IV SEMESTER
Probability Theory and Optimization

Sub Code: 22MAT41D	Credits: 03
L: P: T: S: 3: 0: 0: 0	CIE Marks: 50
Exam Hours: 03	SEE Marks: 100
Total hours: 40	

COURSE OBJECTIVES:

1. To provide the foundations of probabilistic and reliability analysis mostly used in varied applications in engineering and science.
2. Understand the basic concepts of Joint probability distribution and Queuing theory.
3. Introduce the concept of Optimization and Network model

Course Outcomes: At the end of the course, student will be able to:

CO1	Acquire basic knowledge of random variables and probability distributions, transportation and assignment problem, Joint probability distribution and Queuing theory, minimum spanning algorithm and Bathtub curve.
CO2	Choose appropriate method to solve probability and reliability analysis, network model, assignment problem and queuing model
CO3	Explain Transportation Problems, Probability distributions and network model, steady state behavior waiting time distribution.
CO4	Interpret the solution of distribution and queuing theory, MTBF & MTTF
CO5	Analyze the Assignment and Travelling Salesman Problem using Hungarian Algorithm, network analysis by PERT & CPM, probability distribution by lognormal. Queuing model – M/M/1 and component reliability by test data.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**1**	**1**								
CO2	**3**	**3**	**2**	**1**								
CO3	**3**	**3**	**1**	**1**								
CO4	**3**	**3**	**2**	**1**								
CO5	**3**	**3**	**2**	**1**								

Module	Contents of the Unit	Hours	COs
1	**PROBABILITY THEORY:** Introduction to probability, Random variables (discrete and continuous), Probability mass function, Probability density function, Probability distributions: Geometric distribution, Poisson distributions, Gamma distribution, Normal distributions and Lognormal distribution. **Application:** Case study Pedagogy : Chalk and talk/PowerPoint Presentation/Videos Web Link : https://archive.nptel.ac.in/courses/111/102/111102111/	08	CO1-CO5
2	**OPTIMIZATION:** **Transportation problem:** North west corner rule, least cost method, Vogle's approximation method. **Assignment Problem:** Hungarian method, unbalanced assignment problem, Travelling salesman problem. **Application:** Shipping problems Pedagogy: Chalk and talk/PowerPoint Presentation/Video Web Link: https://archive.nptel.ac.in/courses/111/105/111105039	08	CO1-CO5
3	**NETWORK MODEL:** Definitions of Network Models, Minimal spanning tree algorithm, Shortest route problem, Maximal flow model, CPM and PERT. **Application:** Improve future planning Pedagogy: Chalk and talk/PowerPoint Presentation/Video Web Link: https://youtu.be/Tm2HhqMu5Jg	08	CO1-CO5
4	**JOINT PROBABILITY DISTRIBUTION & QUEUING THEORY** **Joint Probability:** Concept of joint probability, joint probability distribution, Expectation, variance, covariance and correlation. **Queuing Theory:** Introduction to general concepts in queuing system. Queuing processes – Notation. Queuing model – M/M/1:∞/FCFS. **Application**: Case Study. Pedagogy: Chalk and talk/PowerPoint Presentation/Videos Web Link: https://nptel.ac.in/courses/111102014	08	CO1-CO5

5	**RELIABILITY:** Definition, Bathtub curve, Causes of Failures, Various phases in equipment life **Component Reliability and Hazard Model:** Introduction, Component reliability from test data, Difference between failure rate and Hazard rate. Time dependent hazard models, Mean time between Failures (MTBF), Mean time to Failures (MTTF). Application Problems. **Application: Case Study** Pedagogy: Chalk and talk/PowerPoint Presentation/Videos Web Link: https://onlinecourses.nptel.ac.in/noc23_ge20/preview	08	CO1-CO5
	Student development program: **Workshop on Project management.** **Self-Study Component:** **Module – 1: Binomial Distribution** **Module – 2: MODI Method** **Module – 3: Crashing of the Project** **Module – 4: Markov Chain** **Module – 5: Problems on Probability of Failure**		

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2014, ISBN: 9788174091956.

2. Erwin Kreyszig; Advanced Engineering Mathematics; John Wiley & Sons, 9th Edition, 2007, ISBN: 9788126531356.

3. S. D. Sharma, Operations Research, Kedarnath Publications, 3rd Edition, ISBN – 9789380803388.

Reference Books:

1. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, 2006; ISBN: 9780070634190.

2. Hamdy A. Taha, “Operation Research: An Introduction” Pearson, 10th Edition, 2017, ISBN 13: 9781292165547.

3. S.C. Gupta, V.K. Kapoor, “Fundamentals of Mathematical Statistics, Publisher: Sultan Chand & Sons, ISBN: 9789351611738.

4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 9th Edition, 2010, ISBN-13. 978-8131808320.

Design of Robotic Components

Sub Code: 22RI42	Credits: 03
L: P: T: S: 3: 0: 0: 0	CIE Marks: 50
Exam Hours: 03	SEE Marks: 100
Total hours: 40	

COURSE OBJECTIVES:

1. Explain the mechanical properties of materials and the concepts of stress and strain, including Hooke’s law and stress-strain diagrams for different materials.
2. Analyze the theories of static strength and elastic failure, applying them to the design of machine elements subjected to static loads.
3. Design and evaluate threaded fasteners and bolted joints under various loading conditions, including fatigue and shear loading.
4. Develop the ability to select and design rolling contact bearings, considering load-life relationships and material properties.
5. Apply the principles of torsion to design shafts and keys, and analyze gear designs for different types of gears to ensure safety and efficiency.

COURSE OUTCOMES:

After completion of the course, students should be able to:

CO1	Determine stresses in simple machine components and design them for static loading conditions.
CO2	Design robotic components based on theories of failure.
CO3	Design fasteners subjected to fatigue loading using appropriate design equations and evaluate their dimensions for impact strength.
CO4	Evaluate the parameters for bearings, ensuring they meet the required specifications for given loads.
CO5	Develop shafts and keys for various loading conditions, ensuring compliance with strength and rigidity criteria.

