Shri. Shamrao Patil (Yadravkar) Educational & Charitable Trust's
Sharad Institute of Technology College of Engineering
(An Autonomous Institute)
Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur
(Approved by AICTE, New Delhi, Recognized by Government of Maharashtra & Affiliated to BATU University, Lonere)
NBA Accredited Programs, Accredited By NAAC 'A' Grade,
ISO 9001:2015 Certified

Teaching and Evaluation scheme as per NEP-2020

Department of Mechatronics Engineering

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING ● DEPT. OF MECHATRONICS ENGINEERING ● YADRAV

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Abbreviations

L: Lecture

T: Tutorial

P: Practical

CA1- Continuous Assessment 1

CA2- Continuous Assessment 2

MSE: Mid Semester Exam

ESE: End Semester Exam

BSC: Basic Science Course

ESC: Engineering Science Course

PCC: Programme Core Course

PEC: Programme Elective Course

MDM: Multidisciplinary Minor

OE: Open Elective

VSEC: Vocational and Skill Enhancement Course

AEC: Ability Enhancement Course

IKS: Indian Knowledge System

VEC: Value Education Course

RM: Research Methodology

CEP: Common Engineering Project

FP: Field Project

CC: Co-curricular Courses

ELC: Experimental Learning Course

HSSM: Humanity Social Science and Management

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Teaching and Evaluation Scheme for S. Y. B. Tech.

Department of Mechatronics Engineering

Semester: III

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING DEPT. OF MECHATRONICS ENGINEERING YADRAV

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Department: Mechatronics Engineering **Rev:** Course Structure/01/NEP/2023-24

Class: S.Y. B.Tech **Semester:** III

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs.	CAI	CAII	MSE	ESE	Total	
23MT2301	PCC	Fluid and Thermal Engineering	3	-	-	3	10	10	30	50	100	3
23MT2302	PCC	Sensors and Instrumentation	3	-	-	3	10	10	30	50	100	3
23MT2303	PCC	Digital Electronics and Microcontrollers	3	-	-	3	10	10	30	50	100	3
23MTMDXX	MDM	Multidisciplinary Minor	2	-	-	2	10	10	30	50	100	2
23OEMT21	OE	Open Elective-I	2	-	-	2	10	10	30	50	100	2
23MT2304	PCC	Fluid and Thermal Laboratory	-	-	2	2	15	15	-	20	50	1
23MT2305	PCC	Sensors and Instrumentation Laboratory	-	-	2	2	25	25	-	-	50	1
23MT2306	PCC	Digital Electronics Laboratory	-	-	2	2	15	15	-	20	50	1
23HSSM01	VEC	Aptitude Skills - I	1	-	-	1	25	25	-	-	50	1
23HSSM02	VEC	Language Skills - I	-	-	2	2	25	25	-	-	50	1
23MILEXX	AEC	Modern Indian Language	2	-	-	2	25	25	-	-	50	2
23MT2307	MC	Constitution of India	2	-	-	2	25	25	-	-	50	Audit
23MT2308	CEP	Mini Project - II	-	-	2	2	25	25	-	-	50	1
		Total	**18**	**-**	**10**	**28**	**255**	**255**	**150**	**290**	**950**	**21**

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Teaching and Evaluation Scheme for SY B. Tech.

Department of Mechatronics Engineering

Semester: IV

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Department: Mechatronics Engineering **Rev:** Course Structure/01/NEP/2023-24

