AUTONOMOUS

SYLLABUS

III & IV Semesters

BE in Robotics and Artificial Intelligence

2023

MITE

Invent Solutions

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

Institute Vision

*"To attain perfection in providing **Globally Competitive Quality Education** to all our Students and also benefit the global community by using our strength **in Research and Development**"*

Institute Mission

*"To establish world class educational institutions in their respective domains, which shall be **Centers of Excellence** in their stated and implied sense. To achieve this objective, we dedicate ourselves to meet the challenges of becoming **Visionary and Realistic, Sensitive and Demanding, Innovative and Practical,** Theoretical **and Pragmatic**; ALL at the same time"*

Department Vision

Emerge as a center of excellence in Robotics and Artificial Intelligence by nurturing students to become innovative, ethical, and socially responsible technologists who can contribute to national development and global technological advancement.

Department Mission

- *To Impart strong knowledge in Robotics, Artificial Intelligence, and allied domains, fostering innovation and technical competence.*
- *To Equip students with industry-relevant tools and state-of-the-art technologies to address real-world challenges.*
- *To Promote critical thinking, interdisciplinary learning, research, and entrepreneurship for societal benefit.*
- *To Inculcate professional ethics, effective communication, teamwork, and lifelong learning among students.*

Program Educational Objectives (PEOs)

After successful completion of the program, the graduates will be able

- *To Apply the principles of Robotics and Artificial Intelligence to design, develop, and deploy intelligent systems in diverse applications.*
- *To Excel in professional careers, advanced studies, or entrepreneurial ventures through continuous learning, skill enhancement and adaptability to emerging technologies*
- *To Demonstrate ethical responsibility, leadership, and societal impact while contributing to sustainable technological advancement.*

Program Specific Outcomes (PSOs)

At the end of the program, graduates will be able to

- *Apply the Knowledge of Mechanical systems, Electronics, and AI/ML techniques to design intelligent robotic solutions for real-world applications.*
- *Design, develop, and implement robotic systems by integrating sensors, actuators, embedded hardware, and software platforms to meet the needs of industry and society.*

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING
(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

LIST OF COURSES

III / IV Semester Courses			
Sl. No.	**Course Code**	**Course Title**	**Sem**
BASIC SCIENCE COURSES			
1	23BSRI201	Statistics and Graph Theory	III
PROFESSIONAL COURSES			
2.	23RIPC202	Fundamentals of Robotics	III
3.	23RIPC203	Materials and Manufacturing Technology	III
4.	23RIPC204	Microcontrollers	III
5.	23RIPC205	Fundamentals Analog & Digital Systems	III
6.	23RIPC206	Modelling Laboratory	III
7.	23RIPC207	AI & ML for Robotics	IV
8.	23RIPC208	Hydraulics and Pneumatics	IV
9.	23RIPC209	Data structures & Algorithms	IV
10.	23RIPC210	Sensors and Actuators for Robotics	IV
11.	23RIPC211	Design of Machine Elements	IV
12.	23RIPC212	Sensors & Actuators for Robotics Laboratory	IV
HUMANITIES & SOCIAL SCIENCE COURSES			
13	23HMCC215	Universal Human Values	III
14	23HMCC216	Research Methodology & Intellectual Property Rights	IV
SKILL ENHANCEMENT COURSES			
15	23RISE251	Supervisory Control and Data Acquisition System (SCADA)	III
16	23RISE252	Python programming	III
17	23RISE253	Rapid Prototyping	III
18	23RISE254	Internet of Robotic Things	IV
19	23RISE255	Virtual Instrumentation and Automation	IV
20	23RISE256	UI/UX Design	IV
AUDIT COURSES			
21	23NMCC221	Yoga-I	III
22	23NMCC222	Physical Education-I	III
23	23NMCC223	National Service Scheme - I	III
24	23NMCC224	Arts-I	III
25	23NMCC225	Yoga-II	IV
26	23NMCC226	Physical Education-II	IV
27	23NMCC227	National Service Scheme - II	IV
28	23NMCC228	Arts-II	IV
29	23NMCC229	Environmental Studies & Sustainability	IV

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III Semester (2023 Scheme): Robotics and Artificial Intelligence

Sl. No	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Examination Marks			Duration of Exam in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23BSRI201	Statistics and Graph Theory	Professional Core	Mathematics	3	0	0	50	50	100	3	3
2	23RIPC202	Fundamentals of Robotics	Professional Core	RAI	3	0	0	50	50	100	3	3
3	23RIPC203	Materials and Manufacturing Technology	Professional Core	RAI	3	0	0	50	50	100	3	3
4	23RIPC204	Microcontrollers	Professional Core	RAI	3	0	2	50	50	100	3	4
5	23RIPC205	Fundamentals of Analog & Digital Systems	Professional Core	RAI	4	0	0	50	50	100	3	4
6	23RIPC206	Modelling Laboratory	Professional Core Laboratory	RAI	1	0	2	50	50	100	2.5	2
7	23HMCC215	Universal Human Values	Humanities & Social Sciences	Any Dept.	2	0	0	50	50	100	2.5	2
8	23RISE25X	Skill Enhancement Course*	Skill Enhancement Course	RAI/Any Dept.	1	0	2	50	50	100	2.5	2
9	23NMCC22X	Yoga/Physical Education/NSS/Arts**	Non-Credit Mandatory Course	Yoga Teacher/ PED/NSS Coordinator/ Cultural Coordinator	0	0	1	100	-	100	-	-
										Total Credits		**23**

***Skill Enhancement Course(s):**

Sl. No.	Course Code	Course Title
1	23RISE251	Supervisory Control and Data Acquisition System (SCADA)
2	23RISE252	Python Programming
3	23RISE253	Rapid Prototyping

****Yoga/Physical Education/NSS/Arts:**

Sl.No.	Course Code	Course Title
1	23NMCC221	Yoga-1
2	23NMCC222	Physical Education-I
3	23NMCC223	NSS-I
4	23NMCC224	Arts-I

Note: ** To be offered from 3rd to 6th Semester

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IV Semester (2023 Scheme): Robotics and Artificial Intelligence

Sl. No.	Course Code	Course Title	Category	Teaching Dept.	Teaching Hrs /Week			Exam Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23RIPC207	AI & ML for Robotics	Professional Core	RAI	3	0	2	50	50	100	3	4
2	23RIPC208	Hydraulics and Pneumatics	Professional Core	RAI	3	0	0	50	50	100	3	3
3	23RIPC209	Data structures & Algorithms	Professional Core	RAI	3	0	2	50	50	100	3	4
4	23RIPC210	Sensors and Actuators for Robotics	Professional Core	RAI	3	0	0	50	50	100	3	3
5	23RIPC211	Design of Machine Elements	Professional Core	RAI	3	0	0	50	50	100	3	3
5	23RIPC212	Sensors & Actuators for Robotics Laboratory	Professional Core	RAI	1	0	2	50	50	100	3	2
6	23HMCC216	Research Methodology & Intellectual Property Rights	Humanities & Social Sciences	RAI	2	0	0	50	50	100	2.5	2
7	23RISE25X	Skill Enhancement Course*	Skill Enhancement Course	RAI/Any Dept	1	0	2	50	50	100	2.5	2
8	23NMCC229	Environmental Studies & Sustainability	Non-Credit Mandatory Course	Civil Engg.	1	0	0	100	-	100	-	-
9	23NMCC22X	Yoga/ Physical Education /NSS/Arts**	Mandatory Non-Credit Course	Yoga Teacher/ PED/NSS Coordinator/ Cultural Coordinator	0	0	1	100	-	100	-	-
											Total	**23**

***Skill Enhancement Course(s):**

Sl. No.	Course Code	Course Title
1	23RISE254	Internet of Robotic Things
2	23RISE255	Virtual Instrumentation and Automation
3	23RISE256	UI/UX Design

****Yoga/Physical Education/NSS/Arts:**

Sl. No.	Course Code	Course Title
1	23NMCC225	Yoga-II
2	23NMCC226	Physical Education-II
3	23NMCC227	NSS-II
4	23NMCC228	Arts-II

Note: ** To be offered from 3rd to 6th Semester

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III Semester

IV Semester

Statistics and Graph Theory			
Semester	**3**	CIE Marks	**50**
Course Code	**23BSRI201**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs.	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Provide strong foundation in Correlation and Regression techniques to solve engineering problems.
2. Impart knowledge of Statistical Inference and Hypothetical Testing.
3. Develop a systematic understanding of Stochastic Processes and Markov Chains, and their applications in solving engineering problems.
4. Build a foundation of Graph Theory for solving problems in engineering.

Module 1: Correlation & Regression	**No. of Hours: 8**

Correlation: Introduction, Types of Correlation, Correlation and Causation, Scatter Diagram Method, Karl Pearson's Coefficient of Correlation.
Regression: Introduction, Linear and Non-Linear Regression, Lines of Regression, Coefficient of Regression, Mean values from the two lines of Regression, Regression coefficients and the Correlation Coefficient from the lines of Regression, Correlation Analysis Vs. Regression Analysis.

Text Book 1- Chapter 8, 9

Module 2: Statistical Inference and Hypothesis Testing	**No. of Hours: 10**

Sampling Theory: Introduction, Population, Sampling, Parameter and Statistic, Errors in Statistics, Simple Random Sampling.
Testing of Hypothesis: Introduction, Sampling Distribution of a Statistic, Central Limit theorem, Test of Significance, Null Hypothesis, Alternative Hypothesis, Types of Errors in Testing of Hypothesis, Level of Significance, Critical Region, One-tailed and Two-tailed tests, Procedure for Testing of Hypothesis.
Parametric tests: Test of Significance of single Mean and difference of Mean. Student's 't' Distribution, Non-parametric tests: Chi-Square test, Wilcoxon Signed-Rank test.

Text Book 1- Chapter 15, 16, 17, 18, 19, 26

Module 3: Multiple and Partial Correlation and Regression Analysis	**No. of Hours: 8**

Introduction, Multiple and Partial Correlation and Regression, Yule's notation, Order of Regression Coefficients, Planes of Regression, Coefficient of Multiple Correlation. Coefficient of Partial Correlation, Use of Computers in Multiple Regression and Correlation Analysis.

Text Book 1- Chapter 27

Module 4: Stochastic Processes & Markov Chains	**No. of Hours: 8**

Stochastic Process (Random Process), Markov Chain, Transition Matrix, Probability vector, Stochastic Matrix, One-step transition probabilities, Chapman–Kolmogorov equations for n-step transition probabilities, Stationary Distribution of Regular Markov Chain, Classification of States of a Markov Chain, Limiting Probabilities

Text Book 2- Chapter 31

Module 5: Graph Theory	**No. of Hours: 8**

Graphs & Graph Models, Graph Terminology, Special types of graphs, Applications of special types of Graphs, Representing Graphs-Adjacency Matrices, Incidence Matrices, Graph Isomorphism, Application of graph Isomorphism, Connectivity, Applications of vertex and edge connectivity, Euler & Hamilton Paths and Circuits, Applications of Hamilton circuits, Shortest-Path Problems, Planar Graphs, Graph Coloring, Application of Planar graphs & Graph Coloring, Trees- Rooted tree, Binary tree, Prefix codes.

Text Book 3- Chapter 9, 10

Course Outcomes:

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

1. Illustrate the fundamental concepts of Correlation and Regression, Hypothetical Testing, Markov chains, and Graph Theory.
2. Apply suitable techniques to solve engineering and scientific problems related to Correlation and Regression, Hypothetical Testing, and Markov chains.
3. Make use of appropriate concepts of Graph Theory to solve engineering and scientific problems.
4. Solve real-life problems related to Correlation and Regression, Hypothetical Testing, Markov chains, and Graph Theory.

Textbooks:

1. S. C. Gupta, "Fundamental of Statistics", 8th Edition, Himalaya Publishing House, 2024.
2. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill Education (India) Private Limited, 2017.
3. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", McGraw Hill Education (India) Private Limited, 8th Edition, 2022.

Reference Books:

1. S. C. Gupta & V. K. Kapoor, "Fundamental of Mathematical Statistics", 12th Edition, Sultan Chand & Sons, 2024.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers & Keying Ye, "Probability & Statistics for Engineers & Scientists", 9th Edition, Pearson Education, 2022.
3. Gary Chartrand & Ping Zhang, "Introduction to Graph Theory", Indian Edition, McGraw Hill Education (India) Private Limited, 2005.

