performance Terminology Displacement, Position and Proximity-Velocity and Motion-Fluid, Classifications of different sensors used in mechatronics systems.	
Unit-III Actuators:	**(7 Hrs.)**
Classifications of Actuators, Types of stepper motors and its control circuit, Types of DC Motor, DC Geared motors, SD Servo geared Motors, Mechanical Actuation Systems, Pneumatic and Hydraulic Actuation Systems. Piezoelectric actuators Introduction to Microprocessors and Micro Controllers used for Mechatronic devices.	
Unit-IV Elements of CNC Machines:	**(6 Hrs.)**
Introduction to Computer Numerical Control, Features of CNC Machines, Structure, Drive Mechanism, gear box, Main drive, feed drive, Spindle Motors, Axes motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation, Sideways, Re - circulating ball screws – Backlash measurement and compensation, linear motion guide ways, Retrofitting of Conventional Machine Tools, Description of a simple CNC control system. Types of measuring systems in CNC machines.	
Unit- V Design of Mechatronics System:	**(7 Hrs.)**
Stages in designing Mechatronics Systems–Traditional and Mechatronic Design-Possible Design Solutions, Intelligent techniques in mechatronics – Algorithms man machine interface- case studies.	

Unit-VI Applied Mechatronics:	**(6 Hrs.)**
Principle of working of automatic camera, engine management system. Pick and Place robot, Mechatronics design in automated car parking system, Automated Washing Machine System, Automated Traffic signal Method, Case studies in: Mechatronics in Home appliances, Medical Devices, Defense, Automobiles and office automation, Industrial Automation, Future of Mechatronics. Medical Devices, Defense, Automobiles and office automation, Industrial Automation, Future of Mechatronics.	
Total Lecture	**39 Hours**

	Textbooks:
1.	W. Bolton,"Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering"– 4thEdition.Pearson Education; 4 edition (2010)
2.	Principles, Concepts and applications - Mechatronics –- Nitaigour and Premchand Mahilik – Tata McGraw Hill – 2003

	Reference Books:
1.	Devdas Shetty and Richard A. Kolk "Mechatronics System design"2nd Edition Cengage learning, (2012)
2.	David G. Alciatore and Michael B.Histand, Introduction to Mechatronics and Measurement systems, 2nd edition Tata McGraw-Hill, 2003.
3.	Mechatronics 2007 Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ., Chapman and Hall, 1991

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/78.%20Engineering-Mechanics-Statics-and-Dinamics-E-W-Nelson-C-L-Best-W-G-McLean-1st-Ed-1997-Schaum-Outline-McGraw-Hill%20(1).pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
3	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://onlinecourses.nptel.ac.in/noc21_me27/preview
2.	https://www.youtube.com/watch?v=zVVITxiec7g&t=1s
3.	https://www.youtube.com/watch?v=0Lpra3VJY6M

II SEMESTER

25AR204 : Lab. Mechatronics System: Design And Analysis

Course Outcomes
Upon successful completion of the course the students will be able to 1. Demonstrate the fundamental concepts and working of microprocessor and microcontrollers. 2. Model the various dc and ac drive systems. 3. Analyze various hydraulic and pneumatic drives. 4. Analyze the application of PLC and PLC programming.

Minimum Eight Practical's to be performed from the list as below

SN	**Experiments based on**
1	Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2	Stepper motor interface.
3	Traffic light interface.
4	Speed control of DC motor.
5	Study of various types of transducers.
6	Study of hydraulic, pneumatic and electro-pneumatic circuits.
7	Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
8	Study of PLC and its applications.
9	Study of image processing technique.