Class: S.Y. B.Tech **Semester:** IV

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs.	CAI	CAII	MSE	ESE	Total	
23MT2401	VSEC	Analytical Skills for Mechatronics	2	-	-	2	10	10	30	50	100	2
23MT2402	PCC	Material and Manufacturing Technology	3	-	-	3	10	10	30	50	100	3
23MT2403	PCC	Advanced Embedded Systems	3	-	-	3	10	10	30	50	100	3
23MTMDXX	MDM	Multidisciplinary Minor	3	-	-	3	10	10	30	50	100	3
23OEMT22	OE	Open Elective-II	3	-	-	3	10	10	30	50	100	3
23MT2404	PCC	Material and Manufacturing Technology Laboratory	-	-	2	2	15	15	-	20	50	1
23MT2405	PCC	Advanced Embedded Systems Laboratory	-	-	2	2	25	25	-	-	50	1
23MT2406	VSEC	Object Oriented Programming using C++	-	-	2	2	15	15	-	20	50	1
23HSSM03	VEC	Aptitude Skills – II	1	-	-	1	25	25	-	-	50	1
23HSSM04	VEC	Language Skills - II	-	-	2	2	25	25	-	-	50	1
23MT2407	VEC	Environmental Science	2	-	-	2	25	25	-	-	50	2
23MT2408	HSSM	Account and Finance Management	2	-	-	2	25	25	-	-	50	Audit
23MT2409	CEP	Mini Project – III	-	-	2	2	25	25	-	-	50	1
		Total	**19**	**-**	**10**	**29**	**255**	**255**	**150**	**290**	**950**	**22**

Course Category	PCC	MDM	OE	VSEC	AEC	HSSM	VEC	CEP	Total
Cumulative Sum of credits	20	05	05	03	02	00	06	02	43
NEP Guideline	16-20	04	06	02	02	04	04	02	40-44

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List of Multidisciplinary Minor Basket

Semester	Basket A (AUTOMATION)	Basket B (DESIGN AND MANUFACTURING)	Basket C (SOFTWARE)
Sem. III	23MTMDA1 Energy Efficient Automation	23MTMDB1 Composite material Technology	23MTMDC1 Computer Architecture and Organization
Sem.IV	23MTMDA2 Human Robot Interaction	23MTMDB2 Material Handling *equipment*	23MTMDC2 Data Structure

List of Open Electives offered by Mechatronics Engineering Department

Semester III:

23OEMT21-Fundamentals of mechatronics

Semester IV:

23OEMT22-*Autotronics*

Note: Open Elective course will be offered to students of other programs and will not be offered to students of the same program

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Semester III
Fluid and Thermal Engineering

23MT2301	PCC	Fluid and Thermal Engineering	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA–I :10 Marks CA–II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic physics, Basic mathematics, Fundamentals of engineering
Course Outcomes: At the end of the course, students will be able to:

CO1	Explain fluid characteristics, including density, viscosity, and surface tension.
CO2	Elaborate fluid flow patterns, continuity equations, and Bernoulli's equation
CO3	Outline basic thermodynamic concepts, laws, and applications.
CO4	Importance of heat conduction, convection, and radiation, along with heat exchangers.
CO5	Discuss compressors, gas turbines, and their applications.
CO6	Elaborate cooling systems, psychometrics, and real-world applications.

Course Contents:

Unit 1 -Properties of Fluids Characteristics of fluids: Mass density, specific density, specific gravity, dynamic viscosity, kinematic viscosity, surface tension, compressibility, vapour pressure and cavitation. Fluid Statics: Hydrostatics law, Pascal's law, Pressure at a point, Total pressure, Centre of pressure, Buoyancy, Stability of submerged and floating bodies, Metacentres.	[6]
Unit 2 -Fluid Kinematics and Dynamics Introduction to Fluid Kinematics: Types of flows, continuity equation (Cartesian coordinate), visualization of flow field (stream, path and streak Line), stream and velocity potential function. Fluid Dynamics: Euler's equation of motion along a streamline, Bernoulli's equation, Applications of Bernoulli's equation, Flow measurement techniques: Venturi meter, Orifice meter, Pitot tube	[6]
Unit 3-Introduction of thermodynamics Basic concepts: system, surroundings, and properties of thermodynamic systems, Thermal equilibrium, processes, and cycles.	[6]