Web Links:

1. Correlation and Regression – https://www.udemy.com/course/correlation-regressionconcepts-with-illustrative-example/?couponCode=ST11MT170325G3
2. Correlation and Regression – https://onlinecourses.nptel.ac.in/noc23_ma50/preview
3. Sampling Theory – https://archive.nptel.ac.in/courses/111/104/111104073/
4. Stochastic Process – https://onlinecourses.nptel.ac.in/noc19_ma30/preview
5. Graph Theory – https://onlinecourses.nptel.ac.in/noc25_ma26/preview
6. Graph Theory – https://onlinecourses.nptel.ac.in/noc25_cs03/preview
7. Application of Graph theory – https://onlinecourses.nptel.ac.in/noc25_me85/preview

Fundamentals of Robotics			
Semester	**III**	CIE Marks	**50**
Course Code	**23RIPC202**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Impart the fundamental concepts of automation and robotics.
2. Provide the knowledge on Robot Anatomy and basic robot programming.
3. Familiarize robot end effectors and sensors
4. Teach the Robot application in various domain.

Module 1: Introduction to Automation and Robotics — **No. of Hours: 9**

Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automation, Basic components of robot, robot specifications, classification, Analysis of Transfer Lines, Numerical, degrees of freedom, Asimov's laws of robotics.

Text Book 1: Sec 1.1-1.3, 2.1.1
Text Book 2: Sec 1.2.1, 1.2.2, 4.1, 4.2, 16.1,16.3

Module 2: Robot Anatomy and Motion Analysis: — **No. of Hours: 8**

Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom, types of movements: vertical, radial and rotational traverse, roll, pitch and yaw, Work volume, Robot kinematics: direct and inverse kinematics, transformations and rotation matrix.

Text Book 1: Sec 2.1- 2.6, 3.1.1, 3.1.2, 3.1.3, 3.4

Module 3: Robot End Effector & Sensors — **No. of Hours: 9**

Types of End effectors, Mechanical Grippers, Types of Grippers Mechanisms, Other types of grippers, Tools and End effectors, The Robot/End effector interface: Gripper selection and Design. Transducers and sensors in robotics: tactile, proximity and range sensors, uses of sensors in robotics

Text Book 1: Sec 5.1- 5.6, 6.1- 6.5

Module 4: Robot Programming languages and systems — **No. of Hours: 8**

Methods of robot programming, lead -through programming methods, A robot program as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods.

Text Book 1: Sec 8.1-8.7

Module 5: Robot Applications — **No. of Hours: 8**

Industrial Application, Material Handling: Material Transfer Applications, Machine Loading and Unloading Application, Palletizing Application Processing Applications: Arc Welding, Robot for Arc Welding Application, Arc Welding Robot Requirements, Assembly Applications: The Assembly Task, Peg-in-hole Assembly, Steps in Assembly, The Compliance, Providing Compliance, Inspection Application: Sensor Based Inspection, Vision Based Inspection, Robot Safety, Non-Industrial Applications

Text Book 3: 10.1 - 10.9

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

1. Explain the fundamental principles of robotics and automation, including robot anatomy, end effectors, sensors & Robot applications,
2. Determine the performance of transfer lines by calculating key metrics such as cycle time, production rate & line efficiency
3. Identify the gripping force required for a mechanical gripper based on different gripping mechanisms and operating conditions
4. Apply robot programming methods to generate robot motion paths and control sequences.

Textbooks:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey& Ashish Dutta, "Industrial Robotics: Technology, Programming, and Applications", 2nd Edition, McGraw-Hill, 2019.
2. Mikell P. Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", 4th Edition, Pearson Education, Book Code: 245, 2020.
3. R.K. Mittal and I.J. Nagrath, "Robotics and Control", 1st Edition, Tata McGraw Hill Education, 2003.

Reference Books:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2008.
2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill,1987.
3. John J. Craig, "Introduction to Robotics: Mechanics and Control", 3rd Edition, Pearson Education, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2005.

Web links:

1. **Introduction to Robotics:** https://onlinecourses.nptel.ac.in/noc21_me32/preview, IIT Kanpur. NPTEL Online Courses
2. **Robotics:** https://onlinecourses.nptel.ac.in/noc21_me76/preview, IIT Madras. NPTEL Online Courses
3. **Introduction to Industrial Automation and Control:** https://nptel.ac.in/courses/108105063, IIT Kharagpur. NPTEL
4. **Bulk Material Transport and Handling Systems:** https://archive.nptel.ac.in/courses/113/105/113105104/, IIT Kharagpur.

Materials and Manufacturing Technology			
Semester	**III**	CIE Marks	**50**
Course Code	**23RIPC203**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hrs.	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Introduce the mechanical properties of engineering materials and their influence on performance in mechanical applications
2. Introduce the fundamentals of additive manufacturing and advanced non-traditional machining methods
3. Provide the knowledge of various metal joining processes and their applicability for different engineering scenarios
4. Impart the Knowledge of various forming operations.

Module 1: Engineering materials	**No. of Hours: 9**

Types of Metals Alloys, Ferrous alloys: Low, Medium & High Carbon Steels, Stainless Steels, cast iron, Gray Iron, White & Malleable Iron, Non-Ferrous alloys: Copper & its Alloys, Aluminium & its Alloys, Titanium its Alloys, Design & Safety Factors, cutting tool Materials: High Speed steels, cast-cobalt alloys, Carbides, Coated Tools, Matrix and Reinforcement Materials, Polymer-Matrix Composites, Metal-Matrix Composites, Ceramic-Matrix Composites.

Text Book 1: Chapter 9.1-9.3,9.10.
Text Book 2: Chapter 22.1-22.5,22.12.

Module 2: Advanced Machining Process	**No. of Hours: 8**

Introduction, Chemical Machining, Electrochemical Machining, Electrochemical Grinding, Laser Beam Machining, Electron Beam Machining, water Jet Machining, Abrasive Jet Machining, Hybrid Machining Systems, Micro Machining OF MEMS, Electroforming based processes, Mesoscale & Nanoscale manufacturing.

Text Book 2: Chapter 27, Chapter 29.2, 29.3, 29.5, 29.6

Module 3: Forming Process	**No. of Hours: 8**

Nature of Plastic Deformation: Hot Working, Cold Working, Forging: Forging Operation, Forging Types, Forging Defects, Calculation of Forging Force, Extrusion: Extrusion Principle, Hot & Cold Extrusion Process, hydrostatic extrusion, Defects in Extrusion, Calculation of Extrusion Force. Wire Drawing, Rod & Tube drawing, Explosive forming. High Pressure Die Casting.

Text Book 3: Chapter 7.1-7.5

Module 4: Metal Joining Process	**No. of Hours: 8**

Introduction, Gas welding, Electric Arc welding process: TIG, SMAW, SAW & GMAW Electrodes for arc welding, Numerical: Arc voltage, current, & weld travel speed, Electron beam welding, Laser beam welding, Cutting, Solid state welding: Cold welding, ultrasonic welding, friction welding, resistance spot welding, explosion welding, diffusion bonding.

Text Book 2: Chapter 30, 30.2 -30.8, 31, 31.2-31.7.

Module 5: Additive Manufacturing	**No. of Hours: 9**
Introduction, Additive Manufacturing (AM) Methodology, Fusion Deposition Modelling, Photopolymerization, Material Jetting, Powder Bed Processes, Laminated-Object Manufacturing, Directed Energy Deposition, Multi-Material and Hybrid AM, Challenges in Additive Manufacturing, Applications of AM in Robotics, Design for AM. Text Book 2: Chapter 20	
Course Outcomes: At the end of the course, the student will be able to 1. Explain mechanical properties of engineering materials and additive manufacturing processes with their engineering applications 2. Explain the principles and applications of metal forming, metal joining and advanced machining processes. 3. Apply different metal forming operations such as forging and extrusion, and compute forces involved in these processes. 4. Apply the principles of metal joining techniques to calculate the process parameters.	
Textbooks: 1. William D. Callister Jr. and David G. Rethwisch, "Materials Science and Engineering: An Introduction", 9th Edition, Wiley India, 2017. 2. Serope Kalpakjian & Steven R. Schmid, "Manufacturing Engineering and Technology", 7th Edition, Pearson Education, 2023. 3. P.N. Rao, "Manufacturing Technology Volume 1 & 2", 4th Edition, McGraw-Hill Education, 2023.	
Reference Book: 1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials: Properties and Selection", 9th Edition, Pearson Education, 2010.	
Web links: 1. Manufacturing Engineering and Technology: https://onlinecourses.nptel.ac.in/noc21_me32/preview, IIT Kanpur. NPTEL Online Courses 2. Advanced Manufacturing Processes: https://archive.nptel.ac.in/courses/113/105/113105104/, IIT Kharagpur.	

Microcontrollers			
Semester	**III**	CIE Marks	**50**
Course Code	**23RIPC204**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:2**	Exam Hrs	**3**
Total Hrs	**64**	Credits	**4**

Course Learning Objectives: This course is designed to

1. Familiarize the basic architecture of 8051 Microcontroller
2. Program 8051 Microcontroller and Arduino controller using assembly and embedded C language
3. Impart the operation of Timer, Interrupt, and Serial Communication of 8051
4. Interface 8051 Microcontroller to external peripherals.

Module 1: Micro controller 8051 Architecture — **No. of Hours: 9+2**

Introduction to 8051 Microcontroller: Brief history, Microprocessor v/s Microcontroller, Classification of MCS-51 family, Processor architecture of 8051, Registers of 8051, Inbuilt RAM, Register banks, Stack, On-chip and external program code memory ROM, Power reset and clocking circuits, I/O port structure.

Text book 1&2 – Chapter 1,2

Laboratory Component.

1. Introduction to Keil microvision programming

Module 2: 8051 Programming — **No. of Hours: 9+4**

Basics of 8051 Assembly Language Programming: Basics of 8051 assembly language programming, addressing modes: Accessing memory using various addressing modes, Arithmetic operations and programs, Logical operations and programs, Branching, I/O Port programs, Bit level instructions and programs.

Text book 1&2 – Chapter 3,4,5,6

Laboratory Components:

1. Assembly program using data movement, arithmetic, and logical operations
2. Assembly program for code conversion (BCD, ASCII, HEX, etc.)

Module 3: Timer/Counter and Interrupt Programming — **No. of Hours: 9+4**

Timer /Counter Programming: Introduction, Timer /counter registers, Different modes, Timer /counter Programming using assembly

Interrupts: Interrupt v/s Polling, Types of interrupts, Interrupt registers, Programming of external interrupts, Timer interrupts

Text book 1 – Chapter 9,11

Laboratory Components:

1. Assembly programs using timer registers
2. Assembly programs using different interrupt operations

Module 4: Serial Communication & 8051 Interfacing Applications — **No. of Hours: 9+4**

Serial Communication: Introduction, Basics of serial communication and its standard, RS232 standard, RS422 standard, Max 232/233 driver, Simple serial port programming using assembly to transmit/ receive data serially

Interfacing of peripherals: ADC & DAC, DC motor and sensor interfacing and programming

Text book 1 – Chapter 10 ,Text book 2 – Chapter 9

Laboratory Components:

1. Assembly program using the serial port
2. Assembly program to transmit/receive data through the serial port

Module 5: Introduction to Arduino Controller	**No. of Hours: 8+6**

Types of microcontrollers, examples of popular microcontrollers, selection of a microcontroller, Arduino Controller: Study different Arduino boards and specifications, Basics of Arduino programming language and commands, Simple Arduino programming to flash an LED

Text book 3 – Chapter 1, Refence Book 1 Chapter 1

Laboratory Components

1. Interface ADC, DAC and LCD
2. Program to flash an LED using Arduino
3. Program for LED Blinking Pattern with Multiple LEDs

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

1. Describe the function of a MPU unit and architecture of 8051 microcontrollers
2. Explain the fundamental concepts and architecture of Arduino controllers."
3. Apply the knowledge in writing assembly and embedded C programs using the basics instructions set of 8051 and Arduino commands
4. Develop Assembly and C programs for timer, interrupts and serial communication applications.

Textbooks:

1. Mazidi M. A., Mazidi J. G., and McKinlay R. D., "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 4th Edition, Prentice Hall of India, 2020.
2. Ayala K. J., "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 3rd Edition, Cengage Learning, 2018.
3. Jermy Blum," Exploring Arduino Tools and Techniques for Engineering Wizardry ,2nd Edition,Wiley,2020

Reference books:

1. Rajkamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", 2nd Edition, Pearson Education, 2015.
2. Predko M., "Programming and Customizing the 8051 Microcontroller", 2nd Edition, McGraw-Hill, 2017.