II SEMESTER
25AR205 : Aerial Robotics

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Express the basic knowledge of Aerial robotics 2. Implement the knowledge of quadrotors and basic mechanics in Aerial robotics. 3. Explain the Dynamics and 1-D Linear Control and select components of the related system 4. Implement the ideas related to modeling and dynamic formulations associated to aerial robotics 5. Execute the planning and 2-D Quadrotor Control, 3-D Quadrotor Control of Aerial Robotics

Unit I: Introduction	**(7 Hrs.)**
Introduction, Background, History of Aerial Robotics, Applications of Aerial Robotics: - Possible Applications of Aerial Robots, Current Applications	
Unit II: Unmanned Aerial Robotics	**(6 Hrs.)**
Unmanned Aerial Robotics (UAVs) and quadrotors, basic mechanics and control strategies. Key Components of Autonomous Flight, State Estimation, Applications, Basic Mechanics	
Unit III: 1-D Linear Control	**(7 Hrs.)**
Dynamics and 1-D Linear Control, Design Considerations, Agility and Maneuverability, Component Selection, Dynamical Systems, Rates of Convergence	
Unit IV: Geometry and Mechanics	**(6 Hrs.)**
Geometry and Mechanics: - Modeling and Dynamics Formulation: Transformations, Rotations, Euler Angles, Axis/Angle Representations for Rotations, Angular Velocity, Component selection and design affect the vehicles' performance, kinematics of quadrotors, dynamic equations of motion for quadrotors, 1-D quadrotor control.	
Unit V: Planning and Control	**(7 Hrs.)**
Planning and Control: 2-D Quadrotor Control, 3-D Quadrotor Control, Time, Motion, and Trajectories, linear controllers, Motion Planning for Quadrotors, Minimum Velocity Trajectories from the Euler-Lagrange, Minimum Velocity Trajectories, Linearization of Quadrotor Equations of Motion	
Unit VI: Sensing and Estimation	**(6 Hrs.)**
Sensing and Estimation: Nonlinear Control, Control of Multiple Robots, Introduction to the Motion Capture System.	
Total Lecture	**39 Hours**

Textbooks:	
1.	A FIRST COURSE IN AERIAL ROBOTS AND DRONES 1ED (Chapman & Hall/CRC Artificial Intelligence and Robotics Series) Hardcover – Import, 24 February 2022
2.	Yasmina Bestaoui Sebbane, A First Course in Aerial Robots and Drones, Chapman & Hall, February 24, 2022
3.	Planning and Decision Making for Aerial Robots, S. G. Tzafestas, Zografou, Athens, Greece, Yasmina Bestaoui Sebbane, Springer Cham Heidelberg New York Dordrecht London

Reference Books:	
1.	M. Vidyasagar Mark W Spong, Robot Dynamics and Control, January 2018, Wiley Publisher
2.	Reza N. Jazar, Theory of Applied Robotics: Kinematics, Dynamics, and Control, Springer, June 2010,
3.	Alejandro Suarez, Jonathan Cacace and Matko Orsag, Aerial Robotics for Inspection and Maintenance, July 2022.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-https://drive.google.com/drive/u/3/folders/1dqGoTKVRXcUHwNpBBNgSNmGk6DqfLiCY
2	http://ifrr.org/aerial-robotics

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/results?search_query=aerial+robotics
2.	https://www.youtube.com/watch?v=zW7SgIeaNmM
3.	https://nptel.ac.in/courses/112106298

II SEMESTER

25AR206 : Lab. Aerial Robotics

II Semester
25AR207 : MINOR PROJECT

OBJECTIVES

The main objective of Mini Project is to let the students apply the knowledge of theoretical concepts which they have learnt as a part of the curriculum using real time problems or situations. Seminar should be conducted on

- Literature survey
- Simulation/ Fabrication/ Mathematical Modeling

II SEMESTER
25AR211 : PE-III: Artificial Intelligence In Automation

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Examine the issues involved in knowledge bases, reasoning systems and planning 2. Design and evaluate intelligent expert models for perception and prediction from intelligent environment. 3. Apply AI frameworks and platforms to improve business, organizational, and technology outcomes. 4. Analyze the concept of neural networks for learning linear and non-linear activation functions

