Annexure E 5

SHRI VISHWAKARMA SKILL UNIVERSITY

(A STATE GOVT SKILL UNIVERSITY ESTABLESHED BY GOVT.OF HARYANA)

Name of the Skill Faculty**:** Skill Faculty of Engineering & Technology

Name of the Programme/Course: **M.Voc. (Robotics and Automation) with JBM Group**

Duration of the course: 4 Semesters/2 Years

Batch: **2020-2022 onwards**

Scheme of M.Voc (Robotics and Automation) Batch: 2020-2022 onwards

Semester-I															
Category	Subject Code	Subjects	Credits			Marks							Hrs per course		
						Th.			Pr.			Total	Total		
			Th.	Pr.	Total	Int.	Ext.	Total	Int.	Ext.	Total		Th.	Pr.	THr.
General Education Component	EE-801	Advanced Electrical & Electronics Engineering	3	-	3	15	35	50	-	-	-	50	45	-	45
	IMS-801	Industrial Management	3	-	3	30	70	100	-	-	-	100	45	-	45
	IMS-802	Research Methodology	4	-	4	30	70	100	-	-	-	100	60	-	60
	EE-802	Drives and Control System for Automation	3	-	3	30	70	100	-	-	-	100	45	-	45
	ENG-801	Advanced Communication Skills	3	-	3	15	35	50	-	-	-	50	45	-	45
	EE-801L	Advanced Electrical & Electronics Engineering Lab	-	2	2	-	-	-	35	15	50	50	-	60	60
	ENG-801L	Advanced Communication Skills Lab	-	2	2	-	-	-	35	15	50	50	-	60	60
	GEC Total		**16**	**4**	**20**	**120**	**280**	**400**	**70**	**30**	**100**	**500**	**240**	**120**	**360**
Skill Education Component	RA-801	Robotics-I	3	-	3	15	35	50	-	-	-	50	45	-	45
	RA-802	Automation-I	3	-	3	15	35	50	-	-	-	50	45	-	45
	RA-801L	Robotics Lab-I	-	2	2	-	-	-	35	15	50	50	-	60	60
	RA-802L	Automation Lab-I	-	2	2	-	-	-	35	15	50	50	-	60	60
	EE-803L	Modelling and Simulation Lab	-	2	2	-	-	-	70	30	100	100	-	60	60
	SEC Total		**6**	**6**	**12**	**30**	**70**	**100**	**140**	**60**	**200**	**300**	**90**	**180**	**270**
	Grand Total		**22**	**10**	**32**	**150**	**350**	**500**	**210**	**90**	**300**	**800**	**330**	**300**	**630**

Scheme of M.Voc (Robotics and Automation) Batch: 2020-2022 onwards

Semester-II															
Category	**Subject Code**	**Subjects**	**Credits**			**Marks**							**Hrs. per course**		
						Th.			**Pr.**			**Total**	**Total**		
			Th.	**Pr.**	**Total**	**Int.**	**Ext.**	**Total**	**Int.**	**Ext.**	**Total**		**Th.**	**Pr.**	**THr.**
General Education Component	*OET-801	*MOOC/Online Course-I	2	-	2	30	70	100	-	-	-	100	30	-	30
	OMS-802	Entrepreneurship (MOOC/Online Course-II)	2	-	2	30	70	100	-	-	-	100	30	-	30
	GEC Total		**4**	**-**	**4**	**60**	**140**	**200**	**-**	**-**	**-**	**200**	**60**	**-**	**60**
Skill Education Component	OJT-801	On Job Training (OJT)	-	24	24	-	-	-	245	105	350	350	-	1080	1080
	SEC Total		**-**	**24**	**24**	**-**	**-**	**-**	**245**	**105**	**350**	**350**	**-**	**1080**	**1080**
	Grand Total		**4**	**24**	**28**	**60**	**140**	**200**	**245**	**105**	**350**	**550**	**60**	**1080**	**1140**

Note: * Relevant MOOC/Online course will be offered as per the availability.

Job Role: Level-8

Robotics and Automation Executive

Scheme of M.Voc (Robotics and Automation) Batch: 2020-2022 onwards

Semester III																
Category	**Subject Code**	**Subjects**	**Credits**			**Marks**							**Hrs. per course**			
						Th.			**Pr.**			**Total**	**Total**			
			Th.	**Pr.**	**Total**	**Int.**	**Ext.**	**Total**	**Int.**	**Ext.**	**Total**		**Th.**	**Pr.**	**THr.**	
General Education Component	OET-901	*MOOC/Online Course-III (Automation in Manufacturing)	2	-	2	30	70	100	-	-	-	100	30	-	30	
	OAE-101	Human Values and Professional Ethics (MOOC/Online Course-IV)	2	-	2	30	70	100	-	-	-	100	30	-	30	
	GEC Total		**4**	**-**	**4**	**60**	**140**	**200**	**-**	**-**	**-**	**200**	**60**	**-**	**60**	
Skill Education Component	ETP-901L	Project/Dissertation	-	2	2	-	-	-	100	100	200	200	-	60	60	
	OJT-901	On Job Training (OJT)	0	24	24	-	-	0	245	105	350	350	0	1080	1080	
	SEC Total		**-**	**26**	**26**	**-**	**-**	**-**	**345**	**205**	**550**	**550**	**-**	**1140**	**1140**	
	Grand Total		**4**	**26**	**30**	**60**	**140**	**200**	**345**	**205**	**550**	**750**	**60**	**1140**	**1200**	

Note: * Relevant MOOC/Online course will be offered as per the availability.

Scheme of M.Voc (Robotics and Automation) Batch: 2020-2022 onwards

Semester IV															
Category	**Subject Code**	**Subjects**	**Credits**			**Marks**							**Hrs per course**		
						Th.			**Pr.**			**Total**	**Total**		
			Th.	**Pr.**	**Total**	**Int.**	**Ext.**	**Total**	**Int.**	**Ext.**	**Total**		**Th.**	**Pr.**	**THr.**
General Education Component	ME-901	Pneumatics & Hydraulics Control	3	-	3	15	35	50	-	-	-	50	45	-	45
	CSE-901/ EE-901/ EE-902	Elective –I	3	-	3	30	70	100	-	-	-	100	45	-	45
	MTH-901/ ECE-901/ ME-902	Elective -II	4	-	4	30	70	100	-	-	-	100	60	-	60
	ECE-902	Sensors Application in Robotics	3	-	3	15	35	50	-	-	-	50	45	-	45
	CSE-902	Machine Vision Systems	3	-	3	30	70	100	-	-	-	100	45	-	45
	ME-901L	Pneumatics & Hydraulics Control Lab	-	2	2	-	-	-	35	15	50	50	-	60	60
	ECE-902L	Sensors Application in Robotics Lab	-	2	2	-	-	-	35	15	50	50	-	60	60
	GEC Total		**16**	**4**	**20**	**120**	**280**	**400**	**70**	**30**	**100**	**500**	**240**	**120**	**360**
Skill Education Component	RA-901	Advance Robotics	3	-	3	15	35	50	-	-	-	50	45	-	45
	RA-902	Automation System Design	3	-	3	15	35	50	-	-	-	50	45	-	45
	RA-901L	Advance Robotics Lab	-	2	2	-	-	-	35	15	50	50	-	60	60
	RA-902L	Automation System Design Lab	-	2	2	-	-	-	35	15	50	50	-	60	60
	RA-903L	HMI & SCADA LAB	-	2	2	-	-	-	70	30	100	100	-	60	60
	ETS-901L	Seminar	-	2	2	-	-	-	70	30	100	100	-	60	60
	SEC Total		**6**	**8**	**14**	**30**	**70**	**100**	**210**	**90**	**300**	**400**	**90**	**240**	**330**
	Grand Total		**22**	**12**	**34**	**150**	**350**	**500**	**280**	**120**	**400**	**900**	**330**	**360**	**690**

Elective –I

Artificial Intelligence & Expert System (CSE-901)

Automatic Control System (EE-901)

Process Control and Automation (EE-902)

Elective-II

Optimization Technique (MTH-901)

Virtual Instrumentation (ECE-901)

CAD/CAM (ME-902)

Note: -Minimum 8 students for elective subject.

Job Role: Level-9 Robotics and Automation Senior Executive

Syllabus

(1st Year-First and Second Semester)

for

M.Voc. (Robotics and Automation)

Industry Partner: JBM Group

Batch: 2020-2022 onwards

Advanced Electrical & Electronics Engineering

Subject Code: EE-801

Credit	Hours	Marks		
03	45	I	E	To
		15	35	50

Objective:

- To impart knowledge of various types of motors used in industries.
- To understand about Special purpose machines used in industries.
- To understand the various types of power-controlled devices such as choppers, thyristors, cycloconverters

Learning Outcome: The student will be able:

- To understand working principles of various types of motors, differences, characteristics and selection criteria.
- To apply the knowledge in selection of motors, heating effects and braking concepts in various industrial applications
- To explain control methods of various motors
- To elucidate various Thyristors, choppers and cycloconverters principles and methods and use the same to application areas

Unit I: Induction Motors: Construction – Types – Principle of operation of three phase induction motors – Speed Torque characteristics - Equivalent circuit - Starting and Speed control – Single-phase induction motors (only qualitative analysis). - Introduction to Linear induction motor – PMSIM – Applications.