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Laws of thermodynamics: Zeroth law, First law, and Second law. **Application of Thermodynamics:** Heat Engine, Thermal Efficiency of Heat Engine, Heat Pump, Refrigerator, Carnot Cycle, Carnot Theorem	
Unit 4 Heat Transfer Introduction to heat transfer mechanisms: conduction, convection, radiation, Thermal conductivity and heat transfer coefficient, Thermal Insulation, Fourier's law, Newton's law of cooling, Stefan-Boltzmann law Heat exchangers: types, applications, and basic design considerations. Introduction to electronic cooling - Discussion on active and passive methods.	[6]
Unit 5 Compressor and Gas turbine Introduction to Compressors: Definition, purpose, and applications, Difference between Centrifugal and Axial Compressors. Typical applications in HVAC, refrigeration, and small-scale gas turbines, jet engines. Construction and performance Introduction to Gas Turbines: Definition, purpose, and applications, Simple Gas Turbine cycle, Combined and cogeneration cycles, Introduction to Aircraft Propulsion and Rocket Propulsion	[7]
Unit-6: Refrigeration and Air conditioning Introduction to Refrigeration and Air Conditioning, Refrigeration Systems, Refrigerants, Components, Air Conditioning Systems, Psychometrics: properties of moist air, psychrometric processes, Types of air conditioning systems, Refrigeration and Air Conditioning Applications Detailed case studies and real-world applications in fluid and thermal engineering from various sectors, Articles and case studies from journals and industry reports)	[6]

Text Books:

1. Sukumar Pati, "Fluid Mechanics and Hydraulics Machines", TATA McGraw Hill.
2. Munson, Young and Okiishi, "Fundamentals of Fluid Mechanics", Wiley India
3. Modi P. N. and Seth S. M, "Hydraulics and Fluid Mechanics", Standard Book House.
4. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
5. M.M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications.
6. V. M. Domkundwar, Heat Transfer, Dhanpat Rai & Co Ltd.
7. Arora, S. C., and S. Domkundwar. *A Course in Refrigeration & Air-conditioning: Environmental Engineering*. Dhanpat Rai, 1980.

Reference Books:

1. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India
2. Potter Wiggert, "Fluid Mechanics", Cengage Learning
3. Fox, Pichard, "Introduction to Fluid Mechanics", McDonald- Wiley
4. Bela G. Liptak, Instrument Engineers' Handbook – Process Control and Optimization, Volume I & II, Taylor & Francis
5. Franck P. Incropera, David P. DeWitt – Fundamentals of Heat and Mass Transfer,
6. Khurmi, R. S. (2006). Textbook of Refrigeration and Air Conditioning. India: S Chand & Company Limited.

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Sensors and Instrumentation

23MT2302	PCC	Sensors and Instrumentation	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA–I :10 Marks CA–II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic knowledge of Semiconductor Physics and Basic Electronics

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

CO1	Select different types of transducers and sensors for given application.
CO2	Illustrate Signal Conditioning Systems.
CO3	Identify and use data acquisition System.
CO4	Select relevant instrument measurement devices.
CO5	Select relevant thermal sensor measuring devices
CO6	Explain different instruments used for displacement, Strain, Flow, Pressure & Speed Measurement

Course Contents:

Unit 1: Introduction to Instrumentation and Sensors. Introduction to measurement, Static & Dynamic Characteristics of measurement, Instrumentation systems architecture, Definition-Sensors, Transducers, Classification of transducers -Resistive, Capacitive and inductive, Specifications of sensors/Transducers, Sensor networks architecture.	[6]
Unit 2: Analog Signals Principles of analog signal conditioning, Signal-Level and Bias Changes, Linearization, Conversions, Filtering and Impedance Matching, Concept of Loading, Passive circuits: Voltage Divider, Bridge Circuits, Bridge Resolution, Wheatstone Bridge.	[6]
Unit 3: Digital Signal Conditioning. Digital Electronics Circuits: comparator, converter, Digital-to-Analog Converters (DACs), Analog-to-Digital Converters (ADCs): Flash, SAR, Dual Slope, Data-Acquisition Systems: Hardware and Software of Data Acquisition System (DAS), Characteristics of digital data: Digitized Value, Sampled Data Systems, Linearization	[6]
Unit 4: Introduction To Instrument Measurement:	[6]

