MGM University

Vision

- To ensure sustainable human development which encourages self-reliant and self-content society.
- To promote activities related to community services, social welfare and also Indian heritage and culture.
- To inculcate the culture of non-violence and truthfulness through vipassanna meditation and Gandhian Philosophy.
- To develop the culture of simple living and high thinking

Mission

- To impart state of art education and technical expertise to students and give necessary training to teachers to create self-reliant society.
- To encourage students to participate in Indian and International activities in sports, literature, etc. so that future generation becomes base for free and liberal society
- To educate students in areas like Management, Finance, Human relations to inculcate philosophy of simple living and high thinking value of simple economic society.
- To inculcate culture of non-violence and truthfulness through Vipassana.

  To sustain activities of Indian culture (viz. classical dance, music and fine arts) through establishing institutes like Mahagami, Naturopathy, etc.

विद्यापीठ गीत

अत्त दिप भव भव प्रदिप भव,

स्वरूप रूप भव हो

ज्ञान सब्ब विज्ञान सब्ब भव ,

सब्ब दिप भव हो

अत्ताहि अत्त नो नाथो ,

अत्ताहि अत्त नो गति

अत्त मार्गपर अप्रमादसे है तुझे चलना

सब्ब का कल्याण हो ,

वो कार्यकुशल करना

सब्ब का उत्तम मंगल , पथप्रदर्शक हो

अत्त दिप भव भव प्रदिप भव ,

स्वरूप रूप भव हो

ज्ञान सब्ब विज्ञान सब्ब भव ,

सब्ब दिप भव हो

बुद्धमं शरनं गच्छामि :

धम्मं शरनं गच्छामि :

संघं शरनं गच्छामि :

Dr. G. Y. Pathrikar College of Computer Science & Information Technology

MGM college of Computer Science and Information Technology was established in 2001 offering undergraduate and postgraduate degree program in Computer Science and Information Technology. College was renamed as Dr.G.Y.Pathrikar College of Computer Science and Information Technology in 2003 in memory of great educationalist, one of the founder member and Ex-Secretary MGM, Dr.G.Y.Pathrikar Sir.

It is first self-financed ISO certified institution offering program dedicated to Computer science and Information technology in Maharashtra and has achieved status of 2f/12b. Ours was the only and first college to be re-accredited as A+ grade with NAAC in the year 2017. Experienced and qualified faculty with Ph.D is strength of our college. Starting with 77 student's College has crossed total students strength of 10,000 passing out. Student are doing well in various MNCs like Infosys, Tech-Mahindra, Wipro, Capgemini, Cognizant etc. Many have their own Startups. Some of the students have completed their Masters and Ph.D. program from foreign countries like US, UK, Australia. Now we are constituent college of MGM University, Chhatrapati Sambhajinagar.

Vision

To be an academic institution in dynamic equilibrium in social, ecological and economical environment striving continuously for excellence in total quality education, research and technological service to the nation.

Mission

- To create and sustain a community of learning in which students acquire knowledge and learn to apply it professionally with due consideration for ethical, and economical issues.
- To upgrade our students in all respect with the help of latest infrastructure in the area of Computer Science and Information Technology in order to build the National Capabilities.
- To understand the culture of Non-violance, truth, peace through Gandhian Philosophy.

Programs offered at Dr. G. Y. Pathrikar College of Computer Science & Information Technology

Undergraduate Programmes	Postgraduate Programmes	PhD Programmes
B.Sc(Computer Science) Honours / Honours with Research	M.Sc. (Computer Science)	Ph.D. in Computer Science and Information Technology
B.Sc(Information Technology) Honours/ Honours with Research	M.Sc. (Information Technology)	
BCA(Science) Honours / Honours with Research	M.Sc. (Data Science)	
B.Sc(Animation) Honours / Honours with Research	M.Sc. (Animation)	
Integrated M.Sc. Data Science		
BCA(Digital Marketing) Honours		
B.Sc(Robotics) Honours		

Name of Program – B. Sc. Robotics

Duration – Four Years

Eligibility –

He / She Must have passed the Higher Secondary (Multipurpose) Examination conducted by H.S.C. Board Government of Maharashtra with Science / Technical Subjects or an Examination of any statutory University and Board recognized as equivalent thereto.