Unit II: Synchronous and Special Purpose Machines: Construction of Synchronous machines - Types – Induced emf – Working principles of: Brushless alternators – Stepper motor - Servomotor – Universal motor -. Applications – rating and duty cycle -Sizing of Motor for an Industrial application.

Unit III: Thyristor and their characteristics: Introduction to thyristor family V-I characteristics of SCR, GTO, LASCR, DIAC and TRIAC, Principle of operation of SCR, Two transistor analogy, Turn on methods of a thyristor Switching characteristics of thyristor during turn-on and turn-off, Gate characteristics, Firing of thyristor, Gate triggering circuits, Series and parallel, operation of SCRs and their triggering circuits.

Unit IV: Choppers: Introduction and principle of chopper operations, Control strategies, two quadrant chopper, Four quadrant chopper, Regenerative chopper, Steady state time domain analysis of type A-chopper, voltage commutated chopper or classical Jones chopper.

Unit V: Cycloconverter: Basic circuit and operation of single phase cycloconverter, Single phase bridge cycloconverter, Three phase to single phase to single phase cycloconverter, Advantages and disadvantages of cycloconverters

Text Books:

1.P.S. Bimbhra, **Power Electronics**, Khanna Publishers.
2. M.D. Singh, K.B. Khanchandani, **Power Electronics**, Tata Mc Graw Hill Publishing company limited.
3. M.H. Rashid, **Power Electronics**, PHI
4. V.K. Mehta and Rohit Mehta, ―Principles of Power System‖, S.Chand and Company Ltd, 2003

Reference Books:

1. P.C. Sen**, Power Electronics**, Tata Mc Graw Hill Publishing company limited
2. K Murugesh Kumar, —Induction and Synchronous machines‖, Vikas Publishing House Pvt Ltd, 2010

Advanced Electrical & Electronics Engineering Lab

Subject Code: EE-801L

Credit	Hours	Marks		
02	60	I	E	To
		35	15	50

Experiments

1. To study principle of operation of SCR, plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2. To draw V-I characteristics of an UJT and to use UJT as relaxation oscillator.
3. Thyristorised speed control of a D.C. Motor.
4. Speed Control of induction motor using thyristor.
5. To study speed Torque characteristics of A.C. servo motor
6. To study speed Torque characteristics of DC servo motor.
7. To study a stepper motor & to execute microprocessor or computer-based control of the same by changing number of steps, direction of rotation & speed

Industrial Management

Subject Code: IMS-801

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Objectives

- Train students about quality assurance programmes implemented in industries.
- To examine the latest business practices crucial for running successful business.

Learning Outcome

- The course will provide a conceptual framework of handling the diverse and complex problems in business and industries. It will help in addressing and solving the real life problems relating to industrial setups.

Unit 1

Introduction: Concept, Development, Application and scope of Industrial Management, Productivity: Definition, Measurement, Types of production system.

Unit 2

Management Function: Principle of Management – Time and motion study, Work simplification – process charts and flow diagrams, Production Planning.

Unit 3

Strategy: Mintzberg's 5P's of strategy – Corporate, Business and Functional Levels of strategy, Preparing an Environmental Threat and Opportunity Profile (ETOP),

Unit 4

Porter's Five Forces Model of competition: Quality Control: Process control, SQC, Control charts, Introduction to TQM, Kaizen, Five S (5S), Introduction to Supply Chain Management, Warehouse Management, Lean Supply Chain Management of an Automotive Industry, Total Productive Maintenance

Unit 5

Six Sigma Quality Management Standards (Introductory aspects only), The ISO 9001:2000 Quality Management System Standard, The ISO 14001:2004 Environmental Management System Standard, ISO 27001:2005 Information Security Management System, JIT.

Suggested Readings

- P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd, New
- L.C.Jhamb , Savitri Jhamb , Industrial Management – I , Everest Publishing House .
- K.Shridhara Bhat, "Materials and Logistics Management", Himalaya Publishing House.
- Azar Kazmi , "Strategic Management & Business Policy ", Tata McGraw Hill, New Delhi
- Ravi M. Kishore, "Project Management", Tata McGraw Hill, New Delhi

Research Methodology

Subject Code: IMS-802

Credit	Hours	Marks		
04	60	I	E	To
		30	70	100

Objectives:

- To import the knowledge on analysis of Research methodology.
- The students will be able to estimate the performance of different testing method for research.

Learning Outcomes:

- The Students will be able to analysis the methods used for data collection hypothesis testing and sampling process for research methodology

Unit I Introduction: Definition, mathematical tools for analysis, Types of research, exploratory research, conclusive research, modelling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. Secondary data- internal sources of data, external sources of data.

Unit II Sampling Methods Scales: Measurement, Types of scale – Thurston's Case V scale model, Osgood's Semantic Differential scale, Likert scale, Q- sort scale. Sampling methods- Probability sampling methods – simple random sampling with replacement, simple random sampling without replacement, stratified sampling, cluster sampling. Non-probability sampling method – convenience sampling, judgment sampling, quota sampling.

Unit III Hypotheses Testing: Testing of hypotheses concerning means -one mean and difference between two means -one tailed and two tailed tests, concerning variance – one tailed Chi-square test.

Unit IV Design of Experiments: Introduction, Types - Full and Fractional Factorial Design- Orthogonal Array Design - Taguchi techniques - Regression Models - Response Surface Methods

Unit V Optimization and Report Writing Optimization: Classification- methods- genetic, particle swarm and artificial bee colony algorithms. Report writing- Types of report, guidelines to review report and typing instructions - oral presentation.

Unit VI Application: Apply Research Methodology principles into design and manufacturing field.

Text Books

1. 1. C.R. Kothari, Research Methodology –Methods and techniques, New Age Publications, New Delhi, 2009.
2. R. Panneerselvam, Research Methodology, Prentice-Hall of India, New Delhi, 2004.
3. K. Deb, Optimization for Engineering Design Algorithms and Examples, Prentice Hall of India Pvt. 2010.

Reference Books

1. Ashok D. Belegundu, R. Tirupathi and Chandrupatla, Optimization Concepts and Applications in Engineering, Pearson Education, 2014.
2. R. PanneerSelvam, Design and Analysis of Experiments, Prentice Hall India Learning Private Limited, 2012.
3. http://nptel.ac.in/courses/11110503

Drives and Control System for Automation

Subject Code: EE-802

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Objective:

- To impart knowledge of various control drives for motors used in industries.
- To understand about Programmable Logic Controller(PLC) and its instructions.
- To understand the various logics used in programming a PLC.

Learning Outcome: The student will be able:

- To understand working principles of various types of motors, differences, characteristics and selection criteria.
- To apply the knowledge in selection of motors, heating effects and braking concepts in various industrial applications
- To explain control methods of special drives
- To elucidate various linear and rotary motion principles and methods and use the same to application areas
- To carry out programming using PLC and use of various PLCs to Automation problems in industries.

Unit I Introduction: Working principle of synchronous, Asynchronous & stepper motors, Difference between Induction and servo motors, Torque v/s speed characteristics, Power v/s. Speed characteristics, Vector duty induction motors, Selection of feedback system, Duty cycle, V/F control, Flux Vector control. (SLE: Current control (sensor less vector control)

Unit II Industrials Drives: DC and AC motors operation and selection, method of control and application of brushless DC motor, PMSM, stepper motor, A.C servomotor, selection criteria for servo motor and servo amplifier, universal motor, electric drive, types of industrial drives, the characteristics of drive, advantages of drives over other prime movers, motor rating, heating effects, electric braking, rheostat and regenerative braking principles in power converters.

Unit III Motion laws for rotary and linear systems: Converting rotary to linear system, concepts and principles of ball screws, rack and pinion, belt and pulley, chain drives, gear drives, Selection of converting systems, Dynamic response gearing, and control approaches of Robots, Control loops using Current amplifier.

Unit IV Introduction to Programmable Logic Controllers: Definitions of PLC, basic structure of PLC, working principles, data storage methods, inputs / outputs flag processing's, types of variables, definition of firmware, software, programming software tool and interfacing with PC (RS232 & TCP-IP), methods of PLC programming (LD, ST, FBD & SFC), difference between relay logic and PLC,Communication Protocols:-CC Link /Profinet/Ethernet/Controlnet/Devicenet/Profibus.

Unit V Logic, instructions & Application of PLC: What is logic, Conventional Ladder v/s PLC ladder, series and parallel function of OR, AND, NOT logic, Ex Or logic, Analysis of rung. Timer and Counter Instructions; on delay and Off delay and retentive timer instructions, PLC counter up and down instructions, combining counters and timers, Comparison and data handling instructions, Sequencer instruction, Visualization Systems, Types of visualization system, PC based Controller.