COURSE CONTENTS:

Unit	Course Contents	Hrs	CO
1	**Introduction:** Meaning of design with special reference to machine design, phases of design process, design considerations, design tools, standards and codes. Mechanical properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, Factor of safety, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections, Shear stress and strain, Poisson's ratio.	8	CO1
2	**Thermal Stresses:** Stresses due to temperature change, Elastic constants and relations between them (No derivation). **Design for Static Strength:** Static Strength, Static loads, Theories of elastic failure- Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory, Failure of brittle materials, Failure of ductile materials, Stress concentration factor.	8	CO2
3	**Threaded Fasteners:** Types of screw fastening, Forms of threads, Stresses in threaded Fasteners, Initial Stresses due to Screwing up Forces, Stresses due to External Forces, Stress due to Combined Forces, Effect of Fatigue loading, shear loading, Design of eccentrically loaded bolted joints. **Belt Drives:** Selection of belt drive, Ratio of tensions, Centrifugal stress in a belt, Power transmitted, effect of centrifugal tension on power transmitted, Simple numerical problems.	8	CO3
4	**Rolling contact bearings:** Introduction, Classification of Bearings, static and dynamic load capacities, equivalent bearing load, load-life relationship, bearing life, load factor, selection of bearing from manufacturer's catalogue, ball and roller bearings, design for variable load and speed, bearings with probability of survival other than 90%, bearing materials and their properties.	8	CO4
5	**Shafts and Keys:** Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, Derivation of power transmitted by solid and hollow circular shafts, design for strength and rigidity with steady loading, ASME & BIS codes for design of transmission shafting. Keys: Types of keys, Design of keys.	8	CO5

	Gears: Types of gears, Terminology, Standard system of gear tooth, number of teeth, gear tooth failures, selection of material. Types of Gear trains.		

TEXT BOOKS:

1) Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke, McGraw Hill International edition, 2003
2) Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., 2010
3) Machine Design, Robert L., Norton, Pearson Education Asia, 5th Edition, 2023
4) Machine Design, R.S. Khurmi, J.K. Gupta, Eurasia Publishing House(PVT.) LTD.

REFERENCE BOOKS:

1) Design of Machine Elements, M.F.Spotts, T.E. Shoup, , L.E. Hornberger, S.R. Jayram and C.V. Venkatesh, Pearson Education, 2006
2) Machine Design, Hall, Holowenko, Laughlin (Schaum's Outlines series). Tata McGraw, Hill Publishing Company Ltd., 2007

APPLIED ARTIFICIAL INTELLIGENCE

Sub Code: 22RI43	**Credits: 04**
L: P: T: S: 3: 2: 0: 0	**CIE Marks: 50**
Exam Hours: 03	**SEE Marks: 100**
Total hours: 50	

COURSE OBJECTIVES:

1. To impart artificial intelligence principles, techniques, and history
2. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem- solving, and learning methods in solving engineering problems
3. To develop intelligent systems by assembling solutions to concrete computational problems

OURSE OUTCOMES:

After completion of the course, students should be able to:

CO1	Evaluate Artificial Intelligence methods and describe their foundations
CO2	Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation, and learning
CO3	Demonstrate knowledge of reasoning and knowledge representation for solving real-world problems

CO4	Analyze and illustrate how search algorithms play vitalrole in problem solving
CO5	llustrate the construction of learning and expert system

COURSE CONTENTS(Theory):

Unit	Course Contents	Hrs	CO
1	**Introduction to Machine Learning**: Overview of Machine Learning: Definition, Types (Supervised, Unsupervised, Reinforcement Learning), Key Concepts: Training, Testing, Overfitting, Underfitting. Simple Linear Regression: Concept, Equation, and Interpretation. Multiple Linear Regression: Model Building, Multicollinearity. Model Evaluation Metrics: RMSE, R^2 Logistic Regression: Binary Classification Problems: Understanding the Sigmoid Function. Logistic Regression Model: Cost Function and Optimization. Evaluation Metrics: Accuracy, Precision, Recall, F1-Score	8	1
2	**Naive Bayes Classifier:** Bayes' Theorem: Conditional Probability, Assumptions of Naive Bayes Classifier: Class Independence, Understanding Different Variants: Gaussian, Multinomial. Decision Trees: Tree Structure: Nodes, Branches, Leaves, Splitting Criteria: Gini Impurity, Entropy, Information Gain, Overfitting in Decision Trees: Pruning. Random Forests: Ensemble Learning: Combining Multiple Models for Better Accuracy, Bagging and Feature Importance in Random Forests, Building a Random Forest Model and Hyperparameters. Boosting Techniques, Introduction to Boosting: How it Combines Weak Learners, AdaBoost, Gradient Boosting, XGBoost, Understanding Loss Functions and Hyperparameters	8	2
3	**Model Evaluation and Selection:** Key evaluation metrics for various types of modelling – Regression, Clustering and classification. Model Selection – Overfitting Vs Underfitting, Computational efficiency, Interpretability, Model Deployment and Monitoring – Drift and Retraining.	8	**3**

	Advanced Machine Learning: Unsupervised Learning: Clustering, Introduction to Clustering: Concepts and Algorithms, K-Means Clustering: Centroid Calculation, Elbow Method, Hierarchical Clustering: Agglomerative, Divisive Methods, Dimensionality Reduction: PCA, Understanding Dimensionality: Curse of Dimensionality, Principal Component Analysis (PCA): Eigenvalues, Eigenvectors, Benefits of PCA: Reducing Noise, Improving Computational Efficiency		
4	Support Vector Machines (SVM): Concept of Hyperplane and Margins, Linear vs. Non-Linear SVM: Kernel Methods, SVM Parameters: C, Gamma, and their Impact, Model Deployment, Model Serialization: Saving and Loading Models with Pickle, Introduction to Flask or FastAPI: Building a Basic Web API, Deployment Steps: Preparing the Model for Deployment	8	4
5	Introduction to Neural Networks: Basics of Neural Networks: Neurons, Layers, and Activation Functions, Feedforward Neural Networks: Structure and Working, Backpropagation: Gradient Descent Algorithm and Error Minimization, Hyperparameter Tuning in Neural Networks, Appications and Trends in AI for multidomain problems, Overview of Further Topics: Deep Learning, Reinforcement Learning, Discussing Emerging Trends in AI and Machine Learning	8	5

COURSE CONTENTS (PRACTICAL)

#	NAME OF THE EXPERIMENT	CO
1	Adopt AI in Production for Overall Equipment Effectiveness(OEE) Prediction	
2	Adopt AI in Production for Production Profiting	
3	Adopt AI in Production for Boiler Operation Optimization	
4	Adopt AI in Quality for Root Cause Analysis	
5	Adopt AI in Quality for Product quality analysis	
6	Adopt AI in Maintenance for Machine performance	
7	Adopt AI in Maintenance for Remaining useful life prediction, Service Level Agreement(SLA) analysis	
8	Adopt AI in Maintenance for Service Level Agreement(SLA) analysis	
9	Adopt AI in Supply chain for Inventory planning and Optimization	
10	Adopt AI in Supply chain for Vendor Scoring and Evaluation	
11	Adopt AI in Supply chain for inventory forecasting and trend prediction	
12	Adopt AI in Sales & Marketing for Market segmentation, sales forecasting	

TEXT BOOKS:

1) "Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third edition, Pearson, 2014.