OR

Candidates having offered prescribed vocational courses, (MCVC) with Computer Techniques / Information Technology / Electronics.

OR

Three Years Course in Diploma Engineering conducted by the Board of Technical Education, Maharashtra State. He / She must have passed at qualifying examination.

Name of Faculty: Faculty of Basic and Applied Sciences
Name of the College: Dr.G.Y.Pathrikar College of Computer Science and IT
Name of the Programme: B.Sc. (Robotics) Honours / Honours with Research
Programme Type (UG/PG): UG
Duration: 04 Years (08 Semesters)

List of Options to select from Bucket of Courses provided in various categories:

Major	
Robotics	
Core Major	**Core Elective**

	GYP	**IBT**	**UDBAS**
Minor options for basic and applied science Faculty	Cyber Security	Food Technology and Processing	Chemistry
	Robotics	Microbiology	Geo-Informatics
	Data Analytics	Biotechnology	Mathematics
	Block-Chain Technologies	Bioinformatics	Statistics
		Food Nutrition and Dietetics	Material Science

	Faculty of Engineering and Technology	**Faculty of Social Sciences & Humanities**	**Faculty of Design**	**Faculty of Management and Commerce**	**Interdisciplinary Faculty**	**Performing Arts**
Minor options from Other Faculty	Data Science	Filmmaking	Product Design	Financial Management	Cosmetic Technology	Theatre Arts
	IoT	Photography	Interior Design	E-Commerce	Education	Dance
	Geo-informatics and Applications	Mass Communication and Journalism	Contemporary Arts	International Business Management	Yog Sciences	Music
	EV Technology	Psychology	Visual Communication	Hospitality Mgmt	Physical Education	Folk Art
	Drone Technology	Economics	Fashion Technology	Travel and Tourism	Home Science	
	Robotics Technology	English		Art of Leadership		
	Chemical Technology	Social Work		Art of Business		
	AI&ML					
	Universal Human Values					
	Energy management					

First Year - Semester I												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCR41MML101	Elements of Robotics and Robot kinematics	Theory	2	2		30	20	50	08		20
MM	SCR41MML102	Basic Electrical and Electronics	Theory	2	2		30	20	50	08		20
MM	SCR41MMP101	Practical Based on Elements of Robotics and Robot kinematics	Practical	1		2	30	20	50		08	20
MM	SCR41MMP102	Practical based on Basic Electrical and Electronics	Practical	1		2	30	20	50		08	20
IKS	SCR41IKT101	Indian Psychology and yoga	Theory	2	2	-	30	20	50	08	-	20
AEC		Basket of AEC From University	Theory	2	2	-	30	20	50	08		20
OE		Basket of OE From University	Theory	2	2	-	30	20	50	08		20
OE		Basket of OE From University	Theory	2	2	-	30	20	50	08		20
VSC	SCR41VSP101	Python Programming	Practical	2		4	30	20	50		08	20
SEC	SCR41SEL101	Computer System Architecture	Theory	2	2	-	30	20	50	08		20
VEC		From Basket of value Education courses from university	Theory	2	2	-	30	20	50	08		20
CC		From Basket of Co-Curricular Courses from University	Practical	2		4	30	20	50		08	20
				22	**16**	**12**	**360**	**240**	**600**			

Note:
Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,
Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

First Year- Semester II												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	SCR41MML103	Robot Mechanics, dynamics and motion planning	Theory	2	2		30	20	50	08		20
MM	SCR41MML104	Micro Processors and Embedded System	Theory	2	2		30	20	50	08		20
MM	SCR41MMP103	Practical based on Robot Mechanics, dynamics and motion planning	Practical	1		2	30	20	50		08	20
MM	SCR41MMP104	Practical based on Micro Processors and Embedded System	Practical	1		2	30	20	50		08	20
MI		Basket of MI From University	Theory	2	2	-	30	20	50	08		20
AEC		Basket of AEC From University	Theory	2	2	-	30	20	50	08		20
OE		Basket of OE From University	Theory	2	2	-	30	20	50	08		20
OE		Basket of OE From University	Theory	2	2	-	30	20	50	08		20
VSC	SCA41VSP102	Electrical Actuators and Drives	Practical	2		4	30	20	50		08	20
SEC	SCA41SEL102	Electronic Devices and Circuits	Theory	2	2	-	30	20	50	08		20
VEC		Universal Human Values (From VEC Annexure)	Theory	2	2	-	30	20	50	08		20
CC		From Basket of Co-Curricular Courses from University	Practical	2		4	30	20	50		08	20
						12	**390**	**260**	**650**			

Note: Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project.