Text Books:

1. Process Control Instrumentation Technology, Johnson Curties, Prentice hall of India, 8th edition
2. Andrew Parr, Industrial drives, Butterworth – Heineamann
3.G.K.Dubey.Fundamentals of electrical drives
4. Programmable Logic Controllers by W.Bolton

References:

1.Introduction to Programmable Logic Controllers by Garry Dunning, 2nd edition, Thomson, ISBN:981-240-625-5
2.Instrumentation Engineers Hand Book - Process Control, Bela G Liptak, Chilton book company, Pennsylvania
3. A.E. Fitzerald ,C.Kingsley and S.D Umans, Electric Machinery - McGraw Hill Int. Student edition
4. S.K.Pillai. A First course on electric drives –Wiley Eastern 1990
5. Programmable Logic Controllers by Hugh Jack.

Advanced Communication Skills

Subject Code: ENG-801

Credit	Hours	Marks		
03	45	I	E	To
		15	35	50

Objectives: To develop effective communication skills among the students for the business world

Learning Outcome

- Able to communicate effectively and will have improved verbal communication. (Theory)
- Able to write paragraphs on different topics with the correct usage of vocabulary and will improve the written as well as verbal communication. (Theory)
- Effectively use established communication systems and protocols in the workplace (Theory)
- Learn the basics of various business processes, challenges and resolution of the customer queries. (Theory)
- Identify clients and their needs through effective communication and use this information to develop effective work practices and outcomes (Theory)

Unit	Topic
I - Basics of Communication	Process, Types, Purpose & Barriers; Oral communication: noise, listening–process, types of listening, deterrents to listening process, essentials of good listening;
II - Presentation skills	Prerequisites of effective presentation, format of presentation; Assertiveness – indicators of assertive behaviour, strategies of assertive behavior.
III - Nonverbal communication	Gestures, handshakes, gazes, smiles, hand movements, style of working, dress and appearance; business etiquettes: business manners of people of different cultures
IV - Written communication	Mechanics of writing, report writing, circulars, notices, memos, agenda and minutes; business correspondence – business letter format, style of letter arrangement, types of letters, electronic mail; developing resume
V - Communication in Practice	Preparing for interviews- types of interviews, group discussion; Telephone Etiquettes-Dos and Don'ts, communicating effectively; Social media profile, Different types of profiles, Editing and Posting on social media profile

Books Recommended

Text Books

1. Essentials of Business Communication - Rajendra Pal and J. S. Korlhalli - Sultan Chand & Sons, New Delhi.

Reference Books

2. Business Communication (Principles, Methods and Techniques) Nirmal Singh - Deep & Deep Publications Pvt. Ltd., New Delhi.
3. Business Communication - Dr. S.V. Kadvekar, Prin. Dr. C. N. Rawal and Prof. Ravindra Kothavade - Diamond Publications, Pune.
4. Business Correspondence and Report Writing - R. C. Sharma, Krishna Mohan – Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Modern Business Correspondence - L. Gartside - The English Language Book Society and Macdonald and Evans Ltd.
6. Business Communication - M. Balasubrahmanyan - Vani Educational Books.
7. Creating a Successful CV - Siman Howard - Dorling Kindersley.
8. Business Communication - K. K. Sinha - Galgotia Publishing Company, New Delhi.
9. Media and Communication Management - C. S. Rayudu - Himalaya Publishing House, Bombay.

Advanced Communication Skills Lab

Subject Code: ENG-801L

Credit	Hours	Marks		
02	60	I	E	To
		35	15	50

List of Experiments

1. Listening skill
2. Presentation Skill
3. Role Plays
4. Business meetings
5. Team work
6. Group discussion
7. Case study

Robotics-I

Subject Code: RA-801

Credit	Hours	Marks		
03	45	I	E	To
		15	35	50

Objectives:

- To impart knowledge on direct and inverse kinematics of manipulator
- To understand the basic elements of serial and parallel robots
- To learn trajectory and motion analysis of robotic movements

Learning Outcomes:

- Understanding of serial and parallel robots
- Trajectory planning of robot motion
- Knowing the controlling aspects of a robot.

Unit-I

Introduction: 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.

Unit-II

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.

Unit-III

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.

Unit-IV

Workspace Analysis and Trajectory 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 technique in trajectory planning.

Unit-V

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.

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 Mc Graw Hill Publishing company Ltd., 1995.
4. Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.

Reference Books:

1. Bernard Hodges, *Industrial Robotics*, Second Edition, Jaico Publishing house, 1993.
2. Tsuneo Yohikwa, *Foundations of Robotics Analysis and Control*, MIT Press. 2003.
3. John J. Craig, *Introduction to Robotics Mechanics and Control*, Third Edition, Pearson, 2008.
4. Bijay K. Ghosh, Ning Xi, T.J. Tarn, *Control in Robotics and Automation Sensor – Based integration*, Academic Press, 1999

Robotics-I Lab

Subject Code: RA-801L

Credit	Hours	Marks		
02	60	I	E	To
		35	15	50

List of Experiments

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
6. Estimation of accuracy, repeatability and resolution.
7. Robot programming exercises

Automation-I

Subject Code: RA-802

Credit	Hours	Marks		
03	45	I	E	To
		15	35	50

Objectives:

- To impart knowledge on Process automation,
- To create expertise in the field of process automation using PLC, DCS and SCADA

Learning Outcomes:

- Able to select the appropriate controller for a particular application.
- Designing various controllers used in the industries.
- Designing safety instrumented systems.

Unit-I

Automation Fundamentals: Automation and its importance, automation applications, expectations of automation. Types of plant and control – categories in industry, open loop and close loop control functions, continuous processes, discrete processes, and mixed processes. Automation hierarchy – large control system hierarchy, data quantity & quality and hierarchical control.

Unit-II

Programmable Logic Controller Hardware: Evolution of PLC, Definition, functions of PLC, Advantages, Architecture, working of PLC, Scan time, Types & Specifications. DI-DO-AI-AO examples and ratings, I/O modules, local and remote I/O expansion, special purpose modules, wiring diagrams of different I/O modules, communication modules, Memory & addressing- memory organization (system memory and application memory), I/O addressing, hardware to software interface.

Unit-III

Programmable Logic Controller Software: Development of Relay Logic Ladder Diagram, introduction to PLC Programming, programming devices, IEC standard PLC programming languages, LD programming- basic LD instructions, PLC Timers and Counters

Unit-IV

Distributed Control System: Introduction to DCS – Evolution of DCS, DCS flow sheet symbols, architecture of DCS – controller, Input and output modules, communication module, data highway, local I/O bus, workstations, specifications of DCS. Introduction to Hierarchical Control and memory: Task listing, Higher & Lower Computer level tasks. Supervisory computer tasks and DCS configuration –Supervisory Computer functions

Unit-V

Supervisory Control and Data Acquisition (SCADA):SCADA introduction, brief history of SCADA, elements of SCADA. Features of SCADA, MTU- functions of MTU, RTU- Functions of RTU, Protocol Detail SCADA as a real time system, and Communications in SCADA- types & methods used, components, Protocol structure and Mediums used for communications.

Text Books:

1. Samuel M. Herb, “Understanding Distributed Processor Systems for Control”, ISA Publication.

2. Thomas Hughes, “Programmable Logic Controller”, ISA Publication.
3. Stuart A. Boyer, “SCADA supervisory control and data acquisition”, ISA Publication.
4. Gruhn and Cheddie, “*Safety Shutdown Systems”* – ISA, 1998,
5. Poppovik Bhatkar, “Distributed Computer Control for Industrial Automation”, Dekkar Publication.

Reference Books:

1. S.K.Singh, “Computer Aided Process Control”, Prentice Hall of India.
2. Krishna Kant, “Computer Based Process Control”, Prentice Hall of India
3. N.E. Battikha, “The Management of Control System: Justification and Technical Auditing”, ISA.
4. Gary Dunning, “Introduction to Programmable Logic controller”, Thomas Learning, edition, 2001.

Automation-I Lab

Subject Code: RA-802L

Credit	Hours	Marks		
02	60	I	E	To
		35	15	50

List of Experiments

1. Wire up a PLC for the given lamp circuit
2. Design a Ladder logic for the given lamp circuit
3. Design and implement ladder logic for the forward and reverse control of a hydraulic cylinder.
4. Design a ladder diagram for performing the given arithmetic operations.
5. Design a ladder diagram for performing the given application using counters
6. Design a ladder diagram for performing the given application using Timers.
7. Interfacing PLC to HMI- text display.
8. Programming a graphical HMI
9. Networking PLCs- drives and a host computer.
10. Troubleshooting PLCs

Note: Any 7 experiments are to be performed

Modelling and Simulation Lab

Subject Code: EE-803L

Credit	Hours	Marks		
02	60	I	E	To
		70	30	100

List of Experiments

1. Obtain the unit step response of a second order system with zeta =0.5% and ωn =6 rad/s.
2. The Closed loop transfer function of a system is %s(s2+9s+19)/(s3+7s2+14s+8). Determine the unit step response of the %system.
3. The open loop transfer function of a servo system with unity %feedback is given by G(s)=10/)(s+2)(s+5). Determine the damping ratio, % undamped natural frequency of oscillation. What is the percentage overshoot of the response to a unit step input.
4. For a unity feedback control system the forward path function is % given by G(s)=20/s(s+2)(s2+2s+20).Determine the steady state error of % the system when inputs are
   i)5
   ii) 5t
   iii) 3t2/2
5. Sketch the polar plot of %G(s)=20s/(s+1)(s+10).
6. Sketch the Bode Plot for the transfer function of %G(s)=1000/s(1+0.1s)(1+.001s).
7. Sketch the Bode Plot for transfer function of %G(s)=1000/(1+.01s)(1+.001s).
8. Sketch the Bode Plot for the transfer function of %G(s)=1000/s(1+0.1s)(1+0.001s).
9. Sketch the Bode Plot for the transfer function of %G(s)=e-0.35/s(1+s).
10. 10.A unity feedback control system is characterised by open loop transfer function of %G(s)=K(s+13)/s(s+3)(s+7). Find the range of values of k for the system to be stable.