Web links:

1. 8051 Microcontroller architecture: https://www.youtube.com/watch?v=bR_If7UD_CI
2. 8051 Instruction set and programming: HTTPs://www.youtube.com/watch?v=O6zLKyVu3Zs
3. Timer and Interrupt programming :https://www.youtube.com/watch?v=CSKnrL4milM
4. 8051 Serial communication programming :https://www.youtube.com/watch?v=LD2Fbhk2fAI
5. Interfacing Applications: https://www.youtube.com/watch?v=aJYrjSLdAyg

Fundamentals of Analog & Digital Systems			
Semester	**III**	CIE Marks	**50**
Course Code	**23RIPC205**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Introduce the concepts of FET, MOSFET and CMOS technology
2. Impart the knowledge of operational amplifier applications
3. Familiarize the concepts of Digital systems
4. Provide the understanding of DAC and ADC concepts

Module 1: Field Effect Transistors	**No. of Hours: 8**

Introduction: Features of JFET's, Construction-operation, Characteristics of JFET- Drain characteristics, Transfer characteristics MOSFET, Depletion MOSFET, E-MOSFET, JFET biasing, Common source, common drain, common gate configurations, Applications of FET ad MOSFET in Robotics.

Text book-1 Chapter 5.1,5.3,5.4,5.5,5.9,5.10,5.11,5.16

Module 2: MOS Transistor Theory	**No. of Hours: 8**

Overview of VLSI Technology, Moore's law and Scaling trends, MOS Transistors, CMOS Logic, CMOS Fabrication and layout, CMOS Processing Technologies

Text Book-2; Chapter- 1.1-1.5,3.1,3.2

Module 3: Operational Amplifier Applications and voltage regulators	**No. of Hours: 9**

Peak detectors, Comparator, Schmitt trigger, Non- linear amplifier, relaxation oscillator, Voltage to current converter, Current to voltage converter, Types of voltage regulator, IC Voltage regulators, Adjustable Voltage regulators, Timing, Signal Conditioning and Voltage Regulation applications in Robotics.

Text Book-1: Chapter- 7.3 -7.6,7.9,7.10,7.11,8.2,8.4,8.5

Module 4: Digital systems	**No. of Hours: 9**

latches, Flip-Flops, counters Data storage and transfer, Serial data transfer: shift registers, Frequency division and counting. BCD to 7-segment decoder, Memory terminology, Digital systems family tree, Digital Logic, Storage, and Control applications in Robotics
Text Book-3; Chapter 5.1, 5.7,5.13,5.17,5.18 ,5.19, 9.2,12.1,13.1

Module 5: Signal Conversion and Interfacing	**No. of Hours: 8**

Introduction, Digital to Analog conversion, DAC applications, Analog to Digital conversion, Data acquisition, Applications in Robotics.

Textbook-3; Chapter 11.1,11.2,11.3, 11.6,11.8,11.10

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

1. Explain the fundamental concepts of Analog and Digital Electronics.
2. Apply the knowledge of Analog and digital electronics for engineering applications
3. Apply signal conditioning and voltage regulation techniques to timing and control circuits.
4. Design analog and digital electronic circuits for the specific functional requirement

Textbooks

1. Charles H. Roth, Jr.Larry L. Kinney Raghunandan G. H, "Analog and Digital Electronics" 1st Edition, Cengage India,2019.
2. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design – A Circuits and Systems Perspective", 3rd Edition, Pearson Education, 2023.
3. Neal S Widmer, Greg Moss, Ronald J .Tocci, "Digital systems principles and applications",12th Edition, Pearson, 2024.

Reference Books:

1. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th Edition, Pearson, 2015.
2. David A. Bell, "Electronic Devices and Circuits", 5thEdition, Oxford University Press, 2008.
3. M. Morris Mano, Michael D. Ciletti, "Digital Design", 6thEdition, Pearson, 2018.

Web links:

1) Analog Electronic Circuits - IITKGP: https://onlinecourses.nptel.ac.in/noc25_ee157/preview
2) Digital Circuits- IITKGP: https://onlinecourses.nptel.ac.in/noc25_ee125/preview

Modeling Lab			
Semester	**III**	CIE Marks	**50**
Course Code	**23RIPC206**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**39**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Familiarize the concepts of limits, tolerance and fits and indicate them on machine drawings and to make drawings using orthographic projections
2. Impart the knowledge of thread forms, different screwed fasteners
3. Introduce the concepts of joints and couplings
4. Deliver the ability to interpret machine component drawings and prepare assembly drawings using manual drafting or CAD tools.

Fundamentals of Mechanical Elements for Robotic Applications — **No. of Hours: 13**

Threads, Fasteners, and Tolerance in Robotics

Introduction to the graphic user interface of CAD software, Limits, Fits & Tolerances: Definitions, deviation types, fit classifications, and placement methods, Geometric dimension and tolerance (GD&T) symbols and applications, Thread terminology and types: ISO Metric, BSW, Square, ACME, Sellers, and American Standard threads

Robotic Joints and Mechanical Couplings

Types of mechanical joints in robotics: Cotter joint (socket and spigot), knuckle joint (pin type), Drive couplings used in robotic actuation systems: Unprotected flanged coupling and universal coupling

Assembly Drawings for Robotics

Basics of detailing drawings and creating exploded views, Application of GD&T text, tables, and Bill of Materials (BOM), Interpretation of robotic assemblies including robotic arm, gripper and lifting mechanism

3D Modeling and CAD-Based Assembly of Robotic Subsystems — **No. of Hours: 26**

1. Model robotic components with threaded connections and extract 2D drawings
2. Practice modeling screwed fasteners (square-head and hex-head bolts with washers)
3. Model and assemble cotter and knuckle joints using 3D CAD software
4. Create assemblies of unprotected flanged coupling and universal coupling
5. Model and assemble key robotic sub-systems:
    - Robot Arm Assembly
    - Robot Gripper Mechanism
    - Plumber block
    - Lifting Mechanism (Screw Jack)
    - Electric Motor Assembly
    - Belt & Pulley Drive for Robotic Joint

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

1. Model the machine components and construct the different thread forms and fasteners in2D and 3D
2. Model joints & couplings, visualize their dimensions & draft the assembly drawings in2D
3. Apply the visualization skills and develop the assembly drawings using part drawings

Textbooks:

1. K L Narayana, P Kannaiah, K Venkata Reddy, “Machine Drawing”, 3rd Edition, New Age International Publishers, 2019
2. N D Bhatt, “Machine Drawing”, 50th Edition, Charotar Publishing House Pvt. Ltd.,2016
3. K R Gopalakrishna, “Machine drawing”, 18th Edition, Subhas Stores, 2004

Reference books:

1. A Textbook of Computer Aided Machine Drawing. S. Trymbakaa Murthy, CBS Publishers, New Delhi, 2007.
2. Machine Drawing. N.Siddeshwar, P.Kannaih, V.V.S. Sastri, published by Tata Mc.Grawhill, 2006.
3. Ajeet Singh. Machine Drawing. Tata McGraw-Hill Education, , ISBN: 9781259084607, 2012

Web Links:

1. Engineering Drawing and Computer Graphicshttps://onlinecourses.nptel.ac.in/noc21_me50/previewIIT Roorkee – NPTEL Online Courses
2. **Geometric Dimensioning and Tolerancing (GD&T) Basics – YouTube** https://www.youtube.com/watch?v=TTa9Q6w6fsU Learn Engineering – YouTube
3. **Motion Simulation and Assembly in Fusion 360** https://www.youtube.com/watch?v=HdVpTDDyzBY Fusion 360 Evangelist – YouTube
4. **Machine Elements Explained (Fasteners, Couplings, Joints)** https://www.youtube.com/watch?v=WXV6GCMN3fI Mechanism Academy – YouTube

Universal Human Values			
Semester	**III**	CIE Marks	**50**
Course Code	**23HMCC215**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:0**	Exam Hrs	**2.5**
Total Hours	**26**	Credits	**02**

Course Learning Objectives: This course is designed to

1.Impart the concepts of value education, life skills and personality
2.Create awareness about human relationship with family and society
3.Impart the knowledge on different orders in nature
4.Deliver the concept of professional ethics and value-based profession

Module 1: Introduction to Value Education	**No. of Hours: 06**

Definition & meaning of Values, Types of values
Life skills-Overview, scope, Types, Importance of life skills, SWOT Analysis
Happiness and prosperity– Basic needs of human aspirations, Current scenario, Methods to fulfill the basic human aspirations

Module 2: Harmony in Self & Body	**No. of Hours: 05**

Human being as co-existence of the Self and the Body, Needs, Harmony, Body as an Instrument of the Self, Strategies to enhance self-regulation and health
Empathy-Definition, Essential characteristics of empathy, Benefits of empathy, Sympathy Vs empathy

Module 3: Harmony in the Family and Society	**No. of Hours: 05**

Family, Types of family, Family dynamics, Family life education
Harmony in the family – Basic unit of human interaction, 'Trust' – the foundational value in relationship, 'Respect' – as the right evaluation, Justice in human-to human relationship, Harmony in the society, Vision for the universal human order

Module 4: Harmony in Nature	**No. of Hours: 05**

Introduction, Interconnectedness, Self-regulation and mutual fulfillment among the four orders of nature, Realizing existence as co-existence at all levels, Relationship of mutual fulfillment, Holistic perception of harmony in existence

Module 5: Implications of the Holistic understanding – A look at professional ethics	**No. of Hours: 05**

Engineering ethics-Overview, Scope and Approach.
Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, Competence in professional ethics holistic technologies, Management models-case studies, Strategies for transition towards value-based life and profession

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

1.Understand personality development through life skills & exhibiting the same
2.Realise the need of harmony in individual, family and society
3.Explain the need of harmony in nature towards co-existence
4.Understand the importance of ethics in professional life towards holistic approach

Textbooks:

1. R.R. Gaur, R. Asthana, G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019.
2. R.S. Naagarazan, "A Textbook on Professional Ethics and Human Values", 1st Edition, New Age International Publishers, 2006.

Reference Books:

1. A.N. Tripathi, "Human Values", 1st Edition, New Age International Publishers, New Delhi, 2004.
2. Nagaraj, "Jeevan Vidya: EK Parichaya", 1st Edition, Jeevan Vidya Prakashan, Amarkantak, 1999.

Web links:

Module 1: https://www.youtube.com/watch?v=2ve49BWAJRE
Module 2: https://youtu.be/0ERSMkRPQBM
Module 3: https://youtu.be/3RAU4hreptI
Module 4: https://youtu.be/LwpU7N6A8fg
Module 5: https://youtu.be/EVWcuFXeSgk

Supervisory Control and Data Acquisition System (SCADA)			
Semester	**III**	CIE Marks	**50**
Course Code	**23RISE251**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hours	**39**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Explain the SCADA system components, communication protocols, and industrial automation applications.
2. Design and implement PLC ladder diagrams for control operations like timers, counters, and logic gates.
3. Configure SCADA systems for parameter monitoring, data acquisition, and apply network security techniques such as firewall configuration and watermarking.

Module 1: Introduction to SCADA system — **No. of Hours: 13**

Overview of SCADA and Industrial Automation, Components of SCADA (PLC, RTU, HMI, Sensors, Actuators). SCADA applications in Power, Manufacturing, Boolean Algebra & Logic Gates in PLC, De-Morgan's theorem and its application, timers in PLC: ON Delay & OFF Delay timers, counters in PLC: UP Counter & DOWN Counter, SCADA Communication Protocols: MODBUS, PROFIBUS, DNP3, parameter monitoring in SCADA using PLC, real-time data acquisition & SCADA-Based control, network segmentation & Firewalls in SCADA, General Firewall Policies for ICS, Network Segregation & Defense-in-Depth Architecture, introduction to steganography & watermarking, steganography techniques, watermarking classification & security applications

Experiments — **No. of Hours: 26**

1. Interfacing Lamp & Button with PLC for ON/OFF Operation
2. Design a PLC ladder diagram for Basic Gate Operations
3. Verify Logic Gates Using PLC
4. Design a PLC ladder diagram for De-Morgan's Theorem
5. Design a PLC ladder diagram for ON Delay Timer for Motor Control
6. Design a PLC ladder diagram for OFF Delay Timer for Motor Control
7. Design a PLC ladder diagram for UP Counter for Motor Control
8. Design a PLC ladder diagram for DOWN Counter for Motor Control
9. Design SCADA-Based Parameter Reading from PLC
10. Design a PLC-Based Temperature Sensing Using RTD
11. Configure a Firewall Between Corporate & Control Network
12. Implement SCADA Network Security Policies
13. Apply Watermarking Techniques Using uMark & TSR Watermark

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

1. Design, implement, and troubleshoot SCADA systems for efficient industrial control and monitoring.
2. Develop PLC ladder diagrams for key industrial processes such as motor control, sensor readings, and logic gate operations.
3. Secure SCADA networks using network segmentation, firewall configuration, and watermarking techniques to protect system integrity and data security.