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Syllabus Semester-I

Course code: SCR41MML101 **Course name:** Elements of Robotics and Robot kinematics
Course category: Major Mandatory **Credits:** 2
Pre-requisites: Pre-university mathematics.
Course Objectives:

1. To impart knowledge about kinematic dynamic analysis of robot manipulators
2. To determine dynamic analysis of robot manipulators

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

CO1: To control both the position and orientation of the tool in the three-dimensional space
CO2: The relationship between the joint variables and the position and the orientation of the tool.
CO3: Planning trajectories for the tool to follow on order to perform meaningful task
CO4: To precisely control the high-speed motion of the system

Contents –

Unit	Content	Teaching hours
1	**INTRODUCTION-** position and orientation of objects, objects coordinate frame Rotation matrix, Euler angles Roll, pitch and yaw angles coordinate Transformations, Joint variables and position of end effector, Dot and cross products, coordinate frames, Rotations, Homogeneous coordinates **DIRECT KINEMATICS-** Link coordinates D-H Representation, The ARM equation. Direct kinematic analysis for Four axis, SCARA Robot and three, five and six axis Articulated Robots.	10
2	**INVERSE KINEMATICS** The inverse kinematics problem, General properties of solutions. Tool configuration, Inverse kinematics of four axis SCARA robot and three and five axis, Articulated robot.	10
3	**WORKSPACE ANALYSIS AND TRACJECTORY PLANNING** Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique - continuous path motion, Interpolated motion, straight line motion and Cartesian space technique in trajectory planning..	10

Text Books: 1. Fundamentals of Robotics Analysis and Control Robert J. Schilling PHI Learning 2009.
2. Robotics Engineering an Integrated Approach Richard D. Klafter, Thomas. A, Chri Elewski, Michael Negin PHI Learning 2009
Reference Books: 1.
Online Resources: 1. NPTEL / SWAYAM lectures.

Course code: SCR41MML102 **Course name:** Basic Electrical and Electronics
Course category: Major Mandatory **Credits:** 2
Course Objectives:
1. Compute the electric circuit parameters for simple problems
Course Outcomes: At the end of the course, the students will be able to -
CO1: To introduce the basics of electric circuits and analysis
CO2: To impart knowledge in the basics of working principles and application of electrical machines
CO3: To introduce analog devices and their characteristics
CO4: To educate on the fundamental concepts of linear integrated circuits

Contents –

Unit	Content	Teaching hours
1	**ELECTRICAL CIRCUITS** DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)	10
2	**ANALOG ELECTRONICS** Resistor, Inductor and Capacitor in Electronic Circuits-Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters	10
3	**MEASUREMENTS AND INSTRUMENTATION** Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.	10

Text Books: 1. "Basic Electrical and Electronics Engineering D P Kothari and I.J Nagrath McGraw Hill EducationSecond Edition, 2020
2.Measurement and Instrumentation Principles Allan S Moris Butterworth Heinemann Third Edition 2001
Reference Books: 1.
Online Resources: 1. NPTEL / SWAYAM lectures.