*MOOC/Online Course-I (Robotics and Control : Theory and Practice)

Subject Code: OET-801

Credit	Hours	Marks		
02	30	I	E	To
		30	70	100

Learning Outcomes

Students will be able to

- Define the robot parameters and describe the kinematic model for a robot manipulator using D-H Procedure
- Describe the concept of differential transformation.
- Describe the concept of robot dynamics.
- Describe the concept of Human fingers using Robotic principles.
- Understand the concept of needling system for robots

Unit	Topic	Key Learning
I	Introduction to Robot parameters	Simple manipulators: Two /three arm manipulators and their kinematics equations, Danavit-Hartimber Algorithm, Robot parameters, Arm matrix, SCARA manipulators.
II	Robotic Exoskeletons	Introduction to Robotic Exoskeletons, Differential transformation and velocity of a frame: Derivative of a frame, Velocity, Jacobian, Inverse Jacobian.
III	Dynamics	Robot dynamics equation, Control: Robot dynamics equation as a control system, Trajectory tracking control
IV	Robotic Principles	Redundancy Resolution of Human Fingers using Robotic Principles, Manipulability Analysis of Human Fingers during Coordinated Object Rotation.
V	Needling System	Robot Assisted Needling System for Percutaneous Intervention-An Introduction, Smart Robotic Needles for Percutaneous Cancerous Interventions.

Text Books:

1. Richard Paul, Robot Manipulators: Mathematics, Programming and Control, MIT Press, 1981
2. Robert Shilling, Fundamentals of Robotics, Prentice-Hall , 2003
3. Laxmidhar Behera and Indrani Kar, “Intelligent Systems and Control”, Oxford University Press, Nov 2009.

Reference Books:

1. M. Felix Orlando, Ashish Dutta, Anupam Saxena, Laxmidhar Behera, Tomoya Tamei and Tomohiro Shibata, “Manipulability Analysis of Human Thumb, Index and Middle Finger in Cooperative 3D Rotational Movements of a Small Object”, Robotica, vol. 31, pp. 797-809, 2013.
2. M. Felix Orlando, Laxmidhar Behera, Tomayo Tamei, Tomohiro Shibata, Ashish Dutta and Anupam Saxena," On Redundancy Resolution of the Human Thumb, Index and Middle Fingers in Cooperative Object Translation," Robotica, vol. 35, pp. 1992-2017, 2016.

Entrepreneurship (MOOC/Online Course-II)

Subject Code: OMS-802

Credit	Hours	Marks		
02	30	I	E	To
		30	70	100

Objectives:

- The course will create awareness among the students about the entrepreneurship and factors that will help in facilitating the entrepreneurial development with a focus on new ventures/ start-ups.
- Enable the students to develop the insight needed to discover and create entrepreneurial opportunities.
- Successfully start and manage their own businesses to take the advantage of these opportunities.

Learning Outcomes:

- To understand the nature of entrepreneurship
- To understand the function of the entrepreneur in the successful, commercial application of innovations
- To confirm an entrepreneurial business idea
- To identify personal attributes that enable best use of entrepreneurial opportunities
- To explore entrepreneurial leadership, management style and legal issues.

Units	Topics	Learning outcomes
Unit-1	Introduction to Entrepreneurship	Introduction to Entrepreneurship, Entrepreneurial Mindset, Characteristic of an Entrepreneur, Advantages and disadvantages of Entrepreneurship
	Recognise Opportunity	Purpose of all businesses, Types of Entrepreneurial organizations, Types of Enterprises
	Creativity & Innovation	Marketing, 4Ps of Marketing, Process of Marketing, Marketing Mix, 7Ps of Marketing
	Conception & Ideation	Business Plan and its elements, Application of Business Plan
	Are you a risk taker?	Entrepreneurs, types of Entrepreneurs, Roles and Responsibilities of Entrepreneurs, Qualities of an Entrepreneur
	Identify Your Customer	Customer segmentation, Criteria for selling customer value proposition, Customer Lifecycle
Unit-2	Self Confidence and Resilience	4 Ps of Entrepreneurship, Qualities of successful entrepreneur, Self-confidence, Positive attitude, Overcoming the fears, Recover from Failure
	Success and Failure Stories of Famous Entrepreneurs – 1	Steve Jobs Success Story, Mumbai Dabbawala delivery success Story
	Never Give Up	Importance of Focusing energy on Business, Importance of Business Networking and its advantages
	Competition Analysis	Competition Analysis, Factors affecting competition strategies, Prerequisites of successful enterprise

	Risks – Identification and Mitigation	Business Risk, Types of Business Risks, Risk Identification, Risk Mitigation,
	Getting Money for Business	Concept Of Funding, Basics terms of Accounting, Types of Funding,
Unit-3	Dream and Achieve	Vision, Mission and Goals, Business Ethics, SMART goals, entrepreneurial work ethics
	Leadership and Team Spirit	Lead by example, Importance of Embracing diversity, Role of Emotional Intelligence to be a leader.
	Success and Failure Stories of Famous Entrepreneurs – 2	
	Serving the Society	Roles of Entrepreneurs in society, Selfless Entrepreneurship,
	Taking Ownership	Taking complete ownership, taking control over the business
	Adapt to Change	Porters competition strategies, Factors affecting business,
	Discover Yourself	Qualities of the successful entrepreneur
Unit-4	Problem Solving: Introduction to Critical Thinking	Critical Thinking, Applying critical thinking, REASON Model of Critical Thinking
	Problem Solving: Apply Critical Thinking To Analyse Data	Data Analytics and Critical thinking, IDEAL Model for Data Analysis
	Problem Solving: Introduction to Creative Thinking	Creative thinking, Importance and benefits of Creative thinking, Creative thinking in problem solving
	Creative Thinking: Apply Design Thinking	Design thinking process, Apply design thinking in various situations, THINK Model for design thinking
	Problem Solving: Introduction to Decision Making	Decision making, Effective decision making process
	Decision Making: Respond Effectively to a Situation	Decision making process, DECIDE model for decision making
	Problem Solving: Apply Critical Thinking to Solve Problems	IDEAL MODEL of critical thinking to solve problems
	Creative Thinking: Evaluate Solutions	SCAMPER Model to evaluate solution
	Decision Making: Analyse Impact of Decisions on Organisations	DECIDE model to analyse decisions in organisation
Unit-5	4Ps of Marketing	4Ps- Product, Place, Price, Promotion, Apply 4Ps to marketing Strategy into action
	Costs in Entrepreneurship	Cost, types of Costs, Introduction to Accounting Basics, main methods of Accounting, Financial Documents, P&L statements, Working capital
	Applicable Sources of funding and Regulatory and Statutory rules	Regulatory and statutory rules for an Entrepreneur, Business Loans for startups and MSMEs by Indian Government

	Analysis of success and failure stories	Analysis of success and failure stories, Key skills involved in the successes of entrepreneurs
	Identification of one's entrepreneurial skills and knowledge	Identify various skills and characteristics o be an entrepreneur, Effective Ways to Build Entrepreneurial Skills, Develop or Improve your Entrepreneurial Skills,
	Legal Issues	Intellectual Property Rights, patents, trademarks, copyrights, trade secrets, licensing, franchising

Text Books:

1. Dollinger, MJ, Entrepreneurship- Strategies and Resources, Pearson Education.
2. Desai,Vasant, Entrepreneurship Development, Himalaya Publishing House.
3. Gupta, C.B. and Srinivasan, P., Entrepreneurship Development, Sultan Chand & Sons.

Reference Books:

1. Charanthimath, P.M., Entrepreneurship Development and Small Business Enterprise, Pearson Education.
2. Havinal, Veerbhadrappa, Management and Entrepreneurship, 1st Edition, New Age International Publishers, 2008.

Syllabus

(2nd Year-Third & Fourth Semester)

for

M.Voc. (Robotics and Automation)

Industry Partner: JBM Group Batch: 2020-2022 Onwards

*MOOC/Online Course-III (Automation in Manufacturing)

Subject Code: OET-901

Credit	Hours	Marks		
02	30	I	E	To
		30	70	100

Course Objectives:

Manufacturing industry contributes a major share in the GDP of our country. Application of automated systems is certainly improving the productivity of the manufacturing industry. In view of this, a course on "Automation in Manufacturing" is designed with the primary focus on the design and development of automated systems in the manufacturing. Initially the course introduces various automated systems being used in the manufacturing industry. Then the building blocks of a typical automated system are described.