REFERENCE BOOKS:

1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third edition, McGraw-Hill Education, 2015.
2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015.

SENSORS AND SIGNAL CONDITIONING

Sub Code: 22RI44	**Credits: 04**
L: P: T: S: 3: 2: 0: 0	**CIE Marks: 50**
Exam Hours: 03	**SEE Marks: 100**
Total hours: 50	

COURSE OBJECTIVES:

1. To detect the inputs from the physical environment of the sensor.
2. Learn how to acquire sensor measurement data from sensors
3. Applications of sensors in robotics.

COURSE OUTCOMES:

After completion of the course, students should be able to:

CO1	Understand the Fundamentals of Sensors.
CO2	Analyze the Sensor types and its applications towards robotics and automation
CO3	Apply Sensor performance and Calibration.
CO4	Interpret the Sensor signal conditioning system.
CO5	To understand the sensor emerging technologies.

COURSE CONTENTS(Theory):

Unit	Course Contents	Hrs	CO
1	**Fundamentals of Sensors:** Introduction to transducers and sensors, Desirable features and functions of sensors, broad Classifications and functions of sensors, Sensor characteristics: accuracy, precision, range, resolution, Speed	8	CO1

	of response, calibration, Reliability, cost, Resolution, Interfacing, sensitivity, repeatability, linearity and ease of operation, Environmental parameters of Sensors, Measurements, requirements of measurement system, generalized measuring system, Hysteresis phenomenon, Errors in measurement, advantages of sensors.		
2	**Sensor Types and Applications:** Vision sensors and cameras, Range, and proximity sensors (ultrasonic, infrared, etc.), Force and tactile sensors. Motion and position sensors (encoders, accelerometers, etc.), Environmental sensors (temperature, humidity, etc.), Smart Sensors, Robot perception and environment sensing, Navigation and localization using sensors, Object detection and recognition, Grasping and manipulation with sensors, Human-robot interaction and sensing	8	CO2
3	**Sensor Performance and Calibration:** Static and dynamic performance Characteristics, Sensor mounting and placement in robotic systems, Sensor fusion and data integration, Sensor calibration and error compensation, Standard test signals, Simple numerical on sensor performance, Selection of sensors and testing with illustration, Signal processing techniques for sensor data Filtering and noise reduction, Feature extraction and pattern recognition.	8	CO3
4	**Signal Conditioning:** Introduction to Signal conditioning, Operational Amplifiers, Op-amp characteristics, Op-amp circuits used in instrumentation, Differential amplifier, Instrumentation amplifier, Filters, types of filters, Passive filters, Active filters, AC and DC bridges, Digital signal conditioning, Digital-to-analog conversion, Analog-to-digital conversion.	8	CO4
5	**Emerging Sensor Technologies:** Microelectromechanical systems (MEMS),LIDAR range sensors, Biomimetic robot sensor, Ground Penetrating Radar sensors, Optical(LASER) gyroscope sensor, Inclination or gravitational sensor, Sensor networks and Internet of Things (IoT) in robotics, End Effector sound-vision recognition sensor, End effector Linear-Variable-Displacement transformer Sensor, Sensor materials and its processing: Silicon as sensing materials, ceramic, metals, glass, nanomaterials, Surface processing: Thick and thin films, Multi Sensor Fusion: Beacon systems and Kalman filter technique used in mobile robotics.	8	CO5

COURSE CONTENTS (PRACTICAL)

#	NAME OF THE EXPERIMENT	CO
1	Calibration curve and time constants (for sensors: mercury in glass thermometer, bimetal dial thermometer, RTD, thermistor and thermocouple)	
2	Seebeck effect for thermocouple	
3	Temperature transmitter and its calibration	
4	Understand principles of operation of capacitive, inductive, and optical proximity sensors and learn Calibration and testing of proximity sensors	
5	Study and calibration of displacement sensors: LVDT and potentiometer	
6	Understand force and torque sensing principles and Types of force/torque sensors: strain gauge, piezoelectric, etc. and learn the force/torque sensing in industrial robotics.	
7	Understand principles of motion and position sensing, Encoders, accelerometers, gyroscopes, Global Position System (GPS), beacons sensor applications of motion and position sensors in robotics	
8	Vision based sensing: Understand machine vision and image processing for object detection and recognition	
9	Ultrasonic, IR and Hall effect sensor-based proximity and range sensing	
10	Analog to digital and digital to analog conversion.	
11	Experimentation with Active Filters	
12	Experimentation with DC bridge and AC bridge	
13	Implementation of convolution and digital filters (Can be done with Raspberry Pi on any analog signal acquired using ADC)	
14	Fourier Transforms (Can be done with Raspberry Pi on any analog signal acquired using ADC)	

TEXT BOOKS:

1. Mikell P Groover, Mitchel Weiss, Roger N Nagel, “Industrial Robotics”, Technology, Programming and Applications,Second Edition, Mc Graw Hill , 2013.

2. Saeed B Niku, “Introduction to Robotics-Analysis, control, Applications”,Second Edition

3. Jacob Fraden, “Hand Book of Modern Sensors-Physics, design and applications”, Fourth Edition,New York.

4. Appuu Kuttan K K, “Robotics” , I K International Publishing House Pvt.Ltd, New Edition.

5. A.K Sawhney, Puneeth Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Ram Publisher, 15 February 2012.

6. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2013

7. Peter Elgar, "Sensors for Measurement & Control", Adison-Wesley Longman Ltd, 1998.

REFERENCE BOOKS:

1. Ganesh S Hegde, “Industrial Robotics” Laxmi Publications, Latest Edition.

2.William Bolton, “ Mechatronics”, Seventh Edition, Pearson.

3.Sabrie Soleman, “Sensors and Control systems in Manufacturing:Second Edition.

4. N.V. Raghavendra, L. Krishnamurthy, “Engineering Metrology and Measurements”, Oxford University Press, Edition 2013

5.Curtis D Johnson, “Process Control instrumentation technology”, Peason, Eight Edition.