Course code: SCR41MMP101 **Course name:** Practical Based on Elements of Robotics and Robot kinematics **Course category:** Major Mandatory **Credits:** 2
Pre-requisites: Pre-university mathematics.
Course Objectives:
1. To model and simulate a robot and verify its kinematics
Course Outcomes: At the end of the course, the students will be able to -
CO1: To model and simulate a robot and verify its dynamics
CO2: Analyze the kinematics and dynamics for various robots
CO3: Simulate and evaluate the kinematics and dynamics for various robots
CO4: Create a robot and program a trajectory plan for the robot

Contents –

Unit	Content	Teaching hours
1	1. Verification of Forward Kinematics for 2R, 2P and RP Robot. 2. Verification of D-H transformation for 6DOF Serial anipulator 3. Verification of Inverse Kinematics for 2R, 2P and RP Robot. 4. Verification of Forward Kinematics for 3R spatial Robot.	10
2	1. Kinematic Analysis of 2R planar robot for varying trajectories using Robo analyzer 2. Workspace Analysis of 2R planar robot manipulator for a specified trajectory 3. Kinematic Analysis of 6 DOF robot for varying trajectories using Robo analyzer 4. Inverse Dynamic Analysis of 6 DOF robot robot for varying trajectories using Roboanalyzer	10
3	1. Forward and Inverse Dynamics of 2R planar robot using Roboanalyzer 2. Creation of Robot in ROS using Gazebo/V-REP 3. Motion Simulation of Robot in ROS using Gazebo/V-REP/Moveit/Industrial. 4. Simulation of Trajectory Analysis of 2R and 3R manipulators using MATLABSIMULINK	10

Course code: SCR41MMP102 **Course name:** Practical based on Basic Electrical and Electronics
Course category: Major Mandatory **Credits:** 1
Pre-requisites: Pre-university mathematics.
Course Objectives:
1. To train the students in conducting load tests on electrical machines
Course Outcomes: After completion of the course the student will be able to:-
CO1: To gain practical experience in characterizing electronic devices
CO2: To train the students to use DSO for measurements
CO3: Use experimental methods to verify the Ohm's and Kirchhoff's Laws
CO4: Analyze experimentally the load characteristics of electrical machines
CO5: Analyze experimentally the load characteristics of electrical machines

Contents –

Unit	Content	Teaching hours
1	**ELECTRICAL** 1. Verification of ohms and Kirchhoff's Laws. 2. Load test on DC Shunt Motor. 3. Load test on Self Excited DC Generator 4. Load test on Single phase Transformer 5. Load Test on Induction Motor	10
2	**ELECTRONICS** 1. Experiment on Transistor based application circuits (Inverting and non-inverting amplifier or switching circuits) 2. Experiments on Operational Amplifier based Inverting and non-inverting amplifier. 3. Experiments on ADC. Experiments on 555 timer	10
3	**MEASUREMENTS** 5. Study on function of DSO. 6. Measurement of Amplitude, Frequency, Time, Phase Measurement using DSO.	10

Course code: SCR41VSP101 **Course name:** Python Programming
Course category: Major Mandatory **Credits:** 2
Pre-requisites: Pre-university mathematics.
Course Objectives:
1. To impart knowledge on Performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics To impart industry oriented learning
Course Outcomes: After completion of the course the student will be able to:
CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs
CO3: Develop and execute simple Python programs
CO4: Deploy functions to decompose a Python program
CO5: Process compound data using Python data structures.

Contents –

Unit	Content	Teaching hours
1	1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.) 2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points). 3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern) 4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)	10
2	5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries) 6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape) 7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters) 8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)	10
3	9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word) 10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation) 11. Exploring Pygame tool. 12. Developing a game activity using Pygame like bouncing ball, car race.	10

Text Books: : 1. Think Python: How to Think Like a Computer Scientist Allen B. Downey O'Reill 2nd Edition 2015
Reference Books 2. Computational Thinking: A Beginner's Guide to Problem Solving and Programming Karl Beecher BCS Learning & Development Limited 2017
Online Resources: 1. NPTEL / SWAYAM lectures.