Learning Outcomes

Students will able to

- learn and understand basic concepts of automation systems
- Acquire the knowledge of fabrication of automated systems
- Acquire the knowledge of sensors, drives and microprocessor technology
- Apply these techniques in applications which involve ball screws, linear motion bearings, electronic cams etc.
- Apply the techniques for designing hydraulic and pneumatic systems

S.No.	Unit	Topics
I	Introduction to Automation	Importance of automation in the manufacturing industry. Use of mechatronics. Systems required. Design of an automated system: Building blocks of an automated system, working principle and examples.
II	Fabrication of Automated Systems	Fabrication or selection of various components of an automated system. Specifications of various elements. Use of design data books and catalogues. study of various sensors required in a typical automated system for manufacturing. Construction and principle of operation of sensors.
III	Microprocessor Technology and Drives	signal conditioning and data acquisition, use of microprocessor or micro controllers. Configurations. Working. electrical drives – types, selection criteria, construction and operating principle.
IV	System Mechanisms	Ball screws, linear motion bearings, cams, systems controlled by camshafts, Electronic cams, indexing mechanisms, tool magazines, and transfer systems.
V	Hydraulics, Pneumatics and CNC Technology	Hydraulic systems: designing of hydraulic circuits, designing of hydraulic circuits, Pneumatic systems: configurations, compressors, valves, distribution and conditioning, CNC technology: basic elements, interpolators and programming.

Text Books and References

1. HMT Ltd. Mechatronics, Tata McGraw-Hill, New Delhi, 1988.
2. Boltan, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore,1999.

3. Regtien, P. P. L., Sensors for mechatronics, Elsevier, USA,2012.
4. Tonshoff, H.K. and I. Inasaki, Sensors in manufacturing, Wiley-VCH, 2001.
5. Gaonkar, R. S., Microprocessor architecture, programming, and applications with the 8085, Penram International Publishing (India), Delhi, 2000.
6. Bradley, D. A., Dawson D., Burd, N. C. and Loader A. J., Mechatronics: Electronics in products and processes, CRC Press, Florida, USA, 2010.
7. Rothbart, H. A., CAM Design Handbook, McGraw-Hill, 2004.• Norton, R. L., Cam Design and Manufacturing Handbook, Industrial press Inc, 2002.
8. https://onlinecourses.nptel.ac.in/noc21_me120/preview

Reference Books:

1. Mechatronics, HMT, Tata McGraw-Hill Education, 1998.
2. Groover, M. P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall, 2001.
3. Parr, A. A., Hydraulics and pneumatics, Elsevier, 1999.
4. Smid, P., CNC Programming Handbook, Industrial Press, New York, USA, 2008.
5. Rao, P. N., CAD/CAM Principles and Applications, Tata McGraw Hill, New Delhi, 2010.

Human Values and Professional Ethics (MOOC/Online Course-IV)

Subject Code: OAE-101

Credit	Hours	Marks		
02	30	I	E	To
		30	70	100

Objectives:

At the end of course, students will attain

- Understanding of Human values for self (Niyama), and for interaction with outer world (Yama).
- Ability to exhibit Professional Ethics in performing a professional task with excellence – योग: कर्मसु कौशलम्
- Understanding of Professional Ethics that demands to see the unseen with emphasis on Sustainable development / eco-friendly implementation of the task.
- Ability to work in team with human values and professional ethics

UNIT I

Human Values-1: Morals, Values (Niyama): -Understanding values, Types of values, Role of tracking values for individual & social wellbeing. And Ethics (Yama):
Integrity: - Understanding integrity and role of integrity in social harmony –Trustworthiness
Work Ethics – Service-Learning – Civic Virtue – Respect for others – Living Peacefully –Caring – Sharing.
Honesty: -Understanding honesty and its role in personal and social –Courage – Value Time. Co-operation: -Understanding cooperation and significance of cooperation its family, work team and social cohesiveness, wellbeing and development – Commitment.
Tutorial Module: Rational Behavior versus Ethical Behavior: Case Studies (from Yoga-Sutra, Bhagwat Geeta, Panchatantra, Autobiography of Mahatma Gandhi) or any other literatures.

UNIT II

Human Values-2: Empathy: Basic **Concept on Empathy**– Self-confidence – Spirituality- Character.
Truthfulness: - Understanding truthfulness, need for truthfulness and role of truthfulness in relationship, social interaction, integrity, faiths & dependence – Customs and Traditions -Value Education – Human Dignity – Human Rights – Fundamental Duties – Aspirations and Harmony (I, We & Nature) – Gender Bias – Emotional Intelligence– Emotional Competencies – Conscientiousness.
Being, body, brain & mind: - Effective & efficient use of body, brain and mind is personal and social well being
Value Judgments, Facts & Values, how values are justified, Aesthetics, Selection of Values, Universal Values, Human Values, Value Education
Tutorial Module: Empathy and its types: Case Studies from Yoga-Sutra, Bhagwat Geeta, Panchatantra, Autobiography of Mahatma Gandhi or any other literature.

UNIT III

Professional Ethics aiming at excellence and Harmony: Value Based Life and Profession, Professional Ethics and Right Understanding, Competence in Professional Ethics, Issues in Professional Ethics – The Current scenario.
Positive and constructive dynamism of power, politics and leadership.
Tutorial Module: Ethical decision making: Case Studies (from Yoga-Sutra, Bhagwat Geeta, Panchatantra, Autobiography of Mahatma Gandhi or any other literature)

UNIT: IV

Professional Ethics: Global Prospective: Globalization and MNCs –Cross Culture Issues – Business Ethics – Media Ethics – Environmental Ethics – Endangering Lives – Bio Ethics – Computer Ethics – War Ethics

Tutorial Module: Ethics and Social Networks: Case Studies (from Yoga-Sutra, Bhagwat Geeta, Panchatantra, Autobiography of Mahatma Gandhi or any other literature)

UNIT V:

Duties and Rights in Profession: Concept of Duty – Professional Duties – Collegiality – Techniques for Achieving Collegiality – Senses of Loyalty – Consensus and Controversy – Professional and Individual Rights – Confidential and Proprietary Information – Conflict of Interest-Ethical egoism – Collective Bargaining – Confidentiality – Gifts and Bribes, Plagiarism

Tutorial Module: Ethics in Corporate: Case Studies (from Yoga-Sutra, Bhagwat Geeta, Panchatantra, Autobiography of Mahatma Gandhi or any other literature)

REFERENCES:

1. **New Approaches in Ethics for the Caring Professions: Taking Account of Change for Caring Professions 2005 Edition,** by Richard Hugman **Publisher:** Red Globe Press; 2005 edition (9 July 2018)

2. **Rethinking Values and Ethics in Social Work 1st ed. 2017 Edition, Kindle Edition** by Richard Hugman (Author), Jan Carter (Author) **Publisher:** Red Globe Press; 1st ed. 2017 edition (16 September 2017)

3. **Professional Ethics and Human Values** Paperback – 2015 by A. Alavudeen (Author), R. Kalil Rahman (Author), M. Jayakumaran (Author) **Publisher:** Laxmi Publications; First edition (2015)

4. **A Foundation Course in Human Values and Professional Ethics** Paperback – 30 Apr 2010 by R.R. Gaur (Author), R. Sangal (Author), G.P. Bagaria (Author) **Publisher:** Excel Books (30 April 2010)

5. **Living Issues in Philosophy (9th Edition) (1995)** By: Titus, Smith and Nolan Publisher: Oxford University Press, New York

6. **Foundation of Ethics and Management** By: B P Banerjee, Publisher: Excel Books, 2005

Assessment Methodology

- Self-Assessment
- Peer Learning
- Assessment Rubries for Behavioural Skills
- Pedagogy:
- Case study based & Group Discussion.