Unit I:	**(6 Hrs.)**
Human and machine intelligence, Artificial Intelligence (AI), Programming in AI environment, Natural Language processing (NLP), Need of AI.	
Unit II:	**(7Hrs.)**
Architecture of an Expert system, Knowledge base, inference engine forward and backward chaining, use of probability and fuzzy logic. Selection of inference mechanism.	
Unit III:	**(7 Hrs.)**
Neural Network and application artificial neural network models, NN applications in Cellular manufacturing and other areas of mechanical Engineering	
Unit IV:	**(6 Hrs.)**
Introduction to Rule Based System. Conflict Resolution Advantages and Drawbacks of Rule Based Systems Clausal Form Logic, Rule Base Verification, Refinement and Validation. Creating Knowledge Base, Knowledge Engineer and Domain Expert, Phases of Knowledge Engineering, Tools for Knowledge Engineering.	
Unit V:	**(7 Hrs.)**
Fundamentals of OOP (Object oriented programming), creating structures and objects, object operations, invoking procedures, programming applications, Object oriented expert systems.	
Unit VI:	**(6 Hrs.)**
Semantic nets, structure and objects, ruled systems for semantic nets, certainty factors, Learning	
Total Lecture	**39 Hours**

Textbooks:	
1.	Elaine Rich "Artificial Intelligence" McGraw Hill Education; 3rd edition (1 July 2017)
2.	Addis, T.R., ―Designing Knowledge Based System‖, Prentice Hall, 1985.
3.	Rolston, D.W., ―Principles of Artificial Intelligence and Expert Systems Development‖, McGraw Hill, 1988.

Reference Books:	
1.	Maus, R. and Keyes, J., ―Handbook of Expert Systems in Manufacturing‖, McGraw Hill, 1991
2.	Robert Levine, ―A comprehensive guide to artificial intelligence and expert systems",Elain Rich ,‖Artificial Intelligence‖,
3.	Sasikumar, Ramani, et al ,‖Rule based expert systems‖.
4.	Graham Winstanley, ―Program Design for Knowledge Based Systems‖, Galgotia Publications
5.	Artificial Neural Networks", Zurada
6.	V.B. Rao and H.V. Rao, ―C++ : Neural Networks and Fuzzy Logic‖, BPB Publications.

II SEMESTER

25AR212 : PE-III: Modeling and Simulation of Mechatronic systems

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Express the basic knowledge of mathematical modeling 2. Implement the knowledge of automatic controls. 3. Simulate the Closed & Open System 4. Implement the ideas related Control panel modeling

Unit I: Introduction	**(7 Hrs.)**
Introduction to mathematical modeling, Need, Advantages, Limitations, Disadvantages & Applicable to mechanical, manufacturing, process, Automotive, Electrical & Control System, Software tools available for modeling [Matlab- Simulink, AutoLISP, ADAMS/Pro-Mechanica/ Visual Nastran/Working Model 4D, MathCAD/Mathematica, Lab View and computer languages [C/C++/Fortran/AutoLISP/ Simula /SIMSCRIPT/GASP/GPSS] for mathematical modelling	
Unit II: Automatic controls	**(6 Hrs.)**
Introduction to automatic controls. Modeling of general second order system (mechanical systems [spring, mass, damper], flow, heat transfer and electrical, pneumatic and vibration systems). Block diagram and transfer function, modeling of continuous system, Extraction of reduced order models. Transient and frequency response evaluation using Laplace transform, Control loop and its elements, Dynamic behavior of first, second and higher order physical systems. Linearization of non-linear systems. Controller hardware, sensors, transmitters and control valves	
Unit III: Hydraulic controller	**(7 Hrs.)**
Characteristics of hydraulic controller, pneumatic, electronic controller, electro hydraulic and electro-pneumatic controllers, PID control, Stability, Gain and phase margins, Control system design using root and compensation	
Unit IV: Simulation	**(6 Hrs.)**
Simulation Introduction, Advantages, Limitations, Disadvantages, Concept of System, Process, Activity, Attributes, Closed & Open System. Activities: Deterministic & Stochastic, Models: Static, Dynamic, Transient, Simulation Approaches: Event Scheduling, Process Interaction, Activity Scanning, Steps in Simulation Study.	
Unit V: Instrumentation and Process Control	**(7 Hrs.)**
Instrumentation and Process Control-Introduction, Study of various measuring parameters of a process/system and Measuring instruments for: Temperature, pressure, level, flow, Control schemes with applications to Machine tool, Boiler, Engine Governing, Aerospace, Active vibration control, Manufacturing, Process control, etc	
Unit VI: Control panel modeling	**(6 Hrs.)**
Application to Control panel modeling, Virtual Instrumentations using Lab View, Auto-tuning, Sequence control, Logic diagram, Introduction to digital control, Implementation using computer language /software, Introduction to control of MIMO systems, State Space modeling	
Total Lecture	**39 Hours**