Course code: SCR41SEL101 **Course name:** Computer System Architecture
Course category: Major Mandatory **Credits:** 2
Pre-requisites: Pre-university mathematics.
Course Objectives: To convey basic introduction of computer system architecture, the structure of computer, Working gates and its functionality
Course Outcomes: After completion of the course the student will be able to:
CO1: Student will be able to learn basic concepts of digital logic.
CO2: Student will be able to design of basic logic circuits using commonly used combinational and sequential circuits
CO3: Student will be able to learn basic concepts of digital logic.
CO4: Student will be able to design of Universal logic circuits using commonly used combinational and sequential circuits
CO5: Student will be able to learn basic concepts of digital logic.
Contents –

Unit	Content	Teaching hours
1	**Data Types** Number Systems, Octal and Hexadecimal Numbers, Decimal Representation, Alphanumeric Representation, 1's Complement, 2's Complement, Subtraction of Unsigned Numbers	10
2	**Introduction** Digital Computers, Logic Gates, Boolean Algebra, Complement of Function, **Karnaugh's Map** Map Simplification, Product of Sums Simplification Don't Care Conditions. **Combinational Circuits** Half Adder, Full Adder, 4-Bit Binary Adder, Half Subtractor and Full Subtractor	10
3	**Flip Flops** SR- Flip Flop, D- Flip Flop, JK- Flip Flop, T- Flip Flop, Edge Triggered Flip Flops, Flip Flop Input Equations, State Table, State Diagram, Problems	10

Text Books:
1. ComputerSystemArchitecture : M.Morris Mano -PEARSON 2. Computer System, Digital Design, Fundamentals of Computer Architecture and Assembly Language: AtaElahi -Springer.
3. Digital Electronics andMicro-Computers :R.K. Gaur -Dhanpatrai
4. Introduction to Digital Electronics :John Croweand Barrie Hayes -Gill
Reference Books: 1.
Online Resources: 1. NPTEL / SWAYAM lectures.

SECOND SEMESTER

Course code: SCR41MML103 **Course name:** Robot Mechanics, dynamics and motion planning
Course category: Major Mandatory **Credits:** 2
Pre-requisites: Pre-university mathematics.
Course Objectives: Compute the electric circuit parameters for simple problems
Course Outcomes: After completion of the course the student will be able to:
CO1: This course aims to familiarize students with basic terminologies of the robotics..
CO2: It also aims to inculcate thorough understanding about basic terminologies, grippers, sensors, actuators and robot kinematic
CO3: Essential knowledge to be acquainted in the field of Robotics
CO4: Identify gripper, sensor and actuator of a robot
CO5: Apply mathematics for manipulator positioning and motion planning

Contents –

Unit	Content	Teaching hours
1	**Introduction to robotics** Brief History, Definition, Robot Anatomy, Three laws, Classification of robots, Robot terminologies: work volume, Degree of Freedom, resolution, accuracy, repeatability, dexterity, compliance, payload capacity, speed of response etc., Wrist assembly, Joint notations, Selection criteria of any robot, Industrial applications of robot, Futuristic robotics. **Robot drive systems, End effectors and Automation** Types of drives – Hydraulic, Pneumatic and Electric, Comparison of all such drives, DC servo motors, Stepper motors, AC servo motor – salient features and applications, pulse count calculations, Types of Grippers – Mechanical, Magnetic, vacuum, pneumatic and hydraulic, selection and design considerations	10
2	**Robot sensors and Machine Vision** Need for sensors, types of sensors used in Robotics, classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Robot Vision setup (RVS), block diagram, components, working of RVS, Human vision Vs Robot Vision, Gradient calculations, Applications of RVS **Mathematical Preliminaries of Robotics** Spatial Descriptions: positions, orientations, and frame, mappings: changing description from frame to frame, Operators: translations, rotations and transformations, Homogeneous transformations, transformation arithmetic, compound Transformations, inverting a transform, transform equations, Euler Angles, Fixed Angles, Euler Parameters.	10
3	**Robot Kinematic** Manipulator Kinematics, Link Description, Link to reference frame connections, Denavit-Hartenberg Approach, D-H Parameters, Position Representations, Forward Kinematics, Inverse Kinematics	10

Text Books:

1. Introduction to Robotics S. K. Saha McGraw Hill Education Second Edition, 2014
2. Robotics: Fundamental concepts and analysis Asitava Ghosha Oxford University Press 2006