Textbooks:

1. Macaulay, T. & Singer, B. "Cybersecurity for industrial control systems: SCADA, DCS, PLC, HMI, and SIS". Boca Raton, FL: CRC Press 2016.
2. Langner, R. "Robust control system networks: How to achieve reliable control after Stuxnet" New York: Momentum Press 2011

Reference Books:

1. Knapp, E.D. &Langill, J.T. "Industrial network security: Securing critical infrastructure networks for smart grid, SCADA, and other industrial control systems" Waltham, MA: Syngress Media, U.S 2011
2. Cox, I., Miller, M., Bloom, J., Fridrich, J. &Kalker, T. Digital Watermarking and Steganography, 2nd Edition, Elsevier 2007

Web links:

1. Components of SCADA Timers in PLC: ON Delay & OFF Delay Timers, Real-Time Data Acquisition & SCADA-Based Control, Industrial Automation and Control, https://archive.nptel.ac.in/courses/108/106/108106022/#
2. lSCADA Communication Protocols: MODBUS, PROFIBUS, DNP3: https://archive.nptel.ac.in/courses/108/106/108106022/, IIT Madra
3. Verify All Logic Gates Using PLC:https://www.youtube.com/watch?v=zsajTNtxfAE
4. Design a PLC Ladder Diagram for ON Delay Timer for Motor Control:https://www.youtube.com/watch?v=1WQ70KJu6EY

Python Programming			
Semester	**III**	CIE Marks	**50**
Course Code	**23RISEC252**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**39**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of python programming
2. Introduce the concepts data types and control structures.
3. Provide an understanding of real-world task handling using python.

Introduction to Python programming	**No. of Hours: 13**

Variables, expressions, and statements, Conditional execution, Functions, Iteration, Strings & Files, Lists, Dictionaries, Tuples, Pattern Matching with Regular Expressions, Working with Excel, PDF and Word Documents

List of Experiments	**No. of Hours: 26**

1. Program for performing arithmetic operations using variables and user input.
2. Program for implementing conditional statements with logical operators and exception handling.
3. Program for creating and using functions, including built-in, user-defined, fruitful, and void functions.
4. Program for demonstrating loops and control statements
5. Program for string manipulation: slicing, counting, reversing, and using string methods.
6. Program for reading from and writing to text files with exception handling.
7. Program for performing operations on lists: sum, average, sorting, and removing duplicates.
8. Program for counting word frequency in a text file using dictionaries.
9. Program for sorting dictionary data using tuples and displaying the most frequent elements.
10. Program for extracting email addresses and phone numbers from text using regular expressions
11. Program for cleaning and substituting text patterns using re.sub() and other regex operations
12. Program for reading and updating Excel spreadsheets
13. Program for processing CSV and JSON files and extracting useful information.

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

1. Explain the fundamentals of python programming.
2. Apply programming constructs to manipulate strings, perform file handling, and implement iterative solutions for problem-solving.
3. Develop programs to automate tasks involving Excel, PDF, Word, CSV, and JSON files, and interact with external data using APIs.

Textbooks:

1. Charles R. Sperance, "Python for Everybody: Exploring Data Using Python 3", Create Space Independent Publishing Platform, 1st Edition, 2016.
2. Al Sweigart,"Automate the Boring Stuff with Python", No Starch Press,1stEdition, 2015.
3. John M. Zelle, "Python Programming an Introduction To Computer Science", Franklin, Beedle, 3rd Edition, 2017.

Reference books:

1. Mark Lutz, "Programming Python", 4th Edition, O'Reilly Media, 2011.
2. AurélienGéron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" 3rd Edition, O'Reilly Media, 2022.

Web Links :

1. Python Tutorial - https://www.w3schools.com/python/
2. Google's Python Class - https://developers.google.com/edu/python

Rapid Prototyping			
Semester	**III**	CIE Marks	**50**
Course Code	**23RISEC253**	SEE Marks	**50**
Teaching Hrs Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**39**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Develop foundational knowledge and hands-on skills in CNC turning, milling, drilling, and threading operations using G/M code and CAM-based simulation tools.
2. Introduce 3D modeling techniques using CAD software and train students in additive manufacturing using FDM/SLA 3D printers for robotics applications.
3. Strengthen the ability to design and fabricate precision components with specific tolerances and fits, suitable for mechanical assemblies and robotic systems.

Introduction to CNC Machining & 3D Printing — **No. of Hours: 13**

CNC Machining: Basic turning operations with G/M codes, pocket milling and drilling operations, CNC turning and milling simulations using Cadem CAM Lab-Pro, CNC drilling with peck and deep cycles, CNC threading for internal/external threads.
3D Pinting: Create simple 3D models in CAD, print using FDM/SLA, model and print M12x50 nut and bolt, multi-part assemblies, design for additive manufacturing, model parts with various fits and tolerance for robotic applications.

Experiments — **No. of Hours: 26**

1. Perform basic turning operations, including facing and grooving, using G/M code programming on a CNC turning machine.
2. Execute pocket milling and drilling operations on a CNC milling machine, utilizing G/M codes for programming.
3. Simulate CNC turning operations using Cadem CAMLab-Pro focusing on parts for 3D printing and robotics.
4. Simulate CNC milling operations with Cadem CAMLab-Pro emphasizing precision milling for robotic components.
5. Simulate CNC drilling operations with peck and deep drilling cycles to create holes for robotic assemblies and sensor mounting.
6. Program CNC machines for internal and external threading operations, essential for creating threaded connections in robotic structures.
7. Create simple 3D models like cubes, gears, and brackets using CAD software for robotic part design.
8. Print the CAD models from the previous experiment using FDM/SLA 3D printers to create physical robotic components.
9. Model and 3D print an M12x50 nut and bolt, performing thread checks and assembly fit tests for robotic applications.
10. Model and print a multi-part assembly like a screw jack or plumber block to create complex mechanical structures for robotics.
11. Model parts with considerations for additive manufacturing, including supports, overhangs, and internal features for optimal 3D printing in robotics.
12. Model and print parts with various hole and shaft fits, studying tolerance and assembly precision for robotic joints and mechanisms.

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

1. Program and execute basic CNC turning and milling operations, including threading and drilling cycles, using G/M codes and CAM software.
2. Create, simulate, and optimize 3D printable models in CAD, considering manufacturing constraints like supports, overhangs, and tolerances.
3. Develop robotic parts and assemblies using additive manufacturing techniques.

Text books:

1. Groover, M. P., "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", 7th Edition, Wiley, 2020.
2. Gibson, I., Rosen, D. W., & Stucker, B., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015.

Reference books:

1. Rao, P. N., "Manufacturing Technology: Metal Cutting and Machine Tools", 4th Edition, McGraw-Hill Education, 2013.
2. Bandyopadhyay, A., & Bose, S., "Additive Manufacturing, 1st Edition", CRC Press, 2015.

Weblinks:

1. **CNC Turning – Facing and Grooving with G/M Code**
   https://www.youtube.com/watch?v=2ToiFQXqB9M
2. **CNC Milling – Pocket and Drilling Operations with G/M Codes**
   https://www.youtube.com/watch?v=JIfNj2QuGAI
3. **CademCAMLab-Pro – CNC Turning Simulation**
   https://www.youtube.com/watch?v=RkKSUiwWfeU
4. **3D Printing Basics – FDM Printing Overview**
   https://www.youtube.com/watch?v=rDq-JzLxS_w
5. **3D Printing Tolerance & Fit – Shaft and Hole Fit Demo**
   https://www.youtube.com/watch?v=4UU_VtMFHoo

Yoga-I			
Semester	**III**	CIE Marks	**100**
Course Code	**23NMCC221**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Empower students to achieve and maintain good health
2. Promote the practice of mental hygiene
3. Facilitate students in attaining emotional stability
4. Impart moral values and higher level of consciousness

Contents **No. of Hours: 13**

- Yoga, its origin, history and development, Yoga, its meaning, definitions
- Different schools of yoga, Aim and Objectives of yoga, importance of prayer
- Yogic practices for common man to promote positive health
- Rules to be followed during yogic practices by practitioner
- Difference between yogic and non yogic practices
- Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar13 count, 1rounds
- Asana, Need, importance of Asana, Different types of asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana
- Different types of Asanas
  a) Sitting
    1. Padmasana
    2. Vajrasana
  b) Standing
    1. Vrikshana
    2. Trikonasana
  c) Prone line
    1. Bhujangasana
    2. Shalabhasana
  d) Supine line
    1. Utthitadvipadasana
    2. Ardhahalasana
- Meaning, importance and benefits of Kapalabhati, 10 strokes/min 3 rounds
- Meaning by name, technique, precautionary measures and benefits of Pranayama AnulomaViloma

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

1. Describe the meaning, aim and objectives of Yoga
2. Perform Suryanamaskar and able to analyze its benefits
3. Exhibit the different Asanas by name, its importance, methods and benefits
4. Perform Kapalabhati
5. Perform the different types of Pranayama by its name, precautions, procedure and uses

Textbooks:

1. Ajitkumar ,"YogaPravesha in Kannada" 1st Edition, RaashtroththaanaSaahithya, 2017,ISBN-13: 978-8175310124
2. BKS Iyengar, "Light on Yoga", 1st Edition, Thorsons, 2017, ISBN-13: 978-0008267919
3. Dr. M L Gharote& Dr. S K Ganguly,"Teaching Methods for Yogic practices", 1st Edition, Kaivalyadhama, 2001, ISBN-13 : 978-8189485252

Reference Book:

Yamini Muthanna, "Yoga for Children step by step", 1st Edition, Om Books International, 2022, ISBN-13: 978-9394547018

Web links:

1. My Life My Yoga: https://youtu.be/KB-TYlgd1wE
2. Adiyoga: https://youtu.be/aa-TG0Wg1Ls

Physical Education-I			
Semester	**III**	CIE Marks	**100**
Course Code	**23NMCC222**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Impart the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2. Familiarization of health-related Exercises, Sports for overall growth and development
3. Build a strong foundation for the professionals in Physical Education and Sports

Contents **No. of Hours: 13**

- Definitions & components of Physical Fitness and Life Style
- Meaning and Definitions of Physical Fitness and Life Style
- Physical activity for engineers: stress management & injury prevention
- Components of fitness: cardiovascular endurance, muscular strength & endurance, flexibility, body composition (Lectures & Assessments)
- FITT principle (Frequency, Intensity, Time, Type) of exercise planning (Lectures)
- Fitness assessments: BMI, flexibility tests (Practical Sessions)
- Warm-up and cool-down techniques to prevent injuries (Practical Sessions)

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

1. Explain the benefits of physical activity for academic performance, stress management, and injury prevention in engineers
2. Design a personalized fitness program utilizing the FITT principle for targeted improvement
3. Demonstrate proper warm-up and cool-down techniques to enhance performance and prevent injuries

Textbooks:

1. Muller, J. P., "Health, Exercise and Fitness", 1st Edition, Sports Publication, 2018
2. Uppal, A.K., "Physical Fitness", Friends Publication New Delhi, 1992
3. Russell R.P., "Health & Fitness through Physical Education: Human Kinematics",Human Kinetics Publishers, 1994

Reference Books:

1. Anaika , "Play Field Manual", Friends Publication New Delhi, 2005
2. Pinto John & Roshan Kumar Shetty, "Introduction to Physical Education"

Web links:

1. How to exercise with a fitness plan: https://www.youtube.com/watch?v=08ryXxjaF1o
2. Health Related Physical Fitness: https://www.youtube.com/watch?v=rc3ZDoheMQs

National Service Scheme -I			
Semester	**III**	CIE Marks	**100**
Course Code	**23NMCC223**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
2. Develop youth leadership in the students
3. Induce social consciousness among students through various societal activities
4. Impart knowledge in finding practical solutions to individual and community problems

NSS -Contents	**No. of Hours: 13**

Introduction:

- Importance and role of youth leadership, Life competencies
- Skill development and empowerment
- Innovation and personal growth

Activities:

- Organic farming
- Waste management

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

1. Understand the importance of nation building and individual contribution to the betterment of the society
2. Discover grassroots challenges of community and solve them by technological intervention
3. Create societal impact by upholding the value of one for all and all for one
4. Maintain discipline and team spirit

Textbooks:

1. Ministry of Youth Affairs & Sports, Government of India, "National Service Scheme Manual", 2022
2. Rajiv Gandhi National Institute of Youth Development, Ministry of Youth Affairs & Sports, Government of India, "Introduction Training Module for National Service Scheme Program officers", 2017
3. Gurmeet Hans, "Case material as Training Aid for field workers", TISS, 1996

Reference Books:

1. Dr. G R Bannerjee, "Social service opportunities in Hospitals", TISS, 2012
2. Ram Ahuja, "Social Problems in India", Rawat publications, 3rd Edition, 2014

Web links:

1. History of NSS: https://thebetterindia.com/140/national-service-scheme-nss/
2. NSS – an introduction: https://www.youtube.com/@nationalserviceschemeoffic4034/videos