Textbooks:	
1.	S.R Bhonsale, K.J., ―Mathematical modeling for design of machine components‖, Weinmann, Prentice Hall.
2.	F. D'souza V K Gar, ―Englewood Cliffs Advanced Dynamics: Modelling and Analysis,‖ N. J., Prentice Hall, 1984
3.	Averal M. Law, W. David Kelton, ―Simulation, Modelling and analysis‖, McGraw Hill.

Reference Books:	
1.	Reference manuals: Matlab- Simulink/AutoLISP/ADAMS/Pro Mechanica/VisualNastran/WorkingModel 4D/ MathCAD/Mathematica, Lab View.
2.	Simulation, Modelling and analysis, Averal M. Law, W. David Kelton, McGraw Hill
3.	Ian Cameron, K. M. Hangos, Katalin Hangos, ―Process Modelling and Model Analysis (Process Systems Engineering) Elsevier Limited, 2006, ISBN: 0121569314
4.	Damian Flynn, ―Thermal Power Plant Simulation and Control‖,Institution Electrical Engineers 2003, ISBN: 0852964196

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-https://drive.google.com/drive/u/3/folders/1dqGoTKVRXcUHwNpBBNgSNmGk6DqfLiCY

MOOCs Links and additional reading, learning, video material	
1.	https://youtu.be/DbGTwvyT_Co
2.	https://youtu.be/MBqOx79ZndM
3.	https://onlinecourses.nptel.ac.in/noc22_me18

II SEMESTER

25AR213 : PE-III: Advanced Manufacturing Techniques and Applications

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Express the basic knowledge of Flexible Manufacturing System 2. Implement the knowledge of automated process planning. 3. Apply the Green and Agile manufacturing for FMS 4. Implement the ideas related Rapid Prototyping

Unit I: Introduction	**(7 Hrs.)**
Introduction- Advanced manufacturing systems- definition, concept, industrial requirement, types of AMS. CNC technology: principle of numerical control - types of CNC machines - features of CNC systems - programming techniques - capabilities of a typical NC, DNC.	
Unit II: Flexible Manufacturing System	**(6 Hrs.)**
Flexible Manufacturing System(FMS): Types of FMS, FMS Components like pallets, fixtures, machines, AS/RS, Work handling equipments and system layout; Control of FMS, FMS applications and benefits. Group Technology and Cellular Manufacturing: Part families, part classification and coding, cellular manufacturing, applications and quantitative analysis.	
Unit III: Automated process planning	**(7 Hrs.)**
Automated process planning: General methodology of group technology - code structures variant and generative process planning methods - process planning software. Reverse Engineering: Need & Techniques, Data collection.	
Unit IV: Green and Agile manufacturing	**(6 Hrs.)**
Green and Agile manufacturing – Introduction, agility through group technology, concept of failure mode effect analysis - JIT,SMED,KANBAN,KAIZEN,FMEA,SCM	
Unit V: Rapid Prototyping	**(7 Hrs.)**
Rapid Prototyping: Process chain in RP in integrated CAD-CAM environment, Advantages of RP, Utility of Rapid Prototyping in Reverse Engineering.	
Unit VI: Integrated manufacturing System	**(6 Hrs.)**
Introduction, concepts, features, components of Integrated manufacturing System	
Total Lecture	**39 Hours**