Course code: SCR41MML104 **Course name:** Microprocessor and Embedded Systems
Course category: Major Mandatory **Credits:** 2
Pre-requisites: Pre-university mathematics.
Course Objectives: This course aims to teach the detailed functioning of AVR Microcontroller and the role of embedded systems in a robotic system
Course Outcomes: After completion of the course the student will be able to:
CO1: To prepare block diagrams for any robotic control-hardware design.
CO2: Learn and analyze assembly language programs for AVR Microcontroller for various peripheral interfacings
CO3: Write programs for interfacing various sensors for robotics applications
CO4: To use advanced embedded processor and software
CO5: Apply mathematics for manipulator positioning and motion planning

Contents –

Unit	Content	Teaching hours
1	**Fundamentals of Microprocessors** History of microprocessor and microcontrollers, Difference between microprocessors and microcontrollers and Applications of microcontrollers, Role of microcontrollers in embedded Systems. **Architecture and instruction set of 8-bit AVR Microcontroller** Microcontroller architecture: Registers, AVR status register, Memory Space, ATmega32 (Arduino) pin-configuration & function of each pin, Addressing mode and instruction set of AVR microcontroller, Data transfer, Arithmetic, Logic and Compare, Rotate and Shift, Branch and Call instructions, Bit manipulation instructions	10
2	**AVR Assembly and C Programming** AVR data types and assembler directives, AVR assembly language programs,AVR I/O Port Programming, Time delay loop, Bit addressability, MACROs, Pros and cons of C and assembly language programming, Data types, Simple C programs for general purpose I/O and bit accessibility **AVR on-chip peripherals and its programming** General purpose I/O Ports, Timers, Interrupts, serial port, Serial port Interfacing protocols, SPI, I2C, UART. Assembly and C Language programming for peripherals	10
3	**Device interfacing and its programming** Sensor interfacing, Relay, Optoisolator and Stepper Motor Interfacing, Industrial servo interfacing, Raspberry Pi based programming for robots. Inverse Kinematics and Path Planning Programming using ROS.	10

Text Books:
1.The AVR Microcontroller and Embedded Systems Using Assembly and C Muhammad Ali Mazidi, SarmadNaimi and SepehrNaimi Pearson Education 1st Edition, 2012
2. Introduction to Robotics . S. K. Saha Tata McGraw Hill Education Pvt. Ltd Press
3.Introduction to Digital Electronics :John Croweand Barrie Hayes -Gill

Course code: SCR41MMP103
Course name: Practical based on Robot Mechanics, dynamics and motion planning
Course category: Major Mandatory **Credits:** 1
Pre-requisites: Pre-university mathematics.
Course Objectives:
1. Compute the electric circuit parameters for simple problems
Course Outcomes: After completion of the course the student will be able to:
CO1: This course aims to familiarize students with basic terminologies of the robotics.
CO2: It also aims to inculcate thorough understanding about basic terminologies, grippers, sensors, actuators and robot kinematic
CO3: Essential knowledge to be acquainted in the field of Robotics
CO4: Identify gripper, sensor and actuator of a robot
CO5: Apply mathematics for manipulator positioning and motion planning
Contents –

Unit	Content	Teaching hours
1	1. Study of components of real robot and its performance 2. Basics of 3D modeling software 3. Modeling of Robot Joints 4. Assembly of 2DOF/3DOF Robot Manipulator	10
2	1.Use of drives for robotic joints and its simulation 2.Roboanalyzer: A learning software of robotics study 3.Understanding coordinate frames and transformation 4.Formulation of DH parameters of robot configuration	10
3	1.Simulation using open source software of robot kinematics using DH Parameters 2.Forward kinematic analysis of a robot 3.Inverse kinematic analysis of a robot 4.Introduction of MATLAB and Robotic Toolkit introduction	10

Course code: SCR41MMP104
Course name: Practical based on Micro Processors and Embedded System planning
Course category: Major Mandatory **Credits:** 1
Pre-requisites: Pre-university mathematics.
Course Objectives:
1. This course aims to teach the detailed functioning of AVR Microcontroller and the role of embedded systems in a robotic system
Course Outcomes: After completion of the course the student will be able to:
CO1: To prepare block diagrams for any robotic control-hardware design.
CO2: Learn and analyze assembly language programs for AVR Microcontroller for various peripheral interfacings
CO3: Write programs for interfacing various sensors for robotics applications
CO4: To use advanced embedded processor and software
CO5: Apply mathematics for manipulator positioning and motion planning