6. Oliver Bittel, Michael Blaich, “Mobile Robot Localization Using Beacons and the Kalman Filter Technique for the Eurobot Competition”, Conference Paper *in* Communications in Computer and Information Science · June 2011, *DOI: 10.1007/978-3-642-21975-7_6*

Modelling and Design Lab

Sub Code: 22RIL45	**Credits: 01**
L: P: T: J: 0: 2: 0 : 0	**CIE Marks: 50**
Exam Hours: 3	**SEE Marks: 50**
Total hours: 15	

COURSE OBJECTIVES:

1) Train students to use a commercial solid modelling package.
2) To learn the basic concepts of drafting and detailing
3) Produce the assembly drawings using part drawings

COURSE OUTCOMES:

After completion of the course, the graduates will be able to:

CO	content	Bloom’s Level
CO1	Understand the concepts of CAD and CAD tools.	L2
CO2	Use, identify and explain standard features in solid modelling.	L2
CO3	Use standard software tools to assembly, drafting and introduce to apply GD&T in drawing.	L3
CO4	Engage in lifelong learning using sketching and drawing as communication tool	L3

COURSE CONTENTS

UNIT	Course Contents	Hrs	COs
1	**Introduction:** Concept of Parametric Modelling, Feature Based Modelling, User Interface, Mouse operations, File types and Management, drawing profiles. **Sketcher:** Profile toolbar, operation (corner, chamfer, delimitations, transformations, project 3D element), constraints, types of constraints, workbench, sketch tools, visualization toolbar, user selection filter.	**2**	**CO1**

2	**Modelling:** Modelling of Machined component, Material Addition and Removal (Pad, Pocket, Shaft, Groove), Sketch and Positioned Sketch, Types of Fillets, Types of Chamfers, Types of Hole, Pattern (Rectangular, Circular, User), Thread/Tap, Datum Features (Plane, Axes, Points), Simple Draft, Loft, Creation of different parts using above commands.	**4**	**CO2**
3	**Assembly and Drafting:** (Part drawings shall be given) Drawing Basics-Detailing Drawings. Explode a 3D model for a drawing, Create a drawing sheet and views, Add geometry and dimensions to a drawing, Add GD & T text, BOM, tables and symbols, Place an exploded view, Edit a title block, Export to different file formats. • Plummer Block • Industrial Robotic Arm	**6**	**CO3**
4	Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry. GD & T symbols with their usage.	**1**	**CO4**
5	Solving Simple Problems of Structural Analysis considering Design of robotic components.	**2**	**CO4**

TEXTBOOKS:

1) An instruction manual on Modelling and Design Lab, Department of Robotics and Artificial Intelligence, DSCE
2) Computer Aided Machine Drawing, K R Gopalakrishna, Subhash Publication, 2016.

REFERENCE BOOKS:

3) CATIA V5 Design Fundamentals-A Step by Step Guide, Jaecheol Koh, ONSIA Inc, 2012.

Measurement Systems

Sub Code: 22RI461	**Credits: 03**
L: P: T: S: 3: 0: 0: 0	**CIE Marks: 50**
Exam Hours: 03	**SEE Marks: 100**
Total hours: 40	

COURSE OBJECTIVES:

1. To impart the knowledge of standards importance and conversion.
2. To explore the students to various aspects regarding the force, torque, strain, pressure and temperature measurements.
3. To identify, analyse the concept and the principle advantages and applications of the above measurements.

COURSE OUTCOMES:

After completion of the course, students should be able to:

CO1	Apply the knowledge of standards and comparisons in measurement
CO2	To use proper measurement system
CO3	Differentiate between metrology and measurement
CO4	Determine the errors involved in measurement system
CO5	Elaborate the use of intermediate modifying devices in measurement system

COURSE CONTENTS:

Unit	Course Contents	Hrs	CO
1	**Introduction to Metrology:** Definition, objectives of metrology, Material Standards, Wavelength Standards, Classification of standards, Line and End standards, Calibration of End bars. Numerical examples. System of Limits, Fits, Tolerance and Gauging: Definitions, Tolerance, Tolerance analysis (addition & subtraction of tolerances) Interchangeability & Selective assembly. Class &grade of tolerance, Fits, Types of fits, Numerical on limits, fit and tolerance. Hole base system & shaft base system. Taylor's principle, Types of limit gauges, Numerical on limit gauge design.	8	CO1
2	Measurement system and basic concepts of measurement methods: Definition, Significance of measurement, generalized measurement system, Static characteristics- Accuracy, Precision, Calibration, Threshold, Sensitivity, Hysteresis, Repeatability, Linearity, Loading effect, Dynamic characteristics- System response, Time delay. Errors in measurement, Classification of errors.	8	CO2
3	Sensors/Transducers: Definition, Types, Basic principle and applications. Potentiometers - Inductance transducers -Capacitance transducers - Piezoelectric transducers - Hall effect transducers - rotary encoders – Accelerometers –Gyroscope. Photo Diode/ Photo Transistor as sensors, LVDT, Strain Gauge, Tactile, IR and Ultrasonic sensors.	8	CO3

	Vision and motion Sensors. Digital transducers: Principle and Construction. Temperature, Flow, velocity, pressure, displacement, position, force and torque measurement.		
4	Intermediate Modifying and Terminating Devices: Mechanical systems, Inherent problems, Electrical intermediate modifying devices, Input circuitry, Ballast circuit, electronic amplifiers. Terminating devices, Cathode ray oscilloscope, Oscillograph	8	CO4
5	Signal Conditioning: Need for pre-processing, identification of signal conditioning blocks and their characteristics. Analysis of DC and AC bridges. Offset and drift compensation circuits. Introduction to Active filters. First order, Second order and higher order filters. Necessity and applications of isolation amplifiers, Grounding and Shielding. Digital Signal Processing: Discrete Sequences and Systems, Periodic Sampling, Discrete Fourier Transform, Fast Fourier Transform. Analog to digital conversion.	8	CO5

TEXT BOOKS:

1) R.K. Jain ,"Engineering Metrology", , Khanna Publishers, 1994
2) Doebelin, E.O. and Manic, D.N., "Measurement Systems: Applications and Design", 7th Edition, McGraw Hill, 2019
3) Richard G. Lyons, "Understanding Digital Signal Processing", 3rd Edition, Pearson, 2011
4) A.K. Sawhney, "A Course in Electronic Measurements and Instrumentation", Dhanpat Rai & Co. (P) Limited, 2015

REFERENCE BOOKS:

1) **I.C. Gupta**, "Engineering Metrology"**,** DhanpatRai Publications, Delhi.
2) **R.K. Jain** , "Mechanical Measurements",Khanna Publishers, 1994
3) **Industrial Instrumentation,** Alsutko, Jerry. D. Faulk, Cengage Asia Pvt. Ltd. 2002.
4) **Ernest O. Doebelin , "**Measurement Systems Applications and Design",, 5th Ed., McGraw Hill.