Textbooks:	
1.	Mikell.P.Groover, "Automation, Production systems and Computer Integrated Manufacturing", Pearson Education..
2.	P.N.Rao, N.K. Tewari & T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill, 2001

Reference Books:	
1.	Tien-Chien Chang, Richard A. Wysk & Hsu-Pin Wang, "Computer-Aided Manufacturing", Pearson.
2.	Andrew Kusiak, "Intelligent Manufacturing Systems", Prentice Hall
3.	P. Radhakrishnan, "Computer Integrated Manufacturing", PSG College of Technology, 2008
4.	P.G. Ranky, "Computer Integrated Manufacturing", Prentice Hall of India, 1996

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1	chrome-https://drive.google.com/drive/u/3/folders/1dqGoTKVRXcUHwNpBBNgSNmGk6DqfLiCY

MOOCs Links and additional reading, learning, video material	
1.	https://youtu.be/KDkGbTt9lOY
2.	https://www.javelin-tech.com/blog/2021/05/the-latest-additive-manufacturing-technology-and-applications/
3.	https://archive.nptel.ac.in/courses/112/107/112107078/

II SEMESTER
25AR221 : PE-IV: Industrial IOT

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Express the interconnection and integration of the physical world and the cyber space 2. Implement the knowledge of IoT based engineering applications. 3. Explain the Internet Principles 4. Implement the Python Programming and Raspberry PI 5. Execute the Seven Generation of IoT Sensors to Appear

Unit I: The Internet of Things	**(7 Hrs.)**
An Overview, The Flavor of the Internet of Things, The Technology of the Internet of Things, Enchanted objects, Affordances, M2M, WoT	
Unit II: Internet Principles	**(6 Hrs.)**
An Overview, IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses, DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports.	
Unit III: Thinking about Prototyping	**(7 Hrs.)**
Prototypes and Production, Costs versus Ease of Prototyping, Changing Embedded Platform, Open Source versus Closed Source, Why Closed? Why Open? Mixing Open and Closed Source, Memory Management, Types of Memory, Making the Most of Your RAM, Performance and Battery Life, Libraries	
Unit IV: Introduction to Python Programming and Raspberry PI	**(6 Hrs.)**
General syntax of Python Programming, Libraries (NumPy, SciPy, Pnadas, Tensor Flow etc), Raspberry PI, Implementation of IoT with Python, Implementation of IoT with Raspberry PI (Domain based application)	
Unit V: Seven Generation of IoT Sensors to Appear	**(7 Hrs.)**
Industrial sensors – First Generation – Description & Characteristics of Advanced Generation – Integrated IoT Sensors – Polytronics Systems – Sensors' Swarm – Printed Electronics – IoT Generation Roadmap.	
Unit VI:	**(6 Hrs.)**
Case studies or mini projects in some of the areas like: Home Automation, Agriculture sector, health sector, Mobility and retail sector etc.	
Total Lecture	**39 Hours**

Textbooks:	
1.	Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, 1st Edition John Wiley and Sons, Ltd.
2.	Internet of Things, Architechture and Design principles, Raj Kamal, 1st Edition, McGraw Hill education (India) Pvt. Ltd.
3.	Dr. Guillaume Girardin, Antoine Bonnabel, Dr. Eric Mounier, 'Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 - 2024',Yole Development Copyrights ,2014

Reference Books:	
1.	Learning of Internet of Things, Peter Waher, 1st Edition, Packt Publishing
2.	Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
3.	Editors Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014

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2.	https://youtu.be/HmbUJEShA-8
3.	https://onlinecourses.nptel.ac.in/noc20_cs69

II SEMESTER

25AR222 : PE-IV: Additive Manufacturing

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Express the CAD-CAM and its integration 2. Implement the knowledge of Process Chain for Rapid Prototyping 3. Explain the model slicing and contour data organization 4. Implement the rapid prototyping machines 5. Execute the rapid tooling and manufacturing