Suggested reading:

Case Study: https://whitneyhess.com/blog/2012/08/21/on-empathy-and-apathy-two-case-studies/Book: De Gruyter - Speaking of Emotions: Conceptualisation and Expression (edited by Angeliki Athanasiadou, Elzbieta Tabakowska)

Book: To Kill a Mockingbird - Lee Harper

Book: Take A Walk In Someone Else's Shoes by Bethany Morlan

A paper on 'University Students' Value Priorities and Emotional Empathy':
file:///C:/Users/Dell/Desktop/University_Students_Value_Priorities_and_Emotiona.pdf

Research paper on ‘Empathy as Added Value in Predicting Donation Behavior’:
file:///C:/Users/Dell/Desktop/wp_10_692.pdf
Decety J and Jackson PL. 2004. The functional architecture of human empathy. Behavioral and cognitive neuroscience reviews 3(2):71-100.
Klimecki OM1, Leiberg S2, Ricard M2, Singer T3. Differential pattern of functional brain plasticity after compassion and empathy training. Soc Cogn Affect Neurosci. 2014 Jun; 9 (6): 873-9.
A paper on ‘The Science of Empathy’ - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5513638/
A paper on ‘The Psychology of Emotional and Cognitive Empathy’ - https://lesley.edu/article/the-psychology-of-emotional-and-cognitive-empathy
Links on the latest research and reviews on articles related to empathy - https://www.nature.com/subjects/empathy

Suggested videos/movies (English/Hindi)
The Boy in the Striped Pyjamas (an English movie based on the novel by the same name by John Boyne) Chhapaak (an Indian movie about how a young woman tries to rebuild her life after a man throws acid in her face on a public street in New Delhi in 2005)
George Lucas Educational Foundation – Edutopia – 3 videos on the importance of empathy
- https://www.edutopia.org/blog/3-videos-importance-empathy
The actor, Mark Ruffalo, and Murray (from Sesame Street) talk about the word "Empathy"
- https://www.youtube.com/watch?v=9_1Rt1R4xbM
http://theconversation.com/understanding-others-feelings-what-is-empathy-and-why-do-we-need-it-68494
https://www.verywellmind.com/what-is-empathy-2795562
“The Present” is a thesis short from the Institute of Animation, Visual Effects and Digital Postproduction at the Filmakademie Baden-Wuerttemberg in Ludwigsburg, Germany.
- https://www.youtube.com/watch?v=96kI8Mp1uOU

Pneumatics and Hydraulics Control

Subject Code: ME-901

Credit	Hours	Marks		
03	45	I	E	To
		15	35	50

Objectives:

- This course will give an appreciation of the fundamental principles, design and operation of hydraulic and pneumatic machines, components and systems and their application in recent automation revolution.

Learning Outcomes:

- To understand the need and importance of hydraulic and pneumatic control
- To identify various components of Hydraulic systems.
- To demonstrate knowledge of fundamental concepts of Pneumatic control
- To identify various components of Pneumatic control systems.
- To design and analyze problems relating to Pneumatic and Hydraulic control systems and components.

UNIT I-Introduction

Fluid properties, Concepts of fluid dynamics, Hydraulic systems and their components, Pneumatic systems and their components, Use of fluid power, Properties of Hydraulic fluids, fluid flow fundamentals, Comparison of hydraulic and pneumatic systems, Safety considerations.

UNIT II- Hydraulic System

Hydraulic power transmission- Fluid power system design, Hydrostatic pumps and motors- Introduction, selection of pumps and motors, Types of motors and pumps, Some general considerations, comparison of motor performance characteristics.

Hydraulic actuators and motors- Introduction, linear actuators, principal features, Actuator selection.

Flow control valves- Valve configurations, symbolic representation, Valve analysis, three-way spool valve analysis, flapper valve analysis, single and two stage pressure control valves, introduction to electro-hydraulic valves.

UNIT III-Pneumatic System

Pneumatic fundamentals, symbols, Pneumatic elements, Steady flow of ideal gases, orifice and nozzle calculations, capillary flow, flow of real gases, linear flow equations in orifices and nozzles.

Multiple restrictions and volume calculations, Single acting pneumatic actuators and their applications.

UNIT IV- Hydraulic Control Elements

Control of single and double acting hydraulic cylinder, regenerative circuit, pump unloading circuit, Counter valve application, Hydraulic cylinder sequencing control, speed control of hydraulic cylinder, Implementation of PID controller using hydraulic control

UNIT V – Pneumatic Control Elements

Simple pneumatic control- direct and indirect actuation pneumatic cylinders, memory valves. Flow control valves and speed control of cylinders- supply air throttling and exhaust air throttling, use of quick exhaust valve, Implementation of PID controller using pneumatic control

Text Books:

1. Herbert E. Merritt, “Hydraulic Control Systems”, John Wiley & Sons.

2. B.W. Anderson, “The Analysis and Design of Pneumatic Systems”, Wiley.

Reference Books:

1. A.B. Goodwin, “Fluid Power Systems”, Macmillan.
2. Anthony Esposito, “Fluid power with applications”, Prentice Hall, 7th Edition.
3. Arthur Akers, Max Gassman, Richard Smith, “Hydraulic Power System Analysis”, Taylor and Francis
4. Group.
5. Andrew Parr, "Pneumatic & Hydraulic", PHI.
6. John Pippenger & Tyler Hicks, “Industrial Hydraulics”, 3rd edition McGraw Hill

Pneumatics and Hydraulics Control Lab

Subject Code: ME-901L

Credit	Hours	Marks		
02	60	I	E	To
		35	15	50

List of Experiments

1. Design of simple pneumatic and hydraulic circuits using basic components.
2. Construction and testing of multiple pneumatic actuator circuit using Cascade method.
3. Co-ordinated motion of actuators using electro – pneumatic elements.
4. Construction and testing of a hydraulic actuator regenerative circuit.
5. Co-ordinated motion of actuators using electro – hydraulic elements
6. Design and Simulation of hydraulic and pneumatic circuits using Fluid SIM .

Sensors Application in Robotics

Subject Code: ECE-902

Credit	Hours	Marks		
03	45	I	E	To
		15	35	50

Objective:

- To introduce the terminologies associated with the sensing & measuring system.
- To understand and calibrate the method of measuring pressure, displacement and velocity.
- To practically expose the students to different measurement devices and use of them to measuring different variable

Learning Outcomes:

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

- To explain various signal condition devices used in electronic devises and use of appropriate method in signal conditions in various applications.
- Analyse and choose appropriate sensors in different industrial applications.
- To describe the impact of an RFID system on manufacturing, defense, distribution, retail and health sectors
- To integrate various sensors in developing Flexible Manufacturing Systems.
- To describe the future advances to the quality and integrity of Manufacturing and related sectors resulting from the use of RFID and other sensor technologies.

Unit I Fundamentals of Sensors and Transducers: Performance terminology, static and dynamic characteristics of transducers, classification of sensors and transducers, signal processing and signal conditioning. Operational amplifiers, filters, protection devices, analog to digital converter, digital to anolog converter.

Unit II Sensors and their applications: Inductive, capacitive, magnetic, various types of photo sensors, detection methods, through-beam detection, reflex detection & proximity detection, ultrasonic and microwave sensors. Applications and understanding of the above sensors.

Unit III Advanced Sensor Technologies: Laser production, characteristics of lasers, types of laser sensors, bar code sensors, benefits of bar coding, transponder, RFID (Radio Frequency Identification), electro-magnetic identifier, optical encoders, color sensors, sensing principles, color theory, unit color measurement, colour comparator, color sensing algorithm, fuzzy logic color sensor. fuzzy logic for opt-electronic colour sensor in manufacturing.

Unit IV Sensors in Flexible Manufacturing Systems: Vision sensors, image transformations, robot visual sensing tasks, detecting partially visible objects, sensors in flexible manufacturing system cell.

Unit V Sensors for Special Applications: A multi objective approach for selection of sensors in manufacturing**,** cryogenic manufacturing applications, semiconductor absorption sensors, semiconductor temperature detector using photoluminescence temperature detectors using point-contact, sensors in process manufacturing plants, measurement of high temperature, robot control through sensors, other sensors, collection and generation of process signals in decentralized manufacturing system.

Text Books:

1. Sabnesoloman, sensors & control systems in manufacturing. Mc-Graw Hill book Company Network, 1994.
2. Mechatronics by W,Bolton,

References:

1. Sensor Technology Handbook by Jon S. Wilson
2. N.L.Buck & T.G.Buckwith, Mechanical measurement.
3. Sensors and Transducers by Ian Sinclair

Sensors Application in Robotics Lab

Subject Code: ECE-902L

Credit	Hours	Marks		
02	60	I	E	To
		35	15	50

List of Experiments

1. Temperature Measurement using thermistor, thermocouple and RTD using LabVIEW
2. Load Cell Measurement using LabVIEW
3. Strain Measurement using LabVIEW
4. Displacement Measurement using LVDT using LabVIEW
5. Vibration Measurement using Accelerometer using LabVIEW
6. ADC and DAC.
7. Speed and Position Control of Servo Moto using LabVIEW
8. Offline Programming: The previously modelled SCARA robot is then programmed offline, also using the industrial robot simulation system.

Machine Vision Systems

Subject Code: CSE-902

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Course Objectives

- To learn the fundamentals of vision systems

Course Outcomes

- Able to know the basics concepts of vision systems.
- To understand the image recognition and retrieval algorithms
- To learn the concepts of object recognition and applications of vision systems.
- To manipulate the trajectory of robots and program the robot for specific applications
- To apply the vision concept of designing robots.

Unit I

Vision System: Basic Components – Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics – Cameras – Camera-Computer Interfaces-Concept of Lightening and Illumination

Unit II

Vision Algorithms: Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours – Image Enhancement: Gray value transformations, image smoothing, Fourier Transform – Geometric Transformation - Image segmentation – Segmentation of contours, lines, circles and ellipses – Camera calibration – Stereo Reconstruction.

Unit III

Object Recognition: Object recognition, Approaches to Object Recognition, Recognition by combination of views – objects with sharp edges, using two views only, using a single view, use of dept values.

Unit IV

Applications: Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking.

Unit V

Robot Vision: Basic introduction to Robotic Operating System (ROS) - Real and Simulated Robots - Introduction to Open CV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to Open CV - The CV bridge Package.