Arts-I			
Semester	**III**	CIE Marks	**100**
Course Code	**23NMCC224**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs.	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. To impart an understanding of the creative process from initial concept to final execution
2. Create and demonstrate proficiency in a chosen arts discipline through practical application
3. Analyze and appreciate diverse art forms and styles
4. To participate in art competitions at regional, state, national, and international levels, as well as in cultural events

Contents	**No. of Hours: 13**

Note: Student shall select any one form of arts and continue the same till 6th semester

Performing Arts (Dance)	Welcome and Brainstorming, Introduction to Performing Arts: Dance, Folk, Cinema, Basic study of Folk Dance Forms, Exploration of Coastal Karnataka Folk Forms, Introduction to Bharatanatyam/Kathak: Theory and Practical, Introduction to Western Dance: Theory and Practical - Basics of Hip Hop, Introduction to Yakshagana: Theory and Practical, Group Presentation, Evaluation
Music	Welcome and Brainstorming, Introduction to Music and its Classifications, Voice and Pitch test, Voice Culture exercises, Exercises for Pitch, Volume, Energy, and Clarity, Basic Singing Practice with Scales, Understanding Compositions and Pitch Mapping, Practice on a Specific Song, Group Presentation, Evaluation
Arts & Crafts	Welcome and Brainstorming, Introduction to Art & Craft, Lines and Shapes, Object Drawing, Colors and Gradations, Color Fusion, Sketching Basics, Paper crafts, Group Presentation, Evaluation
Theatre	Welcome and Brainstorming, Introduction to acting and theatre, Talent Hunt, Physical and Voice Exercise, Body Language in acting, eye contact and tone, Theatre Compositions, Evaluation

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

1. Capable of creating choreography and delivering live performances for an audience
2. Employ a range of acting techniques and use them to create a performance
3. Evolve into creative, effective, independent, and reflective individuals capable of making informed decisions in both process and performance
4. Acquire knowledge and comprehension of the roles and processes used in current theatre arts practice

Textbooks:

1. Bruce Benward and Marilyn Sake, “Music in Theory and Practice”, McGraw-Hill Education, 2014
2. Otto G. Ocvirk, Robert E. Stinson, Philip R. Wigg, Robert Bone, and David L. Cayton, “Art Fundamentals: Theory and Practice”, McGraw-Hill Education, 2012
3. Anne Bogart and Tina Landau, “The Viewpoints Book: A Practical Guide to Viewpoints and Composition”, Theatre Communications Group, 2004

Reference Books:

1. Jacqueline M. Smith, "Dance Composition: A practical guide to creative success in dance making"
2. Ralph Mayer, "The Artist's handbook of method and materials"
3. Dr. Arun Bangre, "Glimpses of Indian music and dance"

Web links:

1. Audio visual catalog: https://ccrtindia.gov.in/audio-visual-catalogue/
2. Essential Acting Lesson for Beginners: https://www.youtube.com/watch?v=GGl9Wri70aQ

AI & ML for Robotics			
Semester	**IV**	CIE Marks	**50**
Course Code	**23RIPC207**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:2**	Exam Hrs	**3**
Total Hrs	**64**	Credits	**4**

Course Learning Objectives: This course is designed to

1. Introduce the concepts of Artificial Intelligence and expert systems.
2. Provide strong understanding of Machine Learning
3. Impart the Knowledge of Model preparation and evaluation

Module 1: Introduction to AI and Expert systems — **No. of Hours: 9+4**

Introduction, Intelligent systems, Phase building in Expert systems, Expert system Architecture, Rule based expert systems, Blackboard expert systems, Truth maintains systems.

Textbook-1: Chapter 1.1,1.3, 8.1-8.3,8.5-8.7

Laboratory Components:

1. Python Program to Implement a Rule-Based Expert System
2. Python Simulation of a Blackboard-Based Expert System

Module 2: Introduction to Machine Learning and Preparing Model — **No. of Hours: 9+4**

Introduction, Types of Machine Learning, Machine learning activities, Basic types of data in ML, Exploring structured data, Data Preprocessing.

Text book-2; Chapter 1.1-1.5, 2.1-2.6

Laboratory Components:

1. Python Program for Data Cleaning and Preprocessing using Pandas
2. Python Program to Split Dataset and Train a Simple Classifier

Module 3: Model Evaluation and Bayesian Learning — **No. of Hours: 8+4**

Selecting Model, Training Model, Model representation, Evaluating Performance, Improving performance, Baye's theorem and concept learning, Bayesian belief network.

TextBook-2; Chapter-3.1-3.6, 6.1-6.5

Laboratory Components:

1. Python Program for Model Evaluation using Cross-Validation
2. Python Program to Implement Naïve Bayes Classifier

Module 4: Supervised Learning — **No. of Hours: 9+4**

Introduction, Classification of Model, classification of Learning steps, Common classification algorithms, Example of Regression, Common Regression algorithms.

TextBook-2; Chapter-7.1-7.5, 8.1-8.3

Laboratory Components:

1. Python Program to Implement Classification using SVM and Random Forest
2. Python Program for Regression using Linear, Ridge, and Lasso Models

Module 5: Unsupervised Learning and Neural Networks — **No. of Hours: 9+4**

Introduction, Applications of Unsupervised Learning, Clustering, Finding pattern using Association Rule, Understanding the biological neuron, Exploring Artificial Neuron, types of activation function, Architecture of Neural network, Learning process in ANN, Backpropagation, Deep Learning.

Textbook-2; Chapter-9.1-9.5,10.1-10.4,10.5-10.9

Laboratory Components:

1. Python Program to Implement K-Means and Hierarchical Clustering
2. Python Program to Build a Simple Neural Network using MLP Classifier

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

1. Explain intelligent systems, expert system architectures, and various types of expert systems.
2. Describe machine learning model preparation, data preprocessing, evaluation, and Bayesian learning.
3. Demonstrate supervised, unsupervised, and neural network techniques for basic AI problem-solving.

Textbooks:

1. Saroj Kaushik, "Artificial Intelligence ", Cengage, 1st Edition, , 2019.
2. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", Pearson, 1st Edition, 2022.

Reference Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, Pearson, 2024.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" 3rd Edition, O'Reilly Media, 2022.
3. Nilakshi Jain "Artificial Intelligence Making A system intelligent", Wiley, 1st Edition, , 2019

Web links:

1. NPTEL AI course- https://onlinecourses.nptel.ac.in/noc21_cs42/preview
2. NPTEL ML Course-https://nptel.ac.in/courses/106105152

Hydraulics and Pneumatics			
Semester	**IV**	CIE Marks	**50**
Course Code	**23RIPC208**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Teach the basic concepts of hydraulic system components and working principle of hydraulic pumps, hydraulic cylinders, hydraulic motors and control values
2. Impart the knowledge of hydraulic circuit design and maintenance of hydraulic systems
3. Familiarize the components and working principle of pneumatic system
4. Impart the knowledge of logic gate applications and electro-pneumatic applications

Module 1: Introduction to Hydraulic Power	**No. of Hours: 8**

Definition of hydraulic system, advantages, limitations, applications, Pascal's law, components of fluid power system. Pumps: Classification of pumps, theory of positive displacement pump, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors

Textbook 1: Chapter 1-Section 1.1, 1.3, 1.4, 1.5, 5.3- 5.8, 5.10

Module 2: Hydraulic Actuators and Control Valves	**No. of Hours: 8**

Linear Hydraulic Actuators: single and double acting cylinder, mounting arrangements, cushioning, Construction and working of hydraulic rotary actuators: gear, vane, piston motors, hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance
Control Valves: classification, directional control valves, solenoid and pilot operated directional control valve, shuttle valve, and check valves
Pressure control valves: types, direct operated types and pilot operated types. Flow control valves: compensated and non-compensated flow control valve, needle valve

Textbook 1: Chapter 6 – Section 6.1- 6.3, 6.8, 7.1- 7.7, 8.1- 8.4

Module 3: Hydraulic Circuit Design and Maintenance	**No. of Hours: 9**

Circuit design: Control of single acting and double acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, hydraulic cylinder sequencing circuits, maintenance of hydraulic system

Textbook 1: Chapter 9- Section 9.1 - 9.6, 9.8, 12.1- 12.3

Module 4: Introduction to Pneumatic systems:	**No. of Hours: 8**

Pneumatic system, advantages, limitations, applications, choice of working medium, characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit.
Direction control valves, flow control valves, pressure control valve, use of memory valve, quick exhaust valve, time delay valve, shuttle valve, twin pressure valve
Simple Pneumatic Control circuits: Direct and indirect actuation, speed control, supply and Exhaust air throttling

Textbook 1: Chapter 13: Section 13.1- 13.5, 14.1, 14.2, 14.5
Textbook 2: Chapter 6, Section-6.1- 6.10

Module 5: Signal Processing Elements and Electro Pneumatic Control	**No. of Hours: 8**

Use of Logic gates: OR and AND gates in pneumatic applications. Practical examples involving the use of logic gates, Pressure dependent controls- types - construction - practical applications, Time dependent controls principle, Construction, practical applications
Principles of electro pneumatic control: signal input and output, pilot assisted solenoid control of directional control valves, Use of relay and contactors

Textbook 1: Chapter 16: Section 16.1, 16.2, 16.4, 15.1, 15.2, 15.3
Textbook 2: Chapter 10: Section 10.6, 10.7, 10.8

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

1. Explain the basic concepts of hydraulic systems and working principle of hydraulic actuators
2. Compute performance characteristics of hydraulic pumps and actuators
3. Design hydraulic circuits for single and double acting cylinders
4. Explain the operation of hydraulic and pneumatic control valve and its maintenance
5. Describe the role of logic gates in pneumatic control systems and principles of electro-pneumatic control

Textbooks:

1. Anthony Esposito, "Fluid Power with Applications", 6th Edition, Pearson Education Inc. 2000
2. S. R Majumdar, "Pneumatics System: Principles and Maintenance", 1st Edition, Tata McGraw Hill India, 2011

Reference Books:

1. S. Ilango, V. Soundararajan, "Introduction to Hydraulics and Pneumatics", 2nd Edition, PHI learning Pvt Ltd., 2011
2. Majumdar S.R, "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw-Hill, 2002
3. Andrew Parr, "Pneumatics and Hydraulics", 1st Edition, Jaico Publishing House, 1993

Web links:

1. Oil Hydraulics and Pneumatics: https://archive.nptel.ac.in/courses/112/106/112106300/
2. Fundamentals of Industrial oil Hydraulics and Pneumatics: https://archive.nptel.ac.in/courses/112/105/112105047/

Data structures & Algorithms			
Semester	**IV**	CIE Marks	**50**
Course Code	**23RIPC209**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**3:0:2**	Exam Hrs	**3**
Total Hours	**64**	Credits	**4**

Course Learning Objectives: This course is designed to

1. Impart knowledge of linear data structures such as arrays, stacks, queues, and linked lists.
2. Provide conceptual and practical understanding of binary trees and hashing techniques.
3. Introduce asymptotic notations and equip students with fundamental algorithm design strategies for problem solving.

Module 1: Arrays, Stack and Queues — **No. of Hours: 8+4**

Data Structure: Classifications, Operations, Abstract Data Types (ADT). Arrays: Storing values in Arrays, Operations on Arrays. Stacks, Queues, Application of Stacks: Tower of Hanoi Problem.

Text Book 2: Sections: 2.1 to 2.4, 3.4 to 3.5, 7.7.4
Text Book 1: Sections: 3.1 and 3.3

Laboratory Components:

1. Programming on Arrays.
2. Programming Exercises on stack Operations: PUSH, POP, PEEK and DISPLAY
3. Programming Exercises on Recursion: Tower of Hanoi
4. Programming Exercises on queue Operations: INSERT, DELETE and DISPLAY

Module 2: Linked List — **No. of Hours: 8+4**

Introduction to Linked list, Singly Linked Lists and Chain, Representation Chain in C, Linked Stacks and Queues, Operations for Chains, Circular Linked List, Operations for Circular Linked List, Polynomials: Polynomial Representation, Adding Polynomials, Doubly Linked Lists operations.

Text Book 1: Sections: 4.1 to 4.3, 4.4.1 to 4.4.2, 4.5 and 4.8

Laboratory Components:

1. Programming Exercises using singly linked list: INSERT, DELETE, SEARCH, COPY, DISPLAY
2. Programming to implement stack using Linked List.
3. Programming to implement queue using Linked List.
4. Programming Exercises using Doubly linked list.

Module 3: Trees and Graphs — **No. of Hours: 9+4**

Trees: Terminology, Representation of Trees, Binary Trees, Properties of Binary Tree, Binary Tree Representations, Binary Tree Traversals: In-order, Pre-order, Post-order, Binary Search Trees: Definition, Searching, Inserting and Deletion, Depth-First Search (DFS) and Breadth-First Search (BFS), Minimum Spanning Trees- Prim's and Kruskal's Algorithm.