Unit I: INTRODUCTION	**(7 Hrs.)**
CAD-CAM and its integration, Development of CAD CAM., The importance of being Rapid, The nature of RP/T, The state of RP/T industry. Rapid Prototyping Defined. Time compression Technologies, product development and its relationship with rapid prototyping.	
Unit II: PROCESS CHAIN FOR RAPID PROTOTYPING	**(6 Hrs.)**
Determination, the function of part supports, support structure design, Automatic support structure Data Preparation (Pre-processing), Part Building, Post Processing. CAD Model Preparation, Reverse Engineering and CAD model, Digitizing Techniques: Mechanical Contact Digitizing, Optical Non-contact Measurement, CT Scanning Method, Data Processing for Surface Reconstruction. Data interface for Rapid Prototyping: STL interface Specification, STL data generation, STL data Manipulation, Advantages and limitations of STL file format. Open files. Repair of STL files. Alternative RP interfaces.Part orientation and support generation: Factors affecting part orientation, various models for part orientation generation.	
Unit III: MODEL SLICING AND CONTOUR DATA ORGANIZATION	**(7 Hrs.)**
Model slicing and skin contour determination, Identification of external and internal contours, Contour data organization, Direct and adaptive slicing: Identification of peak features, Adaptive layer thickness determination, Skin contour computation. Tool path generation. Part Building: Recoating, parameters affecting part building time, part quality. Post Processing: Part removal, finishing, curing. Other issues: Shrinkage, Swelling, Curl and distortion, Surface Deviation and accuracy, Build Style Decisions,	
Unit IV: RAPID PROTOTYPING MACHINES	**(6 Hrs.)**
Classification, Description of RP Machines: SLA, SLS, FDM, 3D Printing, LOM, SDM, Contour Crafting.	
Unit V: RAPID TOOLING AND MANUFACTURING	**(7 Hrs.)**
Classification of RT Routes, RP of Patterns, Indirect RT: Indirect method for Soft and Bridge Tooling, Indirect method for Production Tooling, Direct RT: Direct RT method for Soft and Bridge Tooling, Direct method for Production Tooling, Other RT Approaches. Rapid Manufacturing: Methods, limitations. Robotic additive manufacturing	
Unit VI: APPLICATION OF RP	**(6 Hrs.)**
Heterogeneous objects, Assemblies, MEMES and other small objects, Medicine, miscellaneous areas including art.	
Total Lecture	**39 Hours**

Textbooks:	
1.	Gibson, I. (Ed.), Software Solutions for Rapid Prototyping, Professional Engineering Publications, London., 2002..
2.	Chua C. k. and L. K. Fai, Rapid Prototyping: Principles and Applications in Manufacturing
3.	Jacobs, P.F. (Ed.), Stereo lithography and Other RP&M Technologies: From Rapid Prototyping to Rapid Tooling, Society of Manuf. Engrs. NY

Reference Books:	
1.	Bjorke, Layer Manufacturing, Tapir Publisher. 1992
2.	Jacobs, PF (Ed), Rapid Prototyping and Manufacturing, Society of Manuf. Engrs, 1992.
3.	Burns, M., Automated Fabrication: Improving Productivity in Manufacturing, 1993.

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1.	https://youtu.be/cQjeXVsF_rU
2.	https://youtu.be/cDDeWRB7PCs
3.	https://archive.nptel.ac.in/courses/112/103/112103306/

II SEMESTER

25AR223: Product Design and Development

Course Outcomes :

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

1. Evaluate the product life cycle..(L4)
2. Analyze and select the materials and manufacturing processes for designed product.(L4)
3. Evaluate the product for different design criteria like robust design, benchmarking, DFX ,etc and estimate the product costing.(L4)
4. Illustrate the various prototyping methods and its economics. .(L3)