Text Books:

1. Carsten Steger, Markus Ulrich, Christian Wiedemann, “Machine Vision Algorithms and Applications”, WILEY-VCH, Weinheim, 2008.
2. Damian M Lyons, “Cluster Computing for Robotics and Computer Vision”, World Scientific, Singapore, 2011.
3. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Addition – Wesley Publishing Company, New Delhi, 2007.

Reference Books:

1. Shimon Ullman, “High-Level Vision: Object recognition and Visual Cognition”, A Bradford Book, USA, 2000.
2. R.Patrick Goebel, “ROS by Example: A Do-It-Yourself Guide to Robot Operating System – Volume I”, A Pi Robot Production, 2012.

Advanced Robotics

Subject Code: RA-901

Credit	Hours	Marks		
03	45	I	E	To
		15	35	50

Objectives:

This course covers advanced programming and hardware concepts associated with industrial robots. In this course, several robots are programmed to work together and with other common automation systems to increase the efficiency and throughput of industrial automation processes. Robot safety procedures and standards will be emphasized throughout the course.

Learning Outcomes:

- To explain the basic principles of Robotic technology, configurations, control and programming of Robots.
- Design an industrial robot which can meet kinematic and dynamic constraints.
- To describe the concept of Robot kinematics and dynamics, latest algorithms & analytical approaches
- Program industrial robots to perform complex motions and paths
- To explain the basic principles of programming and apply it for typical Pick & place, loading & unloading and palletizing applications.

Unit-I

Controlling technique: open and closed loop control, second order linear SISO model, joint actuator, control schemes- linear, PID, torque control, force control, Impedance force/toque control

Unit-II

Robot Sensing & Vision: sensors in robotics, kinds of sensors, robotic vision, industrial applications of vision controlled robotic systems, architecture of robotic vision system, image acquisition, image representation and processing, other components of vision sensor

Unit-III

Robot applications: Industrial application, material handling, processing application, assembly applications, inspection application, principles for robot application and application planning, justification of robots, robot safety, non- Industrial application

Unit-IV

VAL Language 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. VAL-II programming-basic commands, applications- Simple problem using conditional statements-Simple pick and place applications-Production rate calculations using robot.

Unit-V

RAPID Language and AML RAPID language basic commands: Motion Instructions-Pick and place operation using Industrial robot- manual mode, automatic mode, subroutine command based programming. Move master command language-Introduction, syntax, simple problems. AML Language-General description, elements and functions, Statements, constants and variables-Program control statements-Operating systems, Motion, Sensor commands-Data processing.

Text Books:

1. R K Mittal and I J Nagrath, *Robotics and control,* TTata McGraw Hill publishing company limited, 2019.
2. S. R.Deb, "Robotics technology and flexible automation", Tata McGraw Hill publishing company limited, 1994.
3. Mikell. P. Groover, "Industrial Robotics Technology", Programming and Applications, McGraw Hill Co, 1995.

Advanced Robotics Lab

Subject Code: RA-901L

Credit	Hours	Marks		
02	60	I	E	To
		35	15	50

List of Experiments

1. Forward and Inverse kinematics of two axis planar articulated robot using analytical and DH algorithm using Lego NXT.
2. Forward and Inverse kinematics to control hand movements in NAO.
3. Study and selection of Gripper.
4. Implementation of trajectory planning algorithm for straight line motion using MATLAB and executing PID based control of two axis planar articulated robot in Lego NXT.
5. Analysis and Simulation using Robo guide software and real time Programming of robot.
6. Programming of SCARA robot.
7. Robot Programing Lab

(Basic Syntax- RAPID introduction, Constant, data objects and variables, data declaration, expressions , using data and aggregates in expression , Functions , function call in expression , priority between operators, Various Instructions, WAIT , SIGNAL and DELAY commands. Routine and subroutine – Input/output interrupts priority between interrupts, Program control and subroutine function call, task modules, error recovery, system and time, Builtin subroutines in RAPID, Intertask Objects)

8. Mini project (mandatory)

Automation System Design

Subject Code: RA-902

Credit	Hours	Marks		
03	45	I	E	To
		15	35	50

Objectives:

- To know about the pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.

Learning Outcomes:

- To understand basic concepts of industrial automation
- Describe the fundamentals of CNC technology
- Able to understand different aspects for high speed automatic assembly
- Able to understand different aspects for transfer lines and automated assembly
- Able to understand about automated controls using pneumatic and hydraulic systems.

Unit-I

Fundamental Concepts of Industrial Automation: Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, levels of automation.

Unit-II

Programmable Automation: Special design features of CNC systems and features for lathes and machining canters. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.

Unit-III

Design for High Speed Automatic Assembly: Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation.

Unit-IV

Transfer Lines and Automated Assembly: General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems.

Unit-V

Elements of Hydraulic Systems: Pumps and motors- types, characteristics. Cylinders, types, typical construction details. Valves for control of direction, flow and pressure, types, typical construction details.

Text Books:

- Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing" Pearson Education, New Delhi, 2001.
- WemerDepper and Kurt Stoll, "Pneumatic Application", KemprathReihe, Vogel BuchVerlagWurzbutg, 1987.

Reference Books:

- Mikell P Groover, "Industrial Robots – Technology Programmes and Applications", McGraw Hill, New York, USA. 2000.
- Steve F Krar, "Computer Numerical Control Simplified ", Industrial Press, 2001.

Automation System Design Lab

Subject Code: RA-902L

Credit	Hours	Marks		
02	60	I	E	To
		35	15	50

List of Experiments

1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems
3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of an LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
6. Inspection using Machine Vision System
7. Control of speed, direction and number of revolutions of a stepper motor using PC.
8. Development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors.

Artificial Intelligence & Expert System in Automation

Subject Code: CSE-901

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Course Objectives:

The purpose of this course is to impart concepts of Artificial Intelligence and Expert System.

Course Outcomes:

- Describe the modern view of AI as the study of agents that receive percepts from the Environment and perform actions
- Demonstrate awareness of fuzzy logic inference systems
- Explain about AI techniques for knowledge representation, planning and uncertainty Management.
- Develop knowledge of heuristic algorithms
- Explain the concept of Knowledge Representation

Unit-I

Introduction: Expert system, Architecture, knowledge base, inference engine, expert system shell, applications.

Unit-II

Fuzzy Logic: Fuzzy sets, membership functions, operation on fuzzy sets; fuzzy control system, Fuzzyfication, knowledge base, inference, defuzzification, application.

Unit-III

Neural Network : Neuron structure, classification, artificial neural network, back propagation training and algorithm, neuro-fuzzy controllers, applications.

Unit-IV

Genetic algorithms: Concepts, encoding and selection methods, genetic operators (crossover and Mutation), applications.

Unit-V

Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Semantic networks, Description logics, Reasoning with Default Information, Truth maintenance systems.
(SLE**:** The Internet Shopping World)

Text Books

1. Haykin “Neural Networks – A comprehensive Foundation” (Mc-millan)

2. J.M. Zureda “Introduction to artificial neural networks” (Jaico)

3. A Cichocki& R Unbehauen “ Neural Networks for optimization and signal Processing” John Wiley

4. George J. Klin & Tina A Polgar “Fuzzy sets, uncertainty and Information”

5. BaertKosko “Neural network and fuzzy systems”

References:

1. Peterson “Introduction to Artificial Intelligence and expert system (PHI)

2. Michell “Introduction to Genetic Algorithm” (PHI)

3. Vidyasagar M “Theory of learning and generalization” Springer

4. S. Rajasekaran, G.A. VijaylakshmiPai “Neural Networks, Fuzzy Logic and Genetic Algotithm”, PHI.

5. T.J. Ross: “Fuzzy Logic with Engineering Applications” Second Edition John Wiley India

Automatic Control System

Subject Code: EE-901

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Course Objectives

- To apply knowledge of mathematics, science and engineering.
- To use modern computer tools such as MATLAB tools to solve control problems.

Learning Outcomes:

- To determine and use models of physical systems in forms suitable for use in the analysis and design of control systems
- To determine the time domain responses of first and second-order systems
- To determine the frequency-domain responses of first and second-order systems
- To determine the stability of the process or system
- To apply root-locus technique to analyze and design control systems and to express and solve system equations in state-variable form (state variable models)

Unit I

Introduction

Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function - Modelling of physical systems – Mechanical, Thermal, Hydraulic systems and Electric Networks - Transfer function of DC generator, DC servomotor, AC servomotor, Potentiometer, Synchro's, Tach generator, Stepper motor - Block diagram - reduction techniques, Signal flow graph – Mason‟
gain formula.

Unit II

Time domain analysis

Standard Test signals – Time response of second order system - Time domain specifications – Types of systems - Steady state error constants - Introduction to P, PI and PID modes of feedback control.

Unit III

Frequency domain analysis

Frequency domain specifications - Time and frequency response correlation – Polar plot – Bode plot – All pass minimum phase and non-minimum phase systems.

Unit IV

System stability

Characteristic equation - Routh Hurwitz criterion of stability - Absolute and Relative stability - Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin.