Text Book 1: Sections: 5.1 to 5.2, 5.3.1 to 5.3.3, 5.7.1 to 5.7.4, 6
Text Book 2: Sections: 15.1 to15.5

Laboratory Components:

1. Programming Exercises on Representation of binary tree traversals: In-order, Pre-order and Post-order.
2. Programming Exercises on Binary Search tree (BST).

Module 4: Introduction to Algorithms	**No. of Hours: 8+4**

Introduction, Problem Solving, Analysis Framework, Asymptotic Notations: Big O, Omega Ω, Theta Θ notations. Brute Force: Brute-Force String Matching, Divide and Conquer: Merge Sort.

Text Book 3: Sections: 1.1, 1.2, 2.1, 2.2, 3.2, 4.1, 5.1, 5.2, 6.4

Laboratory Components:

1. Programming Exercises on Brute Force: Brute-Force String Matching
2. Programming Exercises on Divide and Conquer: Merge Sort.

Module 5: Applications of Data Structure and Algorithms for Robotics	**No. of Hours: 9+6**

Decrease-and-conquer Approach: Introduction, Decrease by Constant Method, Insertion Sort, Decrease by Constant Factor Method. Greedy Algorithms: Introduction to Greedy Approach, Scheduling Problems, Scheduling with Deadline, Optimal Tree Problems, Minimum Spanning Trees, Single-source Shortest-path.

Text Book 3: Sections: 4, 9

Laboratory Components:

1. Programming Exercises on Decrease and Conquer: Insertion Sort
2. Implement minimum spanning tree.
3. Stacks & Queues in Robotic Control: Backtracking, real-time scheduling using queues.
4. Graph-based Path Planning: Implement BFS and DFS for a grid maze.

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

1. Apply fundamental data structures like arrays, stacks, and queues to solve real-time computational problems.
2. Implement and manipulate various linked list structures for problem solving
3. Develop and traverse binary trees and implement binary search tree operations for structured data organization and retrieval.
4. Apply brute-force, divide-and-conquer, decrease-and-conquer, and greedy strategies to design algorithms for solving well-defined computational problems

Textbooks:

1. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, 2023.
2. Reema Thareja, "Data Structures Using C", 2nd Edition, Oxford University Press, 2014.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 2nd Edition, Pearson Education, 2008.

Reference Books:

1. Seymour Lipschutz, "Data Structures with C Schaum's Outlines", Revised 1st Edition, McGraw Hill, 2014.

Web links:

1. NPTEL course on Data structures: https://nptel.ac.in/courses/106102064

Sensors and Actuators for Robotics

Semester	**IV**	CIE Marks	**50**
Course Code	**23RIPC210**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Deliver the operating principles of different types of sensors used in robotics
2. Provide and comprehensive understanding of advanced sensors and actuator technology for robotics.
3. Impart the knowledge of smart actuators and their applications in robots

Module 1: Fundamentals & Performance	**No. of Hours : 8**

Introduction, Definitions, Classification of sensors and activators, General requirements for interfacing, Performance characteristics of sensors and activators, Input and Output characteristics

Textbook 1: 1.1-1.5, 2.1-2.2

Module 2: Motion, Position & Force Sensing	**No. of Hours : 9**

Force sensors- Strain gauges, force and tactile sensors, Accelerometers, Presser sensors, Velocity sensing, Gyroscopes.

Textbook 1: 6.1-6.7

Module 3: Vision, Environmental & Proximity Sensing	**No. of Hours : 9**

Photoelectric sensors, Charge coupled (CCD) sensors and detectors, Thermal-based optical sensors, Capacitive sensors and actuators, Magnetic sensors and actuators, Microphones, MEMS sensors

Textbook 1: 4.6-4.8, 5.3,5.4, 7.4, 10.3.1

Module 4: Specialized Sensing in Robotics	**No. of Hours : 8**

Electrochemical sensors, Potentiometric sensors, Thermochemical sensors, Humidity and moisture sensors, Radiation sensors, Microwave sensors.

Textbook 1: 8.3-8.8,9.3,9.4

Module 5: Actuators in Robotics	**No. of Hours : 8**

Optical actuators, Magnetic actuators, Acoustic actuators, Ultrasonic sensors and actuators: transducers, Piezo electric actuators, MEMS sensors Actuators, Chemical actuation

Textbook 1: 4.10, 5.9,7.6, 7.7,10.3.2

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

1. Explain the principles, classification, performance characteristics, and interfacing needs of sensors and actuators in robotics.
2. Select and apply suitable sensing and actuation technologies for motion, vision, environmental, and specialized robotic applications.
3. Analyze the suitability and performance of sensors and actuators for different robotic tasks and operating conditions.

Textbooks:

1. Nathan Ida, Sensors, Actuators, and Their Interfaces A multidisciplinary introduction 2nd Edition,2020, IET, Control, Robotics and Sensors Series 127.
2. D. Patranabis, Sensors and Transducers, PHI Learning Pvt. Ltd.

Reference Books:

1. Sabrie Soloman, Sensors Handbook, McGraw-Hill.
2. Andrzej M. Pawlak, Sensors and Actuators in Mechatronics: Design and Applications, CRC Press.

Web links:

1. NPTEL course on Sensors and Actuators: https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2. Coursera course on Internet of Things: Sensing and Actuation From Devices : https://www.coursera.org/learn/internet-of-things-sensing-actuation

Design of Machines Elements			
Semester	**IV**	CIE Marks	**50**
Course Code	**23RIPC211**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Provide the knowledge of basic kinematic elements & common mechanisms.
2. Equip students to perform velocity and acceleration analysis in planar mechanisms.
3. Introduce concepts of stress, strain, elasticity, and explain deformation in bars and composite sections.
4. Familiarize the knowledge of machine element design principles and gear and belt drive systems

Module 1: Fundamentals of Kinematics and Mechanisms	**No. of Hours : 8**

Kinematic Link, Kinematic Pair, Kinematic chain, Structure, mechanism, machine, Types of Constrained Motions, Degrees of Freedom, Grubler's Criterion for Plane Mechanisms, Equivalent linkage Mechanism, Inversions of Four Bar Chain, Single Slider Crank Chain. Pantograph, Straight Line Motion mechanisms. Hooke's Joint / Universal Joint.

Text book 1: Chapter 5-Sec 2, 3, 4, 6, 7, 12, 14, 18, 19, 21,
Chapter 9: 2, 3, 11

Module 2: Velocity and Acceleration Analysis in Mechanisms	**No. of Hours : 8**

Relative Velocity (Velocity polygon) for Kinematic link. Acceleration Diagram for a Link. Coriolis component of Acceleration. Velocity and acceleration in a Slider Crank Mechanism by Klein's construction. Instantaneous Centre of Rotation (ICR). Angular Velocity Ratio Theorem, Methods of Locating ICR in a Mechanism. Velocity analysis of a Kinematic Link by ICR Method

Text book 1: Chapter 6, 7, 8

Module 3: Introduction to Stress and Strain	**No. of Hours : 8**

Introduction, Concept of Stress and Strain, Linear elasticity, Hooke's Law and Poisson's ratio. Extension / Shortening of a bar, bars with varying cross sections (step and tapering circular and rectangular), Elongation due to self-weight, Principle of super position, St. Venant's Principle, Thermal stress, Simple shear stress and Shear strain, Volumetric strain, expression for volumetric strain, Elastic Constants and relations.

Text book 3: Chapter 2

Module 4: Introduction to Machine Design	**No. of Hours : 9**

Fundamentals of machine design: Machine Design, Basic Procedure of Machine Design, Basic Requirements of Machine Elements, Design Synthesis, Standardization,

Theories of Failure: Types of Load, Modes of Failure, Factor of Safety, Theories of Elastic Failure, Maximum Principal Stress Theory, Maximum Shear Stress Theory, Distortion Energy Theory, Selection and Use of Failure Theories, Stress Concentration, Fluctuating Stresses, Notch Sensitivity, Reversed Stresses Design for Finite and Infinite Life, Modified Goodman Diagrams, Soderberg's Equations, Fatigue Design under Combined Stresses

Text Book 2 Chapter : 1.1, 1.2, 1.3, 1.7, 1.8, 4.1, 4.2, 4.3, 4.13, 4.14, 4.15, 4.16, 4.17,5.1, 5.4, 5.8, 5.12, 5.15, 5.16, 5.18

Module 5: Design of Shafts, Belt and Gear Drives	**No. of Hours: 9**

Pure torsion, assumptions, Torsion of shafts, solid and hollow shaft design with steady loading based on strength and rigidity

Belt Drives, Belt Constructions, Belt Length, Geometrical Relationships, Analysis of Belt Tensions, Selection of V-Belts, Basic Procedure for Selection of V-Belts, V-Grooved Pulley, Belt Tensioning Methods, Ribbed V-Belts

Gear Drives, Classification of Gears, Type of Gears, Design of Spur Gear, Stresses in Gear Tooth: Lewis Equation and Form Factor, Design for Strength, Dynamic Load and Wear

Text Book 2 Chapter 13, Chapter 17: 17.1, 17.2, 17.3, 17.4, 17.5, 17.6, 17.7, 17.8

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

1. Explain basic kinematic elements, types of motion, degrees of freedom, and simple mechanisms.
2. Construct velocity and acceleration diagram for various mechanisms
3. Design machine elements under static and combined loading, applying appropriate failure theories for different materials
4. Apply the fundamental concepts of stress and strain to analyze deformation in simple structural members.
5. Design shaft, gear, and belt drive systems for power transmission.

Textbooks:

1. R.S. Khurmi, “Theory of Machines”, S. Chand & Company Ltd., 14th Edition, 2005.
2. V.B. Bhandari, “Design of Machine Elements”, 5th Edition, McGraw Hill Publication, 2020
3. S.S. Bhavikatti, Strength of Materials, 4th edition 2013, Vikas Publishing house

Reference Books:

1. Robert L. Norton, “Machine Design- An integrated Approach”, 6thEdition., Pearson Education, 2021
2. S.S. Rattan, “Theory of Machines”, Tata McGraw Hill, 5th Edition, 2014.

Web links:

1. Theory of Machines – I: https://nptel.ac.in/courses/112105268, IIT Kharagpur. NPTEL Online Courses
2. Kinematics of Machines: https://nptel.ac.in/courses/112107215, IIT Roorkee. NPTEL Online Courses
3. Mechanics of Machines: https://nptel.ac.in/courses/112108098, IISc Bangalore. NPTEL Online Courses
4. Design of Machine Elements – I: https://nptel.ac.in/courses/112105124, IIT Kharagpur. NPTEL Online Courses

Sensors & Actuators for Robotics Laboratory

Semester	**IV**	CIE Marks	**50**
Course Code	**23RIPC212**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**39**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Impart practical knowledge and hands on training in sensor and its data acquisition
2. Teach the construction of various circuits for sensing and actuating robotics components
3. Provide basic concepts in understanding the working principles of various actuators

Introduction to Sensors and Actuators — **No. of Hours: 13**

Sensor classification and characteristics, Sensors: Position sensors, Rotary and linear encoders, Potentiometers, Hall-effect sensors, Accelerometers, Gyroscopes, Inertial Measurement Units (IMUs), Infrared sensors, Ultrasonic sensors, Time-of-Flight (ToF) sensors, Proximity sensors, Optical encoders, Touch sensors, Slip sensors, Force-sensing resistors (FSRs), Load cells, Tactile sensors, Temperature sensors, Light sensors.

Actuator and Transducer Technologies, Smart sensors: Accelerometers, Force sensors, Load cells, Torque sensors, Pressure sensors, Servo feedback sensors, Electrical actuators: DC motors, AC motors, Stepper motors, Servo motors, Rotary actuators, Linear actuators, Piezoelectric actuators. Motion transmission: Gear transmission, Belt transmission, Chain drives, Harmonic drive.

Lab Experiments — **No. of Hours: 26**

1. Obstacle Distance Measurement Using Ultrasonic Sensor
2. Line Detection Using Infrared Sensor Module
3. Ambient Light Monitoring Using LDR Sensor
4. Tactile Force Sensing Using Force-Sensitive Resistors (FSR)
5. Angular Position Sensing Using Rotary Encoders
6. Tilt and Motion Detection Using Accelerometer (MPU6050/ADXL335)
7. Magnetic Field Detection Using Hall Effect Sensor
8. Precision Angular Control Using Servo Motors
9. Speed Regulation of DC Motors Using PWM Control
10. Temperature Sensing Using LM35/Thermistor
11. IoT-Based Sensor Monitoring Using ESP32 and Cloud Integration
12. Color Detection and Identification Using TCS3200 Sensor

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

1. Apply appropriate sensors and actuators to measure, detect, and control physical parameters relevant to robotic and IoT applications
2. Design, implement, and analyze hardware-based experiments integrating microcontrollers and IoT platforms to demonstrate real-time sensing, actuation, and data communication.