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Introduction, Static Characteristics, Error In Measurement, Types Of Static Error, Sources Of Error, Dynamic Characteristics, Digital Voltmeters- Introduction, Types Of DVM , General Specifications Of DVM, Digital Multimeter, Digital Measurements Of Time, Digital Frequency Meter , Q Meter, Instrument Calibration.	
Unit 5: Thermal Sensors. Electrical Methods: RTD, Thermistors, Thermocouples, Thermoelectric Effects, Laws of Thermocouple, Thermocouple characteristics, Non Electrical thermal sensor: Bimetallic Strip, Vapor Pressure Thermometers, Liquid-Expansion Thermometers, Solid-State Temperature Sensors.	[7]
Unit 6: Mechanical Sensors Displacement Sensors: LVDT, Potentiometer, Strain measurement- Metal Strain Gauges and Semiconductor Strain Gauges (SGs),Load Cell,Flow sensors: Obstruction type flow meter-Venturimeter, Orifice plate, Pitot tube, Rotameter, Electromagnetic flow meter, Pressure sensors: Pirani Gauge, Thermocouple vacuum gauge, Photoelectric, Piezoelectric pressure transducer. Speed Sensors: Eddy current generation tachometer, Stroboscope.	[6]

Text Books:

1. A course in Electrical, Electronics measurement and Instrumentation, A.K.Sawhney
2. Mechanical & Industrial measurements, Jain R.K., Khanna Publications, New Delhi.
3. Mechanical measurements & instrumentation, Rajput. R.K., S.K.Kataria and sons, New Delhi.
4. Electronic Instrumentation, H. S. Kalsi, MGH, 3rd Edition

Reference Books:

1. Electronic Instrumentation and Measurement Techniques, Welfrick Cooper.
2. Instrumentation for Engineers And Scientists , John Turner ,II Edition , Wiley
3. Electronic Instrumentation and Measurements, David A Bell, Third Edition, Oxford.
4. Instrumentation for Engineering Measurements, James W Dally, II Edition , Wiley India

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Digital Electronics & Microcontrollers

23MT2303	PCC	Digital Electronics & Microcontrollers	3-0-0	3Credits

Teaching Scheme	**Examination Scheme**
Lecture:3hrs/week	CA–I :10 Marks CA–II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam:50Marks

Pre-Requisites: Basic Electronics, Logic Gate
Course Outcomes: At the end of the course, students will be able to:

CO1	Apply Boolean laws/k map method to reduce given Boolean function
CO2	Design combinational logic circuits.
CO3	Design and Analyze Synchronous and Asynchronous Sequential logic circuits
CO4	Explain 8051 architecture, addressing modes & instruction set.
CO5	Make use of 8051 to interface stepper motor, keyboard, ADC using programmable peripheral
CO6	Develop assembly language program for arithmetic & logical operations using 8051

Course Contents:

Unit 1: Fundamentals of Digital Electronics Number Systems: binary, signed binary, octal, hexadecimal number, binary arithmetic, ones and two's complements arithmetic Introduction of Boolean algebra, Concept of Min Terms-Max terms, SOP-POS forms, Reduction Techniques, K- Map, K-map with Don't Care Condition	[6]

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Unit 2: Combinational Circuits Design Combinational Logic: Adder, look ahead carry generator, Sub Tractor, Sub tractor using 1's complement & 2's Complement, BCD Adder, serial adder, ALU, elementary ALU design, Magnitude Comparator, Parity generators/checkers, Code converters, Design of Multiplexers and Demultiplexers, Encoders, Decoders, BCD - to - 7 segment decoder.	[6]
Unit3: Sequential Circuits 1-bit memory cell, latches and Flip-Flops (S-R, D, J-K &T), Use of preset and clear inputs, Excitation table for Flip-Flops, Conversion of Flip-Flops Applications of Flip-Flops: Shift Registers, Counters-Ripple counters, Synchronous Counters, Ring Counters, and Johnson Counter	[8]
Unit4: Introduction to MCS 51 Introduction to MCS 51 Family, Architecture, Functional Pin out diagram, Programming Model, Memory Organization, Addressing Modes, Instruction Set: Classification, Reset Circuit, Oscillator Circuit, Introduction to Assembly Language Programming	[6]
Unit 5: Hardware overview Input/output Ports, Counters & Timers, Serial Communication, Interrupt Input/output Ports, Counters & Timers, Serial Communication, Interrupt Note: Structure of Above, Related S.F.R, Instruction, Associated Program	[6]
Unit6: Interfacing & Application Interfacing: LCD, ADC, DAC, Key board. Minimum System Design & Application: Interfacing of Temperature Sensor (LM 35) 8051 Connection to RS 232. Note: Assembly Language Programming to be done using Keil or Pinnacle Simulator	[6]