Unit I: Introduction:	**(6 Hrs.)**
Importance of product design, types of design, product definition, product specification, Phases of product development: conceptual, embodiment and detailed design, product and technology development cycle, concept generation and evaluation methods. **CO 1**	
Unit II: Material and Process selection	**(6 Hrs.)**
Material selection – Importance, classification, material performance characteristic, Selection criteria, Ashby Material selection chart. Process selection – Importance types of manufacturing processes and their classification, sources of information, selection criteria, Material and Process selection Methods- Expert systems, Computer Database Approach, Performance indices, decision matrix, AHP and fuzzy approach, introduction to material and process selection software **CO 2**	
Unit III: Value Engineering	**(7 Hrs.)**
Introduction to Value Engineering (V.E.) and Value Analysis, Types of Value, Types of Functions, Introduction to V.E. Job plan / Functional Approach to Value Improvement, Various phases and techniques of the job plan, Fast diagramming , DARSIRI method of value analysis . **CO 3**	
Unit IV: Benchmarking	**(6 Hrs.)**
Benchmarking – DFM, DFA, DFX, Early supplier involvement, robust design, QFD and concurrent engineering. **CO 3**	
Unit V: Costing & Assembly	**(7 Hrs.)**
Mathematics of Time Value of Money, Cost Comparison, Depreciation, Taxes, Inflation, Profitability of Investment and Investment Decision Analysis Sensitivity Analysis. Methods of Cost Estimates. Industrial Engineering Approach, Parametric Approach, Introduction to Assembly Modeling, Top-Down and Bottom-Up Approaches of AM, Mating Conditions, Representation Schemes, Generations of Assembly Sequences. **CO 3**	

Unit VI: Rapid Prototyping	**(6 Hrs.)**
Product Development Cycle and Importance of Prototyping, Types of Prototypes, Principle and Advantages & Different Type of Generative Manufacturing Process, Viz, Stereolithography, FDM, SLS etc. Factors Concerning to RP: Consideration for Adoptions, Advantages, Accuracy and Economic Considerations. **CO 4**	
Total Lecture	**39 Hours**

Textbooks:	
1.	Dieter George E. ―Engineering Design‖, McGraw Hill Pub. Company, 2000
2.	Ulirich Karl T. and Eppinger Steven D., ―Product Design and Development‖ McGraw Hill Pub. Company
3.	A. K. Chitale and R. C. Gupta, Product Design and Manufacturing, PHI Pvt. Ltd.,

Reference Books:	
1.	Bralla, James G., ―Handbook of Product Design for Manufacturing‖ McGraw Hill Pub. Company
2.	Harry Nystrom, " Creativity and innovation", John Wiley& Sons,
3.	Brain Twiss, " Managing technological innovation", Pitman Publishing Ltd.,
4.	Harry B.Watton, " New Product Planning ", Prentice Hall Inc.
5.	P.N.Khandwalla - " Fourth Eye (Excellence through Creativity) – Wheeler Publishing ",Allahabad,

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/e-copies%20of%20books/2.Mechanical%20Engineering/
2	http://103.152.199.179/YCCE/e-copies%20of%20books/2.Mechanical%20Engineering/
3	http://103.152.199.179/YCCE/e-copies%20of%20books/2.Mechanical%20Engineering/

MOOCs Links and additional reading, learning, video material	
1.	nptel/courses/video/112107217/L01.html
2.	https://www.youtube.com/watch?v=5OQAD606Yow
3.	https://www.youtube.com/watch?v=qgVs8vskWl0

III Semester
25AR301 : PROJECT PHASE-I

OBJECTIVES

As the project methodology for the batches is decided in the 2 nd semester the student shall carry out the project work further 3 rd semester.

The project work consists of:

1. A comprehend since and update survey of literature.
2. Study of processes /phenomenon related to project.
3. Design of any equipment its fabrication and testing.
4. Critical analysis of design or process for optimization
5. Verification by experimentation.
6. In case of industrial project the necessary modifications with the proper drawing / design suggested to the industry should be explained. The letter from the industry should be attached in the report related to the performance of the student

IV Semester
25AR401: PROJECT PHASE-II

OBJECTIVES

As per the Project Phase 1, the students should carry out and submit the project work that include the implementation of all Semesters subjects knowledge with required validation and certification