Textbooks:

Nathan Ida, Sensors, Actuators, and Their Interfaces A multidisciplinary introduction 2nd Edition,2020, IET, Control, Robotics and Sensors Series 127.
D. Patranabis, Sensors and Transducers, PHI Learning Pvt. Ltd.

Reference Books:

1. Sabrie Soloman, Sensors Handbook, McGraw-Hill.
2. Andrzej M. Pawlak, Sensors and Actuators in Mechatronics: Design and Applications, CRC Press.

Web link:

1. Virtual lab : https://sl-coep.vlabs.ac.in/

Research Methodology & Intellectual Property Rights			
Semester	**IV**	CIE Marks	**50**
Course Code	**23HMCC216**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:0**	Exam Hrs.	**2.5**
Total Hrs	**26**	Credits	**2**

Course Learning Objectives: This course is designed to
1.Impart knowledge on basics of research
2.Discuss the concepts of Intellectual Property Rights

Module 1: Introduction, Literature Review and Technical Reading	**No. of Hours: 7**

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research
New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Effective Search: The Way Forward, Introduction to Technical Reading, Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet

Module 2: Research Design	**No. of Hours: 5**

What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, Meaning of Research Design, Need for Research Design, features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs

Module 3: Ethics in Engineering Research & Technical Writing	**No. of Hours: 5**

Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship, Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Writing Strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Publish Articles to Get Cited, or Perish, IMRaD Guidelines, COPE Guidelines

Module 4: Introduction to Intellectual Property	**No. of Hours: 4**

Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP History of IP in India- Copyrights, Patents, Trademarks, Geographical Indications, Trade secrets, Semiconductor Integrated circuits and layout designs, Plant varieties, Industrial Design

Module 5: Process of Patenting	**No. of Hours: 5**

Prior Art Search, Choice of Application to be Filed, Patent Application Forms. Jurisdiction of Filing Patent Application, Publication, Pre-grant Opposition, Examination. Grant of a Patent. Validity of Patent Protection, Post-grant Opposition, Commercialization of a Patent

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

1. Apply the basic research principles and methodologies
2. Review the Literature, Technical Reading, Attributions and Citations
3. Understand Various Intellectual Property Rights
4. Draft patent application

Textbooks:

1. C.R Kothari "Research Methodology Methods and Techniques" 2nd Edition, Newage international, 2009
2. Dipankar Deb, Rajeeb Dey, Valentina E. Balas,"Engineering Research Methodology A Practical Insight for Researchers",1st Edition, Springer Nature, 2019
3. Prof. Rupinder Tewari Ms. MamtaBhardwa, "Intellectual Property A Primer for Academia", Publication Bureau Panjab University Chandigarh, 2021

Reference Books:

1. David V. Thiel,"Research Methods for Engineers", 1st Edition, Cambridge University Press, 2014
2. William G. Zikmund, Barry J. Babin, Jon C Carr, Mitch Griffin, "Business Research Methods", 9th Edition, Cengage India Private Limited, 2013
3. "WIPO Intellectual Property Handbook", WIPO Publication

Web links:

1. Research Methodology Course:https://onlinecourses.nptel.ac.in/noc24_ge41/preview
2. Module 4,5:https://www.ipindia.gov.in/
3. Module 4,5:https://www.wipo.int/
4. Refence Management tool:https://desktop-download.mendeley.com/download/Getting_Started_Guide.pdf
5. IMRad Guidelines:https://writingcenter.gmu.edu/writing-resources/imrad/writing-an-imrad-report
6. COPE Guidelines:https://publicationethics.org/files/u7141/1999pdf13.pdf

UI/UX Design			
Semester	**IV**	CIE Marks	**50**
Course Code	**23RISEC251**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**39**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of UX, UI and how to relate UX-UI for designing visual elements
2. Familiarize with open-source software tools for creating visual elements
3. Provide the concept of UX/UI design in robotics applications

Introduction to UX, UI and how to relate UX-UI for designing visual elements — **No. of Hours: 13**

User experience (UX) design

1. Involves research to understand user needs
2. Maps out the structure and flow of a product
3. Considers the entire process of acquiring and integrating a product
4. Includes aspects of branding, design, usability, and function
5. User interface (UI) design
6. Focuses on the look, feel, and interactivity of a product screen or web page
7. Designs all the screens and components that the user interacts with
8. Includes navigational elements such as menus, buttons, and icons
9. How to relate UX and UI
10. While UI can impact UX, the two are distinct
11. A UX designer is concerned with the entire process of acquiring and integrating a product, including UI design

Create various digital visual elements using UI/UX design — **No. of Hours: 26**

1. Creating a UI/UX tool Account, creating a new design file, mapping the user journey, creation of wireframes.
2. UI/UX tool Toolkit Essentials: Frames, fonts, and layouts, creating frames, function of tools, font usage, layout planning.
3. UI/UX tool Prototyping: Framing, layering, grouping, creating and editing shapes, images, and masking.
4. Exploring UI/UX tool toolkit part I: Importing icons and other graphics, working with color and styles, and setting up the components.
5. Exploring UI/UX tool toolkit part II: 3D Buttons, gradient graph tricks, forms, buttons, plugins.
6. UI/UX tool Animations: Animating “Like” buttons, animating a burger Menu.
7. Mobile Application development using UI/UX tool: Wireframing, brand name page, Sign in /Signup page, Menu page, prototyping
8. Web Application development using UI/UX tool: Wireframing; brand name page, Sign in /Signup page Menu page, interactive prototyping using tools like: Figma’s Interactive Components and Adobe XD’s Auto-Animate.
9. UI/UX for IoT devices, HCI (Human-Computer Interaction) principles and Dashboard Design for Embedded Systems & Robotics Applications.

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

1. Apply UX/UI design skills to create a visual element
2. Develop web application using UX and UI tools
3. Apply UX/UI tools for robot interactions

Textbook:

1. James Cabrera, “Modular Design Frameworks: A Projects-based Guide for UI/UX Designers”, A Press, 1st edition, 2017.

Reference books:

1. Apurvo Ghosh, "Mastering UX Design with Effective Prototyping: Turn your ideas into reality with UX prototyping", 1st edition, 2023
2. Fabio Staiano, "Designing and Prototyping Interfaces with Figma: Learn essential UX/UI design principles by creating interactive prototypes for mobile, tablet, and desktop", Packt Publishing Limited (Kindle Edition), 2022.
3. Tom Mulligan, "UX/UI Design Tutorial for Beginners: The Complete Step by Step Guide to UX/UI Design and Best Practices for designers with no Experience", (Kindle Edition), 2021.

Web links:

1. https://onlinecourses.nptel.ac.in/noc21_ar05/preview
2. https://nptel.ac.in/courses/124107008

Internet of Robotic Things			
Semester	**IV**	CIE Marks	**50**
Course Code	**23RISE254**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**39**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Understand the fundamentals of IoT and embedded systems, including architecture, communication models, and their practical applications using Arduino and Raspberry Pi.
2. Develop hands-on skills in interfacing digital and analog sensors/actuators, data acquisition, and control systems relevant to IoT and automation.
3. Explore wireless communication techniques, IoT cloud integration, and autonomous robotics using embedded platforms.

Introduction to Embedded Systems and IoT	**No. of Hours: 13**

Introduction to Arduino and Raspberry Pi, Digital and Analog Interfacing, Sensor Interfacing and Data Acquisition, Actuator and Motor Control, Wireless Communication and IoT, Embedded System Integration and Robot Development, Headless Operation and Remote Access,

Lab Components	**No. of Hours: 26**

1. Interfacing LED and Buzzer with Arduino / Raspberry Pi
2. Push Button and Digital Sensor (IR/LDR) Interfacing with Arduino / Raspberry Pi
3. Temperature and Humidity Monitoring using DHT11 with Arduino / Raspberry Pi
4. Displaying Sensor Data on OLED using Arduino / Raspberry Pi
5. Motor Control using Relay with Arduino / Raspberry Pi
6. Bluetooth-based Sensor Data Transmission using Arduino / Raspberry Pi
7. LED Control via Bluetooth using Arduino / Raspberry Pi
8. Uploading Temperature and Humidity Data to ThingSpeak using Arduino / Raspberry Pi
9. Obstacle-Avoiding Robot using Arduino / Raspberry Pi
10. Operating Raspberry Pi in Headless Mode and Interfacing with Arduino / Raspberry Pi

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

1. Demonstrate the ability to configure and program Arduino/Raspberry Pi for interfacing sensors, actuators, and performing basic IoT tasks.
2. Analyze and implement sensor-based data acquisition, processing, and transmission using local displays and cloud platforms like ThingSpeak.
3. Design and execute embedded system-based robotic applications, including obstacle detection, motor control, and wireless communication for automation tasks

Textbooks:

1. Raj Kamal, "Internet of Things: Architecture and Design", 1st Edition, McGraw Hill Education, 2017.
2. Simon Monk, "Programming Arduino: Getting Started with Sketches", 2nd Edition, McGraw Hill Education, 2016.

Reference Books:

1. Michael Margolis, "Arduino Cookbook", 2nd Edition, O'Reilly Media, 2011.
2. Upton, E., &Halfacree, G., "Raspberry Pi User Guide", 4th Edition, Wiley, 2016.

Web links:

1. Introduction to Internet of Things: https://nptel.ac.in/courses/106/105/106105166/, IIT Kharagpur.
2. Introduction to Industry 4.0 and Industrial Internet of Things: https://onlinecourses.nptel.ac.in/noc25_cs43/preview, IIT Kharagpur.NPTEL Online Courses+1NPTEL Online Courses+1
3. Internet of Things (IoT)/What is IoT/How it Works https://www.youtube.com/watch?v=LlhmzVL5bm8
4. IoT for Beginners - Lesson 1, Introduction to IoT: https://www.youtube.com/watch?v=1KVrBjSqS5s,

Virtual Instrumentation and Automation Lab			
Semester	**IV**	CIE Marks	**50**
Course Code	**23RISE256**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hours	**39**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Develop proficiency in using LabVIEW to perform basic arithmetic operations, logical operations and programming loops
2. Provide the Knowledge of designing and implementing data acquisition systems (DAQ), temperature monitoring, and real-time sequential control applications for industrial automation.
3. Use the principles of array functions and data sorting, and apply LabVIEW's case and sequence structures to build complex systems like a simple calculator.

Introduction — **No. of Hours: 13**

Introduction to LabVIEW Programming, Basic Arithmetic Operations Using LabVIEW, Half Adder and Full Adder Verification in LabVIEW, First N Natural Numbers Addition Using Loops, Array Functions Implementation in LabVIEW, Continuous Temperature Monitoring in LabVIEW, Case and Sequence Structures in LabVIEW, Factorial Calculation Using Loops, Sorting Even Numbers in LabVIEW Arrays, Signal Generator Development Using DAQ Card, Real-Time Sequential Control of Batch Processes.

Lab Components — **No. of Hours: 26**

1. Perform Basic Arithmetic Operations Using LabVIEW
2. Verification of Half Adder and Full Adder Using LabVIEW
3. Addition of First N Natural Numbers Using For and While Loop in LabVIEW
4. Implementation of Array Functions (Even and Odd Numbers Using While Loop in an Array)
5. Continuous Monitoring of Temperature Using LabVIEW
6. Programming Exercises on Case and Sequence Structures (Designing a Simple Calculator)
7. Factorial Calculation Using For Loop in LabVIEW
8. Sorting Even Numbers Using While Loop in an Array in LabVIEW
9. Developing a Signal Generator Using DAQ Card
10. Real-Time Sequential Control of a Batch Process

Course Outcome (Course Skill Set): At the end of the course, students will be able to

1. Apply LabVIEW programming skills to implement arithmetic operations, logical circuits, and data processing functions in various engineering applications.
2. Design, simulate, and test real-time monitoring systems and process control systems using LabVIEW for efficient automation and control in batch processes.
3. Demonstrate the ability to use LabVIEW for developing complex systems, such as signal generators and real-time monitoring solutions, and understand how to integrate with DAQ cards for practical use.

Textbooks:

1. Robert H. Bishop, "Virtual Instrumentation Using LabVIEW", 2nd Edition, Pearson Education, 2015.
2. A. K. Gupta, S. K. Arora, “Industrial Automation and Robotics”, 1st Edition, University Science Press, 2013.

Reference Books:

1. Gary Johnson, "Virtual Instrumentation: LabVIEW", 2nd Edition, McGraw-Hill Education, 2006.
2. Mikell P. Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", 4th Edition, Pearson Education, 2015.
3. Jim Wylde, "Industrial Data Communications: Best Practice Techniques", 1st Edition, ISA, 2006.