Unit V

Root locus method

Root locus concepts - Construction of root loci – Root contours.

State Space Analysis: Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time invariant systems - Introduction to state space representation using physical - Phase and canonical variables.

Text Book

1. Norman Nise S, “Control system Engineering‟, John Wiley & Sons, New Delhi,2013
2. Nagrath I J, and Gopal, M, 'Control Systems Engineering” Prentice Hall of India, New Delhi, 2008.

Reference Book

1. Richard C Dorf and Robert H Bishop, "Modern Control Systems.", Addison-Wesley -2007
2. Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 2006.
3. Kuo B C, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, New Delhi, 2004.

Process Control & Automation

Subject Code: EE-902

Credit	Hours	Marks		
03	45	I	E	To
		30	70	100

Course Objective:

The purpose of this course is to introduce the key concepts in automatic control and instrumentation of process plants. Material and energy balances are extended to unsteady state (dynamic) systems and Laplace Transforms are introduced as a means of conveniently representing process control systems and solving ordinary differential equations.

Course Outcomes:

On successful completion of this course students will be able to:

- Explain the basic principles & importance of process control in industrial process plants
- To design feedback control for industrial process
- To design feedforward control for industrial process
- Draw a PID (Process & Instrumentation Diagram) & devise simple but effective plant wide control strategies using appropriate heuristics.
- To design model predictive controller for industrial process

Unit-I

Process Modeling- Introduction to Process control and process instrumentation-Hierarchies in process control systems-Theoretical models-Transfer function-State space models-Time series models Development of empirical models from process data-chemical reactor modelling-. Analysis using softwares

Unit-II

Feedback Control- Feedback controllers-PID design, tuning, troubleshooting-Cascade control- Selective control loops-Ratio control-Control system design based on Frequency response Analysis-Direct digital design

Unit-III

Feedforward Control-Feedforward and ratio control-State feedback control- LQR problem- Pole placement - Simulation using Softwares-Control system instrumentation-Control valves- Codes and standards- Preparation of P& I Diagrams.

Unit-IV

Advanced process control-Multi-loop and multivariable control-Process Interactions-Singular value analysis-tuning of multi loop PID control systems-decoupling control-strategies for reducing control loop interactions-Real-time optimization-Simulation using softwares

Unit-V

Model predictive control-Batch Process control-Plant-wide control & monitoring- Plant wide control design-Instrumentation for process monitoring-Statistical process control-Introduction to Fuzzy Logic in Process Control

,Introduction to OPC-Introduction to environmental issues and sustainable development relating to process industries. Comparison of performance different types of control with examples on softwares

Text Books

1. Seborg, D.E., T.F. Edgar, and D.A. Mellichamp, Process Dynamics and Control, John Wiley , 2004

2. Johnson D Curtis, Instrumentation Technology, (7th Edition) Prentice Hall India, 2002.

3. Bob Connel, Process Instrumentation Applications Manual, McGrawHill, 1996.

Reference Books

1. Edgar, T.F. & D.M. Himmelblau, Optimization of Chemical Processes, McGrawHill Book Co, 1988.

2. Macari Emir Joe and Michael F Saunders, Environmental Quality Innovative Technologie

Optimization Techniques

Subject Code: MTH-901

Credit	Hours	Marks		
04	60	I	E	To
		30	70	100

Unit-I

SINGLE VARIABLE NON-LINEAR UNCONSTRAINED OPTIMITION: One dimensional Optimization methods, Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods- quadratic & cubic interpolation methods.

Unit-II

MULTI VARIABLE NON-LINEAR UNCONSTRAINED OPTIMIZATION: Direct search method – Univariant Method – pattern search methods – Powell's – Hook – Jeeves, Rosenbrock search methods – gradient methods, gradient of function, steepest decent method, Fletcher reeves method, Variable metric method.

Unit-III

GEOMETRIC PROGRAMMING: Polynomials – arithmetic – geometric inequality – unconstrained G.P – constrained G.P

Unit-IV

DYNAMIC PROGRAMMING: Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

Unit-V

LINEAR PROGRAMMING: Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Simulation: Introduction – Types – Steps – application – inventory – queuing – thermal system.

Text Book:

1. Optimization theory & Applications/ S.S Rao/ New Age International

2. Introductory to operation research/Kasan& Kumar/Springar

3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ Narosa Publications.

Reference Book:

1. Operation Research/H.A. Taha/TMH

2. Optimization in operations research/R.L Rardin.

3. Optimization Techniques/Benugundu & Chandraputla/Person Asia.

4. Optimization Techniques /Benugundu & Chandraputla / Pearson Asia.

VIRTUAL INSTRUMENTATION

Subject Code: ECE-901

Credit	Hours	Marks		
04	60	I	E	To
		30	70	100

Course Objective:

Make use of software platform for analysis and application design for computer-based measurement and automation systems.

Course Outcomes:

- Recollect and compare basic knowledge of programming languages.
- Understand & use data handling for representation and analysis.
- Understand basics of acquisition techniques and its interface.
- Study and use interfacing techniques to connect with hardware.
- Ability to use state machines to solve complex problems.

UNIT- I

Virtual Instrumentation: An introduction Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems.

UNIT- II

VI programming techniques: VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT- III

Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

UNIT -IV

VI Interface requirements: Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT- V

VI toolsets: Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

Text Books

1. LabVIEW Graphical Programming , Gary Johnson, Second edition, McGraw Hill, New York, 1997.

2. LabVIEW based Advanced Instrumentation Systems, S. Sumathi and P. Surekha, Springer.

Reference Books

1. PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Kevin James, Newnes, 2000.

2. WEB RESOURCES: www.ni.com.

3. LabVIEW for everyone, Lisa K. wells & Jeffrey Travis Prentice Hall, NewJersey, 1997.

CAD/CAM

Subject Code: ME-902

Credit	Hours	Marks		
04	60	I	E	To
		30	70	100

Course Outcomes: After the successful completion of this course, the student will be able:

1. To design and do manufacturing planning of mechanical system using state of the art CAD/ CAM and CAE tools and integrated database.
2. To create and manipulate 2D and 3D objects on graphic work station
3. To explain surface modelling and solid modelling and the use of application software in designing mechanical systems
4. To use FEM in the design of mechanical system
5. To integrate technical skill with business activities of a company.

Unit I

Computer Aided Design: Introduction, Conventional Approach to Design, Description of the Design Process, Parametric and Variation Designs, Engineering Analysis and CAD, Compute Aided Engineering, Integrated Database Management System in CAE, CAE product Development, CAE implementation.

Unit II

Transformation and Manipulation of Objects: Introduction, Homogeneous Co-ordinatesystem,2DTransformation Translation, Scaling, Rotation, Mirroring, Reflection, Concatenation, , Manipulation of Simple Geometrical objects, Algorithms.

Unit III

Curves and Surfaces: - Conic sections, Involutes, Cycloids, Spirals and other curves, Parametric equations-algorithms. Line Fitting, Non Linear Curve Fitting with a Power Function, Curve Fitting with a High Order Polynomial, Chebyshev Polynomial Fit. Cubic Splines, Bezier Curves, B-Spline Curve, Surface creation, Plane Surface, Ruled Surface, Rectangular Surface.

Unit IV

Finite Element Modeling and Analysis: Introduction, Basic Concepts in FEM, Potential Energy Formulation and Closed form Solution, Galerkin Method, Bar element**:** Introduction, FE formulation, Proprieties of the Local Stiffness Matrix, Global Stiffness Matrix, Solution of the Truss Problem.

Unit V

Advances in CAD/CAM: CIM, Architecture, Objectives, CIM Implementation, Agile Manufacturing, Reverse Engineering, Concurrent Engineering, Rapid Prototyping, Virtual Manufacturing & Prototyping and Factory of the Future.

Text Books:

1. Principles of Computer Aided Design and Manufacturing- Farid Amirouche,2nd Edition, Pearson Prentice Hall, 2003
2. CAD/CAM Theory and Practice- Ibrahim-Zeid, TATA McGraw Hill, 2nd edition, 2009.
3. Introduction to Finite elements in Engineering – Chandru Patla& Belagundu, 3rd edition, 2009.

Reference Books:

1. CAD/CAM/CIM – P. Radhakrishnan, New age international, 3rd edition, 2007.
2. Finite Element procedure- Bathe, Eastern Economy Edition. PHI, 2009
3. Interactive Computer Graphics- Principles & Practice- Foley &Vandam, 2nd Edition, 2006
4. CAD/CAM - P.N.Rao, 3rd edition, 2010.
5. Computer graphics- Hearn Donald & Beaker, M.Pauline, PHI, 3rd edition, 2009.

HMI & SCADA Lab

Subject Code: RA-903L

Credit	Hours	Marks		
02	60	I	E	To
		70	30	10

List of Experiments

1. PLC interfaced with SCADA and status read/command transfer operation.
2. Parameter reading of PLC in SCADA.
3. Alarm annunciation using SCADA.
4. Reporting and Trending in SCADA System.
5. Temperature sensing using SCADA.
6. To understand the trouble of interacting with machines - Redesign interfaces of home appliances.
7. Design a system based on user-centered approach.