Fundamentals of Materials Science

Sub Code: 22RI462	**Credits: 03**
L: P: T: S: 3: 0: 0: 0	**CIE Marks: 50**
Exam Hours: 03	**SEE Marks: 100**
Total hours: 40	

COURSE OBJECTIVES:

1. Understanding of the fundamental properties of materials, including mechanical, thermal, electrical, and optical characteristics
2. To analyze the atomic and molecular structures of materials, including crystallography and defects, to explain material behavior.
3. Investigate various methods for processing and shaping materials, such as casting, forming, and heat treatment, to achieve desired properties
4. Evaluate the performance of materials in different environments and applications, considering factors like corrosion, fatigue, and wear resistance

COURSE OUTCOMES:

After completion of the course, students should be able to:

CO1	Understand the mechanical properties of metals and their alloys
CO2	Analyze the various modes of failure and understand the microstructures of ferrous and nonferrous materials.
CO3	Describe the processes of heat treatment of various alloys
CO4	Acquire the Knowledge of composite materials and their production process as well as applications
CO5	Understand the properties and potentialities of various materials available and material selection procedures.

COURSE CONTENTS:

Unit	Course Contents	Hrs	CO
1	**Introduction:** Classification of Materials, Introduction to Crystal Structure: Coordination number, atomic packing factor, Simple Cubic, BCC, FCC and HCP Structures, Crystal imperfections–point, line, surface and volume imperfections. Atomic Diffusion: Phenomena, Fick's laws of diffusion (First and Second Law); Factors affecting diffusion. Mechanical Behaviour: Stress-strain diagrams showing ductile and brittle behaviour of materials, Engineering stress and true strains, Linear and non- linear elastic behaviour and properties, Mechanical properties in plastic range: Stiffness, Yield strength, Offset Yield strength, Ductility, Ultimate Tensile strength, Toughness. Plastic deformation of single crystal by slip and twinning, Mechanisms of strengthening in metals.	8	CO1
2	**Fatigue:** Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, S-N diagram, fatigue testing. Creep: Description of the phenomenon with examples, three stages of creep,	8	CO2

	creep properties, Stress relaxation. Concept of fracture toughness. Binary phase diagrams: Eutectic, and Eutectoid systems, Lever rule, Intermediate phases, (The same type of process will study in Iron Carbon Phase Diagrams) Gibbs phase rule, Effect of non-equilibrium cooling, Coring and Homogenization Iron-Carbon (Cementite) diagram: description of phases, Effect of common alloying elements in steel, Common alloy steels, Stainless steel, Tool steel, Specifications of steels.		
3	Heat Treatment, Ferrous and Non-Ferrous Alloys: Heat treating of metals: Time-Temperature Transformation (TTT) curves, Continuous Cooling Transformation (CCT) curves, Annealing: Recovery, Re crystallization and Grain growth, Types of annealing, Normalizing, Hardening, Tempering, Mar tempering, Austempering, Concept of harden ability, Factors affecting harden ability. Surface hardening methods: carburizing, cyaniding, nit riding, flame hardening and induction hardening, Age hardening of aluminium-copper alloys and PH steels. Ferrous materials: Properties, Compositions and uses of Grey cast iron and steel	8	CO3
4	Composite Materials: Composite materials - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate reinforced and fiber- reinforced composites, Fundamentals of production of composites, characterization of composites, constitutive relations of composites, determination of composite properties from component properties, hybrid composites. Applications of composite materials. Numerical on determining properties of composites	8	CO4
5	Ceramics: Structure type sand properties and applications of ceramics. Mechanical/ Electrical behaviour and processing of Ceramics. Plastics: Various types of polymers/plastics and their applications. Mechanical behaviour and processing of plastics, Failure of plastics. Brief description of other materials such as optical and thermal materials Smart materials – fiber optic materials, piezo-electrics, Shape Memory Alloys – Nitinol, superelasticity, Biological applications of smart materials - materials used as implants in human Body, Selection of Materials, Performance of materials in service Residual life assessment – use of non-destructive testing, Economics, Environment and Sustainability	8	CO5

TEXT BOOKS:

1. Foundations of Materials Science and Engineering Smith McGrawHill 4thEdition, 2009.
2. Material science and Engineering and Introduction WilliamD.Callister Wiley 2006.
3. Materials Science Shackle ford., & M. K. Muralidhara Pearson Publication 2007

REFERENCE BOOKS:

1. Materials Science and Engineering V.Raghavan PHI 2002
2. The Science and Engineering of Materials Donald R. Askland and Pradeep.P. Phule Cengage Learning 4lhEd., 2003.
3. Mechanical Metallurgy George Ellwood Dieter McGrawHil.

Mechanics of Fluids

Sub Code: 22RI463	Credits: 03
L: P: T: S: 3: 0: 0: 0	CIE Marks: 50
Exam Hours: 03	SEE Marks: 100
Total hours: 40	

COURSE OBJECTIVES:

1. To teach the students, fluid properties and fluid statics concepts.
2. To teach the students, derivation of governing equations of fluid flow.
3. To teach the students, flow measurements and measuring equipments.
4. To provide the students, knowledge of Dimensional Analysis and Flow through pipes.
5. To teach the students, concept of boundary layer, types of boundary layers and derivation of Navier-Stokes equations.

COURSE OUTCOMES:

After completion of the course, students should be able to:

CO1	Understand the basic fluid flow properties.
CO2	Apply the basic laws and governing equations of fluid statics and dynamics.
CO3	Understand the basics of Dimensional analysis and non-dimensional numbers
CO4	Understand the application of Bernoulli's principle in flow measuring devices.
CO5	Understand the nature of viscous flows and the boundary layers and boundary layer equations.
CO6	Understand flow through pipes with minor losses due to friction using Darey's and Chezy's equations.

COURSE CONTENTS:

Unit	Course Contents	Hrs	CO

1	**FLUID PROPERTIES AND FLUID STATICS:** Density, Specific weight, Specific gravity, viscosity, Vapor pressure, compressibility, Surface tension Pressure at a point, Pascal's law, pressure variation with temperature, density and altitude. Hydro static law, Piezometer, Simple and differential manometers, pressure gauges, total pressure and center of pressure plane, vertical and inclined surfaces.	8	CO1
2	**KINEMATICS** : Types of fluid flow, velocity and acceleration, velocity potential function and stream function. Numericals	8	CO2
3	**FLUID DYNAMICS & FLOW MEASUREMENTS:** Introduction equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation. Venturimeter, Orifice meter, Pitot-tube, Vertical orifice, Numericals	8	CO3
4	**DIMENSIONAL ANALYSIS & FLOW THROUGH PIPES:** Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham-pi-theorem, dimensionless numbers, similitude, types of similitudes, Numericals. Flow through pipes: Minor losses through pipes. Darey's and Chezy's equation for loss of head due to friction in pipes.	8	CO4
5	**VISCOUS FLOW:** Boundary layer flows, boundary layer thickness, boundary layer separation -drag and lift coefficients. Newton's law of viscosity, Boundary Layer, Navier- Stokes equation, Flow over a flat plate, Blasius solution. Numericals, viscous flow over two-dimensional streamlined and bluff bodies and drag characteristics, aspects of boundary layer separation and airfoil stall.	8	CO4

TEXT BOOKS:

1) Pijush.K.Kundu, Iram Cochen , "Fluid Mechanics", ELSEVIER, 3rd Edition. 2005.
2) Anderson, J.D., "Fundamentals of Aerodynamics", McGraw -Hill Book Co., New York, 1985

REFERENCE BOOKS:

1) R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", 10th edition, Laxmi Publications, 2011, New Delhi, India.