Web links:

1. Engineering Metrology :https://onlinecourses.nptel.ac.in/noc20_me94/preview, IIT Kanpur.
2. NI LabVIEW Tutorials: https://www.ni.com/en-us/innovations/labview.html, National Instruments.
3. Coursera (Virtual Instrumentation & Automation Courses):https://www.coursera.org.
4. edX (Virtual Instrumentation & Automation Courses): https://www.edx.org.

Environmental Studies & Sustainability			
Semester	**IV**	CIE Marks	**100**
Course Code	**23NMCC29**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**1:0:0**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Create environmental awareness among the students
2. Provide knowledge on different types of pollution and their impacts in the environment
3. Enable the learners to understand the environmental management plan and socio-economic skills for sustainable development
4. Know about the major challenges in Environmental Issues and Evaluate possible solutions

Module 1: Ecosystems and Biodiversity	**No. of Hours: 02**

Ecosystems: Value of Forest, Desert, Wetlands, River, Oceanic and Lake
Biodiversity: Types, Value, Hot-spots, Threats and Conservation of biodiversity, Forest Wealth and Deforestation

Module 2: Sustainable Energy Resources	**No. of Hours: 02**

Energy Resources: Types of Energy, Conventional Sources and Non-Conventional Sources, Renewable Energy Sources: Hydrogen, Solar, OTEC, Tidal, Wind, Geothermal, Biomass and Bio Fuels

Module 3: Environmental Pollution and Sustainable Waste Management	**No. of Hours: 03**

Environmental Pollution: Surface and Ground Water Pollution, Noise pollution, Air Pollution and Carbon Trading
Sustainable Waste Management & Public Health Aspects: Bio-medical Waste, Solid Waste, Hazardous Waste, E-waste, Industrial and Municipal Sludge

Module 4: Global Environmental Concerns	**No. of Hours: 03**

Population Growth, Climate Change, Ground Water Depletion/Recharging, Ozone Depletion, Radon and Fluoride problem in drinking water, Disaster Management, Resettlement and Rehabilitation of People

Module 5: Environmental Pollution Mitigation Tools	**No. of Hours: 03**

Remote Sensing& G.I.S., Environment Impact Assessment, Environmental Management Systems, ISO14001, Green Credit Program, Waste Audits, Environmental Stewardship - NGOs

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

1. Describe the principles of ecology and environmental issues of air, land and water on a global scale
2. Explain their environmental knowledge and observation skills to analysis of a problem or question related to the sustainable environment and energy
3. Illustrate the Global environmental concerns and the individual responsibility to protect environment with environmental protection laws and education for sustainable environment
4. Outline the strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environment

Textbooks:

1. Benny Joseph, "Environmental Studies", 2nd Edition, Tata Mcgraw-Hill, 2012
2. ErachBharucha, "Environmental Studies",1st Edition, University Grant Commission and Bharati Vidyapeeth Institute of Environmental Education and Research, Pune, 2004

Reference Books:

1. B. S Chauhan, "Environmental Studies", 1st Edition, Laxmi Publications Pvt. Ltd.,2019
2. S M Prakash, "Environmental Studies", 3rd Edition, Pristine Publishing House, Mangalore, 2018
3. AlokaDebi,"Environmental Science and Engineering", 2nd Edition, Universities Press (India) Pvt. Ltd, 2012
4. R. J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", 1st Edition, Wiley India Private Ltd., New Delhi, 2009
5. M.Ayi Reddy, "Environmental Science and Technology", 1st Edition, BS Publications, 2007

Web links:

1. Environmental Studies Module 1:https://www.youtube.com/watch?v=siGaqKXCmg8
2. Question Bank| Environmental Studies:https://www.youtube.com/watch?v=F9uwkhoT3MQ
3. Environmental Science and Engineering Module 1-5:https://www.youtube.com/watch?v=Y5B1nWYle40

Yoga-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23NMCC225**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Empower students to achieve and maintain good health
2. Promote the practice of mental hygiene
3. Facilitate students in attaining emotional stability
4. Impart moral values and higher level of consciousness

Contents **No. of Hours: 13**

- Ashtanga Yoga, its need and importance
- Yama : Ahimsa, satya, asteya, brahmacarya, aparigrahaNiyama :shoucha, santosh, tapa, svaadhyaya, Eshvarapranidhan etc.,.
- Suryanamaskar13 count- 2 rounds of practice
- Asana, Need, importance of Asana, Different types of asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana
- Different types of Asanas
  a) Sitting
    1. Sukhasana
    2. Paschimottanasana
  b) Standing
    1. ArdhakatiChakrasana
    2. ParshvaChakrasana
  c) Prone line
    1. Dhanurasana
    2. Sarpasana
  d) Supine line
    1. Halasana
    2. KarnaPeedasana
- Meaning, importance and benefits of Kapalabhati. 20 strokes/min 3 rounds
- Meaning, Need, importance of Pranayama, Different types, Meaning by name, technique, precautionary measures and benefits of each Pranayama
    1. Suryanuloma –Viloma
    2. Chandranuloma-Viloma
    3. Suryabhedana
    4. Chandra Bhedana
    5. Nadishodhana

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

1. Describe the meaning, aim and objectives of Yoga
2. Perform Suryanamaskar and able to analyze its benefits
3. Exhibit the different Asanas by name, its importance, methods and benefits
4. Perform Kapalabhati
5. Perform the different types of Pranayama by its name, precautions, procedure and uses

Textbooks:

1. Ajitkumar ,"YogaPravesha in Kannada" 1st Edition, Raashtroththaana Saahithya, 2017,ISBN-13: 978-8175310124
2. BKS Iyengar, "Light on Yoga", 1st Edition, Thorsons, 2017, ISBN-13: 978-0008267919
3. Dr. M L Gharote& Dr. S K Ganguly,"Teaching Methods for Yogic practices", 1st Edition, Kaivalyadhama, 2001, ISBN-13 : 978-8189485252

Reference Book:

1. YaminiMuthanna, "Yoga for Children step by step", 1st Edition, Om Books International, 2022, ISBN-13: 978-9394547018

Web links:

1. My Life My Yoga: https://youtu.be/KB-TYlgd1wE
2. Adiyoga: https://youtu.be/aa-TG0Wg1Ls

Physical Education-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**24NMCC226**	SEE Marks	**-**
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Impart the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2. Familiarization of health-related Exercises, Sports for overall growth and development
3. Build a strong foundation for the professionals in Physical Education and Sports

Contents **No. of Hours: 13**

- Training Components: Strength, Speed, Endurance, Flexibility, Agility & Coordinative abilities
- Basic rules and strategies of chosen team sports. (Practical Sessions)
- Causes & Prevention of Sports Injuries: Sprain, Strain, Cramps, Fractures and Dislocation
- Specific Games (Any one to be selected by the student)

Basic Training

Basket ball Dribbling with both hands - Layup shot - Chest pass - Proper footwork and body positioning - Basic jump shot technique

Cricket Holding the bat grip - Stance and footwork - Basic batting shots (defense & hitting) - Bowling grip and action - Fielding techniques (catching & throwing)

Football Dribbling with both feet - Passing with accuracy (short and long) - Controlling the ball (laces, inside of foot) - Shooting technique - Stopping the ball - Basic heading technique

Hockey Dribbling the ball with a stick - Stopping the ball with the stick - Basic passing techniques (forehand, backhand) - Shooting technique (push shot, flick shot) - Body positioning and balance

Table Tennis Holding the paddle grip - Forehand and backhand grip changes - Basic strokes (forehand drive, backhand push) - Footwork and positioning - Serving technique (underhand serve)

Throwball One-handed chest pass - Two-handed overhead pass - Pivoting with the ball Footwork and movement - Shooting technique (one-handed and two-handed throws) - Catching the ball safely

Volleyball Overhand serve - Proper hand setting technique (bump pass) - Forearm pass

Badminton Holding the racquet grip : Forehand , backhand, universal and panhandle grip changes ,Basic serves (high serve, low serve), Stance and Strokes

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

1. Design a basic training program incorporating various training components to improve specific physical fitness aspects
2. Identify common sports injuries, explain their causes, and implement preventative measures
3. Perform in the selected sports or athletic events

Textbooks:

1. Muller J. P., "Health, Exercise and Fitness", 1st Edition, Sports Publication, 2018
2. Uppal A.K., "Physical Fitness", Friends Publication New Delhi, 1992
3. Russell R.P., "Health & Fitness through Physical Education: Human Kinematics", Human Kinetics Publishers, 1994

Reference Books:

1. Anaika, "Play Field Manual", Friends Publication New Delhi, 2005
2. IAAF Manual
3. Pinto John & Roshan Kumar Shetty, "Introduction to Physical Education"

Web links:

1. Football:https://www.youtube.com/watch?v=wvlztaJYKYI
2. Basketball Basics:https://www.youtube.com/watch?v=d0z7QqblJaM
3. Cricket with the correct grip:https://www.youtube.com/watch?v=UxX4IQL03UU
4. Basics of Dribbling:https://www.youtube.com/watch?v=naEccnjzLxM
5. Karate Training:https://www.youtube.com/watch?v=br89-xhWezs

National Service Scheme-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23NMCC227**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
2. Develop youth leadership in the students
3. Induce social consciousness among students through various societal activities
4. Impart knowledge in finding practical solutions to individual and community problems

NSS -Contents	**No. of Hours: 13**

Introduction:

- Youth development programmes
- Health, hygiene and sanitation awareness programs
- Peer leadership training

Activities:

- Social and economic activities to support the society
- Water conservation – awareness sessions on water conservation, rain water harvesting, maintaining the surroundings, safeguarding water sources, etc.

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

1. Understand the importance of nation building and individual contribution to the betterment of the society
2. Discover grassroots challenges of community and solve them by technological intervention
3. Create societal impact by upholding the value of one for all and all for one
4. Maintain discipline and team spirit

Textbooks:

1. Ministry of Youth Affairs & Sports, Government of India, "National Service Scheme Manual", 2022
2. Rajiv Gandhi National Institute of Youth Development, Ministry of Youth Affairs & Sports, Government of India, "Introduction Training Module for National Service Scheme (NSS) Program officers", 2017
3. Gurmeet Hans, "Case material as Training Aid for field workers" TISS, 1996

Reference Books:

1. Dr. G R Bannerjee, Social service opportunities in Hospitals, TISS, 2012
2. Ram Ahuja, Social Problems in India, Rawat publications, 3rd Edition2014

Web links:

1. History of NSS :https://thebetterindia.com/140/national-service-scheme-nss/
2. NSS – an introduction:https://www.youtube.com/@nationalserviceschemeoffic4034/videos

Arts-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23NMCC228**	SEE Marks	**-**
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. To impart an understanding of the creative process from initial concept to final execution
2. Create and demonstrate proficiency in a chosen arts discipline through practical application
3. Analyze and appreciate diverse art forms and styles
4. To participate in art competitions at regional, state, national, and international levels, as well as in cultural events

Contents	**No. of Hours: 13**

Note: Student shall continue the arts form selected in previous semester

Performing Arts (Dance)	Orientation, Head to Toe Exercise, Contemporary /filmy dance, Basic expression and choreography, Zumba and aerobics, Dance practice and Group Performance, Evaluation
Music	Orientation, Introduction to Musical Instruments, Basic Instrumental Practice, Singing Genres Demo, Niche Mapping, Folk Singing with instrument, Group Song Practice, Group Presentation, Evaluation
Arts & Crafts	Orientation, Sketching lifestyle and modelling, Pencil Shading-practical, Brush/Crayon Techniques, Charcoal Drawing, water color practical, collage, Group Presentation, Evaluation
Theatre	Orientation, Realistic Acting: input and output applications, Stylized Acting, Absurd acting, Group Rehearsal, Basics of Costume Design, Prop Usage, Group Presentation, Evaluation

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

1. To be capable of creating choreography and delivering live performances for an audience
2. Employ a range of acting techniques and use them to create a performance
3. Evolve into creative, effective, independent, and reflective individuals capable of making informed decisions in both process and performance
4. Acquire knowledge and comprehension of the roles and processes used in current theatre arts practice

Textbooks:

1. Bruce Benward and Marilyn Sake, “Music in Theory and Practice”, McGraw-Hill Education, 2014
2. Otto G. Ocvirk, Robert E. Stinson, Philip R. Wigg, Robert Bone, and David L. Cayton, “Art Fundamentals: Theory and Practice”, McGraw-Hill Education, 2012
3. Anne Bogart and Tina Landau, “The Viewpoints Book: A Practical Guide to Viewpoints and Composition”, Theatre Communications Group, 2004