Contents –

Unit	Content	Teaching hours
1	1. Introduction to Robotic controller card like Arduino UNO board and write program to blink LED using Arduino instructions, C language & Assembly language. 2. Interfacing drivers for Arduino Controller for Robotic application. Various sensor interfacing with Robotic Controller like Arduino UNO board 3. Interface Digital/Analog input output interfacing module with Arduino board and write programs related to I/O module 4. Write and execute Arduino program for serial communication. Transmit temperature value through serial communication and store it in spreadsheet or text file	10
2	1.Write assembly language programs for ATMega32 Microcontroller and simulate using ATMEL Studio 2. Interface Stepper motor with AVR Microcontroller and Write program to rotate stepper motor in clockwise and anticlockwise direction. 3. Interface DC Motor with AVR Microcontroller and write program to rotate DC motor in clockwise and anticlockwise direction. 4. Write Arduino program to receive IR Signal from IR remote and operate Electrical device based on switch pressed.	10
3	1.To simulate joint torque control of manipulator 2.To study feedback control of robot manipulator 3. To study adaptive control of robot manipulator 4. Design a robotic car using Arduino and other accessories	10

Course code: SCR41VSP102 **Course name:** Electrical Actuators and Drives
Course category: Major Mandatory **Credits:** 2
Pre-requisites: Pre-university mathematics.
Course Objectives:
1. To impart knowledge on Performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics To impart industry oriented learning
Course Outcomes: After completion of the course the student will be able to:
CO1: To evaluate the use of computer-based analysis tools to review the major classes of machines and their physical basis for operation
CO2: Practice the basic working of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive
CO3: Demonstrate the control of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive
CO4: Analyze the performance of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive
CO5: Apply mathematics for manipulator positioning and motion planning

Contents –

Unit	Content	Teaching hours
1	1. Load test on DC Motor 2. Load test on 3 Phase Induction Motor 3. Load test on 3 Phase Synchronous Motor. 4. Rheostat based Speed control of motors (AC and DC)	10
2	1. Switching circuits of MOSFET, IGBT, SCR and TRAIC. 2. Gate pulsation generation using PWM signals. 3. Speed control of DC motor using Power Electronic Drive. 4. Position and direction control DC servomotor using Power ecteronic Drive.	10
3	1. Position, Direction and speed control of stepper Motor. 2. Four quadrant operation of three-phase Induction Motor using Power Electronic Drive. 3. VFD control of single phase and three-phase induction motor using Power Electronic Drive. 4. AC servomotor position, direction and speed control using Power Electronic Drive.	10

Course code: SCR41SEL102 **Course name:** Electronic Devices and Circuits
Course category: Major Mandatory **Credits:** 2
Pre-requisites: Pre-university mathematics.
Course Objectives:
1. To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
Course Outcomes: After completion of the course the student will be able to:
CO1: To analyze the frequency response of small signal amplifiers
CO2: To design and analyze single stage and multistage amplifier circuits
CO3: To study about feedback amplifiers and oscillators principles
CO4: To understand the analysis and design of multi vibrators
CO5: Design and analyze amplifiers.

Contents –

Unit	Content	Teaching hours
1	**SEMICONDUCTOR DEVICES** PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator. **AMPLIFIERS** Load line, operating point, biasing methods for BJT and MOSFET, BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –Analysis of CS and Source follower – Gain and frequency response- High frequency analysis	10
2	**MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER** Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods. **FEEDBACK AMPLIFIERS AND OSCILLATORS** Advantages of negative feedback – Analysis of Voltage / Current, Series, Shunt feedback Amplifiers – positive feedback–Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.	10
3	**POWER AMPLIFIERS AND DC/DC CONVERTERS** Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.	10

Text Books: 1. Electronic Devices and Circuits David A. Bell Oxford Higher Education press 5th Edition,2010
2. Electronic Devices and Circuit Theory Robert L. Boylestad and Louis Nasheresky Pearson Education / PHI 10th Edition 2008
Reference Books: 1.
Online Resources: 1. NPTEL / SWAYAM lectures.