2) Frank M. White, " Fluid Mechanics", 7th edition, Tata McGraw Hill, 2011, New Delhi, India.
4) John F. Dauglas, "Fluid Mechanics", 5th edition, Pearson Education Limited, 2005 New Delhi, India.

Manufacturing Technology for Robots

Sub Code: 22RI464	Credits: 03
L: P: T: S: 3: 0: 0: 0	CIE Marks: 50
Exam Hours: 03	SEE Marks: 100
Total hours: 40	

COURSE OBJECTIVES:

1. Develop an understanding of the materials used in robotic component fabrication and their properties.
2. Introduce students to different methods of fabrication used in the manufacturing of robotic components.
3. Familiarize students with traditional manufacturing processes commonly employed in the robotics industry.
4. Provide an overview of additive manufacturing techniques and their applications in robotics.
5. Introduce students to CNC programming and machining for precise fabrication of robotic components.

COURSE OUTCOMES:

After completion of the course, students should be able to:

CO1	Understand various fabrication methods and their applications in the robotics field
CO2	Understand the material behaviour and analyze its usages for different robotic components based on their properties
CO3	Apply traditional manufacturing processes to fabricate robotic components accurately
CO4	Adopt additive manufacturing techniques for rapid prototyping and production of robotic components
CO5	Demonstrate proficiency in CNC programming and machining operations to create precise robotic components

COURSE CONTENTS:

Unit	Course Contents	Hrs	CO
1	**Materials for Robotic Components:** Material Selection for Robotic Components, Introduction to materials used in robotics (metals, polymers and composites), Material properties and their significance in robotic component design, Factors influencing material selection for specific applications.	8	CO1

	Metal Alloys and Composites: Overview of commonly used metal alloys in robotics, Properties and advantages of composite materials, Application areas and considerations for using composites in robotic components, Polymers and Elastomers, Properties and characteristics of polymers and elastomers, Use of polymers and elastomers in robotic component fabrication.		
2	**Introduction to Manufacturing Process:** Concept of Manufacturing process, its importance. Classification of Manufacturing processes. Casting: Introduction to Casting process & steps involved. Various components produced by casting process, Advantages & Limitations. Patterns: Definition and types. Introduction to Die Casting and injection moulding. **Introduction to metal working:** Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Forging: Classification, Forging machines & equipment. Die-design parameters. Forging defects, Applications of forging. Rolling: Classification, Types of rolling mills.	8	CO2
3	**Extrusion:** Types of extrusion processes, extrusion equipment & dies, Extrusion of seamless tubes, lubrication & defects in extrusion, Extrusion variables, Applications. Sheet & Metal Forming: Forming methods dies & punches, progressive die, compound die, combination die. Advanced Welding processes: Classification, Advantages & limitations of welding. Metal Arc welding (MAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes (AHW), Resistance welding, Applications	8	CO3
4	**Additive Manufacturing:** Introduction to Additive Manufacturing, Definition and principles of additive manufacturing, Various additive manufacturing technologies (3D printing, selective laser sintering, etc.), Benefits and limitations of additive manufacturing in robotics. **Additive Manufacturing Techniques:** Detailed study of different additive manufacturing processes, Materials used in additive manufacturing for robotic components, Design considerations and optimization for additive manufacturing, Applications of Additive Manufacturing in Robotics, Case studies showcasing the use of	8	CO4

	additive manufacturing in robotics, Future trends and advancements in additive manufacturing for robotics.		
5	**CNC Programming and Machining:** Introduction to CNC Programming, Fundamentals of Computer- Aided Design (CAD) and Computer-Aided Manufacturing (CAM), Basics of CNC programming language (G-code, M- code), Programming techniques and syntax for CNC machining operations, CNC Machining Operations, Detailed study of CNC machining processes (turning, milling, drilling, etc.). Machining strategies and tool selection for specific operations: Troubleshooting common issues in CNC machining, CNC Machining of Robotic Components, Programming and machining of simple robotic parts using CNC machines, Precision requirements and dimensional tolerances in robotic component fabrication, Inspection and quality control techniques for CNC machined parts	8	CO4

TEXT BOOKS:

1. "Manufacturing Engineering and Technology" by Serope Kalpakjian and Steven R. Schmid. Kalpakjian, Serope. 6th edition in SI units Serope Kalpakjian Illinois Institute of Technology Steven R. Schmid The University of Notre Dame SI Conversion by Hamldon Musa Universiti Teknologi Malaysia Prentice Hall Singapore London." (2007).
2. "Materials Science and Engineering: An Introduction" by William D. Callister Jr. and David G. Rethwisch. 10th edition, John Wiley & Sons, 2020.
3. "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" by Ian Gibson, David W. Rosen, and Brent Stucker. 2nd edition, Springer Publications 2015

REFERENCE BOOKS:

1. Introduction to Robotics: Mechanics and Control Authors: John J. Craig
2. Renfrew, Alasdair. "Introduction to robotics: Mechanics and control." International Journal of Electrical Engineering & Education 41.4 (2004): 388

PYTHON PROGRAMMING LAB

Sub Code: 22RIL471	**Credits: 01**
L: P: T: S: 0: 2: 0: 0	**CIE Marks: 50**
Exam Hours: 02	**SEE Marks: 50**
Total hours: 15	

COURSE OBJECTIVES:

1. Apply various data pre-processing techniques using Python for cleaning, transforming, and organizing datasets for machine learning applications.
2. Integrate their machine learning models with popular Python libraries such as NumPy, Pandas, and scikit-learn
3. Perform exploratory data analysis and advanced data visualization techniques using Python libraries such as Matplotlib and Seaborn. Design and develop small applications using advance python libraries

COURSE OUTCOMES:

After completion of the course, students should be able to:

CO1	Apply Python programming skills to preprocess and clean real-world datasets for machine learning tasks.
CO2	Ability to conduct experiments using modern tools like Tensorflow, Keras
CO3	Ability to analyse outputs of machine learning models and Perform statistical hypothesis testing to validate the significance of machine learning results.
CO4	Present experimental findings in writing, to convey the importance and relevance of the experiments

COURSE CONTENTS:

Unit	Experiments
1	Design and Implement a Python program to accept 3 digits from the user andprint all possible combination from digits. Create a Python program to take two command line inputs and compute the GCD
2	A list rotation consists of taking the last element and moving it to the front. For instance, if we rotate the list [1,2,3,4,5], we get [5,1,2,3,4]. If we rotate it again, we get [4,5,1,2,3]. Write a Python function rotate list(ls,k) that takes a list ls and a positive integer k and returns the list ls after k rotations. If k is not positive, your function should return ls unchanged. Note that your function should not change ls itself, and should return the rotated list. Here are some examples to show how your function should work. >>>rotatelist([1,2,3,4,5],1) #output is [5, 1, 2, 3, 4] >>>rotatelist([1,2,3,4,5],3) #output is [3, 4, 5, 1, 2]>>>rotatelist([1,2,3,4,5],12) #output is [4, 5, 1, 2, 3] Design and implement a python code that accepts two string from user and displays the characters which are present in both the strings. Use Set sequence type to achieve the same
3	Design a python program to compute the number of characters, words and lines in a file. Also Print the most frequent words read from the file. Apply import, from, * and other module related concepts to create a module called “calc” consists of 4 function that should return sum, division, multiplication and subtraction. Create

	another module caller “user”, import the calc module and illustrate the use of all the functions of calc module.
4	Design & implementation of programs in python to Manipulate image.
5	Data Science and Python: Discovering the match between data science and python: Understanding the role of programming in Data Science, Creating the Data Science Pipeline: Preparing the data, Performing exploratory data analysis, Learning from data, Visualizing, Obtaining insights and data products .Introducing Python's Capabilities and Wonders: Why Python?, Flavors of Python, Python as a calculator, Working with Python, Getting a taste of the language, Understanding the need for indentation, Working at the command line or in the IDE:IDLE, Notepad, Jupyter notebook, Pycharm, VS Code, Google Colab. Using the Python Ecosystem for Data Science:Pandas,Numpy,Scipy, SKlearn, Statsmodes, Spacy, NLTK, Beautiful Soap, Matplotlib, Seaborn, Plotly, Tkinter, Flask, Stremlit. Programs on Overview of Python and Inbuilt Data Structures:Basics of Python including data types, variables, expressions, loops and functions, Lambda, Python data structures including:String, Array, List, Tuple, Set, Dictionary. Programs on Getting the Data: Create a pandas data frame, Reading from a text file Reading CSV delimited format, Reading Excel and other Microsoft Office files, Managing Data from Relational Databases – Theory only as we may not have a DB, 13 CO1,2 L3/L4 COMPUTER ORGANIZATION & ARCHITECTURE Programs on Interacting with Data from NoSQL Databases - Theory only as we may not have a DB, Accessing Data from the Web using beautiful soup, Working with web API, Sending Data in Unstructured File Form
6	Juggling between NumPy and pandas, Knowing when to use NumPy, knowing, when to use pandas, Validating Your Data, Removing duplicates, Manipulating Categorical, Variables, Reggex, Dealing with Dates in Your Data: Formatting date and time values, Using the right time transformation. Dealing with Missing Data: Finding the missing data, Encoding missingness, Imputing missing data,Slicing and Dicing: Filtering and Selecting Data, Slicing rows, Sclicing columns, Dicing, Removing data, Sorting Shuffling, Aggregating data, concatenating and Transforming. Programs on Visualizing the Data: Choosing the Right Graph ,Showing parts of a whole with pie charts, Creating comparisons with bar charts ,Showing distributions using histograms, Depicting groups using boxplots, Seeing data patterns using scatterplots, Creating 13 CO4, CO5, CO6 L3/L4 Advanced Scatterplots, Depicting groups, Showing correlations, Plotting Time Series, Representing time on axes, Plotting trends over time.

	Programs on Creating a web app Using streamlit: Understanding web basics, Introduction to streamlit, Creating first webapp, Hosting Locally.

TEXT BOOKS:

1)

DEVELOPMENT OF SOFT SKILLS FOR ENGINEERS

Sub Code: 22RI472	**Credits: 01**
L: P: T: C: 1: 0: 0: 0	**CIE Marks: 50**
Exam Hours: 02	**SEE Marks: 50**
Total hours: 15	

COURSE OBJECTIVES:

1) Acquire verbal and non-verbal communication skills

2) Get the essence of personal and professional leadership skills

3) Understand the self-managerial skills and time management.

4) To develop and nurture the soft skills of the students through individual and group activities.

5) Understand the significance of engineering soft skills.

6) To expose students to right attitudinal and behavioural aspects and to build the same through activities.

COURSE OUTCOMES:

After completion of the course, the graduates will be able to:

CO	content	Bloom's Level
CO 1	Understand how learning to connect and work with others to achieve a set task.	L2
CO 2	Demonstrating clear briefing and listening skills, not being afraid to ask for help and support.	L2
CO 3	To effectively communicate through verbal/oral communication and improve the listening skills.	L2
CO 4	To function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.	L3

COURSE CONTENTS

UNIT	Course Contents	Hrs	COs
1	**Creativity :** Creativity, Innovation, and Change and the Knowledge Economy, Collaboration in the Workplace - Definition, Benefits & Examples, What is Critical Thinking - Definition, Skills & Meaning.	3	CO1, CO2
2	**Leadership :** Leadership in Engineering: Skills & Strategies, Leadership in Engineering, Skills & Strategies, Teamwork and people skills.	3	CO1, CO2
3	**Communication:** Verbal and non-verbal communication, Characteristics of Technical Communication, Public speaking and presentation, Strategies for Developing Effective Presentations.	3	CO1, CO2
4	**Self-Management Skills:** Self-Management Skills for the Workplace, Sustaining a Strong Relationship With Your Manager, Personal Accountability, Adaptability & Initiative at Work. **Stress Management:** Individual and Organizational Techniques & Methods. What is Time Management? - Definition, Examples & Studies	3	C03, CO4
5	**Engineering Soft Skills:** Problem Solving in High-Performing Teams, Adaptability in the Workplace: Strategies & Importance, Practicing a Presentation: Importance, Techniques & Feedback, Practical Application: Creative vs. Critical Thinking in the Workplace	3	C03, CO4

TEXTBOOKS:

1) Fast-Tracking Your Career: Soft Skills for Engineering and IT Professionals 1st Edition Wushow Chou (Author), 2017
2) Soft Skills 3rd Edition: Personality Development for Life Success Paperback – 30 October 2021 by Prashant Sharma

REFERENCE BOOKS:

3) Robers Lusier, Thomson, "Management Fundamentals Concepts, Application, Skill Development", 3rd Edition, 2018
4) Soft Skills Training: A Workbook to Develop Skills for Employment – by Frederick H. Wentz, 7th Edition, 2016
5) Everyone Communicates, Few People Connect: What the Most Effective People do differently – by John C. Maxwell, 2020 Edition
6) Teamwork is an Individual Skill: Getting Your Work Done While Sharing Responsibility – by Christopher M. Avery, Meri Aaron Walker, and Erin O'Toole., 2nd Edition 2014.

MANUFACTURING LAB

Sub Code: 22RI473	**Credits: 01**
L: P: T: C: 1: 0: 0: 0	**CIE Marks: 50**
Exam Hours: 02	**SEE Marks: 50**
Total hours: 15	

COURSE OBJECTIVES:

1) Acquire verbal and non-verbal communication skills

2) Get the essence of personal and professional leadership skills

COURSE OUTCOMES:

After completion of the course, the graduates will be able to:

CO	content	Bloom's Level
CO1	Apply traditional manufacturing processes to fabricate robotic components accurately.	L2

COURSE CONTENTS

UNIT	Course Contents	Hrs	COs
1	Joining Processes: Students should practice for joining processes, such as Soldering, Brazing and welding (any two models on each).	3	CO1, CO2
2	Machining Practice: Students should practice for machining operations (turning, milling, and drilling) on sample work pieces to develop their machining skills	3	CO1, CO2
3	Sheet Metal Fabrication: Students should practice for Sheet metal operations for preparing frustum of cone, cylinder and tray.	3	CO1, CO2
4	Casting and Molding: Students should practice to prepare different patterns to pour molten metal by using sand casting.	3	C03, CO4

TEXTBOOKS:

1. Manual for Manufacturing Lab, DSCE

ROBOTIC PROCESS AUTOMATION LAB

Sub Code: 22RIL474	**Credits: 01**
L: T: P: S: 0: 0: 2: 0	**CIE Marks: 50**
Exam Hours: 2	**SEE Marks: 50**
Total hours: 24	

COURSE OBJECTIVES:

1. Understand the concept of Robotics Process Automation in business application.
2. Know about the utilization of Robotics Process Automation in any organization
3. Utilize the RPA knowledge and provide the cost effective solution
4. Understand business functionalities in Robotics Process Automation
5. Learn Skills in cost efficiencies of various RPA solutions

COURSE OUTCOMES:

After completion of the course, the graduates will be able to:

CO	content
CO1	Implement basic and arithmetic operations using different data types
CO2	Validation of data input and outputs
CO3	Develop real time application using Excel file
CO4	Develop and deploy ready bots using UiPath platform
CO5	Students will analyze visual workflow automation straightforward and intuitive

COURSE CONTENTS

UNIT	Contents of the experiment	Hrs
1	Download, Install and Activate Ui-Path Studio. Working with Automation Projects in UiPath Studio, Creating an Automation project, Understand Automation Debugging.	**2**
2	Understand Layout Diagrams Understand Type of Decisions Switch Activity.	**2**
3	Implement control statements such as if-activity, switch – activity.	**2**
4	Implement while activity, do-while activity, for-each activity in any application	**2**
5	Implement Flowchart and Sequence activity on Scalar and collection variables	**2**
6	Develop: i) build a data table(static) ii) build a data table using data scraping (Dynamically)	**2**
7	Create a simple calculator using a separate workflow and arguments	**2**
8	Develop clipboard management. (Suggested Hint: open Notepad, write some data into it, and then copy the data to the clipboard.Later extract the data from the clipboard)	**2**
9	Perform the following operations on an Excel file: i) Read cell ii) Write cell iii) Read range iv) Write range v) Append range	**2**
10	Implement Arithmetic operations in 2 Excel files.	**2**
11	Perform read operations on Excel file and creating a data table by using	**2**

	data from the Excel file	
12	Create and extract Email Address	**2**

TEXTBOOKS:

1) Alok Mani Tripathi, Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath, 1st Edition, Packt Publishing Ltd., 2018
2) Nandan Mullakara, Arun Kumar Asokan, Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere, 1st Edition, Packt Publishing Ltd., 2020
3) Automation Anywhere Enterprise, Exercise Handbook V1.0 2. https://resources.automationanywhere.com/eboo

UNIVERSAL HUMAN VALUES

Sub Code: 22UH48	**Credits: 01**
L: T: P: S: 1: 0: 0: 0	**CIE Marks: 50**
Exam Hours: 2	**SEE Marks: 50**
Total hours: 15	

COURSE OBJECTIVES:

1. Recognize the need for Value education harmony in self, family and society.
2. Understand the underlying the propositions of harmony in nature.
3. Verify the propositions and realize the implications of holistic understanding and professional ethics.

COURSE OUTCOMES:

After completion of the course, the graduates will be able to:

CO1	Recognize the importance of Value education.
CO2	Understand the concepts of harmony in self.
CO3	Develop skills for living in harmony and apply in professional life.
CO4	Outline the principles of human values and examine its role in education
CO5	Adapt to natural acceptance of human values build holistic understanding
CO6	Test and verify the propositions on human values by self-exploration

COURSE CONTENTS

UNIT	Contents of the experiment	Hrs
1	Introduction to Value Education (3 hours) : Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Case studies, videos and real world examples	**3**

2	Harmony in the Human Being (3 hours) : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Case studies, videos and real world examples.	**3**
3	Harmony in the Family and Society (3 hours) : Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order. Case studies, videos and real world examples	**3**
4	Harmony in the Nature/Existence (3 hours): Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence. Case studies, videos and real world examples	**3**
5	Implications of the Holistic Understanding: a Look at Professional Ethics (3 hours) Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession. Case studies, videos and real world examples. Presentation/Videos	**3**

Text Books:

1. A foundation course in HUMAN VALUES and Professional ethics; presenting a universal approach to value education- through self-exploration by, R R Gaur, R Sangal & GP Bagaria, Excel books Pvt. Ltd.

2. Professional Ethics & Human Values: Prof. D.R. Kiran, TATA Mc Graw Hill Education.

Reference Books:

1. Human Values: A. N. Tripathy (2003, New Age International Publishers)

2. Ethics in Engineering Mike W. Martin, Department of Philosophy, Chapman University and Roland Schinzinger, School of Engineering, University of California, Irvine.

3. Fundamentals of Ethics, Edmond G. Seebauer & Robert L. Barry, Oxford University Press.