Text Books:

1. Fundamentals of Digital Circuits by Anand Kumar, TMH publication.
2. M Morris Mano: Digital Logic and Computer Design, 10th Edition, Pearson, 2008
3. The 8051 Microcontroller by Ayala 3rd Edition
4. The 8051 Microcontroller & Embedded Systems by Muhammad Ali Mazidi & Janice Gillispie Mazidi Pearson Edition L.P. E

Reference Books:

1. Digital Design Principles, Wakerly, Pearson, 4th Edition, 2006
2. Digital Design, Leach, Malvino, 4th Edition, TMH,2011
3. Modern Digital Electronics, R.P. Jain, 3rd edition TMH,2011
4. Architecture Programming, Interfacing & System design By Rajkamal Pearson edition

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Fluid and Thermal Engineering Laboratory

23MT2304	PCC	Fluid and Thermal Engineering Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Evaluation Scheme:**
Practical: 2 hours/week	CA–I :15 Marks CA –II :15 Marks End Semester Examination: 20 Marks

Pre-Requisites: Engineering Physics, Engineering Mechanics

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

CO1	Measure and analyze fluid behavior, including pressure, viscosity, and energy conservation.
CO2	Evaluate thermal properties and heat transfer in various materials and systems.
CO3	Demonstrate practical skills in operating, maintaining, and evaluating engine and compressor systems.
CO4	Interpret theoretical knowledge with practical applications through simulations, experiments and industrial visits.

List of Experiments:

At least a minimum of 8 experiments should be performed from the following list.

1. Demonstrate Pressure Measuring Devices
2. Calibration of Venturi meter and Orifice meter
3. Verification of Bernoulli's equation
4. Determination of major losses /minor losses in pipe fittings Apparatus
5. Reynolds Experiment
6. Study and Trial on Blower
7. Dismantling and assembly of IC engines
8. Study of two and four-stroke petrol and diesel engines
9. Determination of Heat Transfer Coefficient under forced convection
10. Software demonstration related to fluid mechanics and thermal engineering simulations
11. Determination of thermal resistance and temperature distribution in a Composite wall.
12. Industrial visit report

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Text Books:

1. Sukumar Pati, "Fluid Mechanics and Hydraulics Machines", TATA McGraw Hill.
2. Munson, Young and Okiishi, "Fundamentals of Fluid Mechanics", Wiley India
3. Modi P. N. and Seth S. M, "Hydraulics and Fluid Mechanics", Standard Book House.
4. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
5. M.M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications.
6. V. M. Domkundwar, Heat Transfer, Dhanpat Rai & Co Ltd.

Reference Books:

1. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India
2. Potter Wiggert, "Fluid Mechanics", Cengage Learning
3. Fox, Pichard, "Introduction to Fluid Mechanics", McDonald- Wiley
4. Bela G. Liptak, Instrument Engineers' Handbook – Process Control and Optimization, Volume I & II, Taylor & Francis
5. Franck P. Incropera, David P. DeWitt – Fundamentals of Heat and Mass Transfer,
6. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited.
7. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.

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Sensors and Instrumentation Laboratory

23MT2305	PCC	Sensors and Instrumentation Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Evaluation Scheme:**
Practical: 2 hours/week	CA–I :25 Marks CA –II :25 Marks

Pre-Requisites: Basic knowledge of Semiconductor Physics and Basic Electronics.

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

CO1	Explain the characteristics of Instruments.
CO2	Select appropriate sensor for given application.
CO3	Illustrate various smart sensors with their applications.

List of Experiments:

At least minimum 8 experiments should be performed from the following list.

1. Introduction to Instrumentation& Identify contact &Non-contact type Instruments.
2. Study of Characteristics of LVDT.
3. Study of potentiometer as Error Detector.
4. Characteristics of temperature sensors.
5. Measurement of Speed using tachometer/Photoelectric pickup/Proximity switch.
6. Pressure measurement using pressure cell.
7. Study of Hall effect sensor.
8. Measurement of strain using strain gauge.
9. Measurement of flow using Rotameter.
10. Measurement of sound using sound meter.
11. Study of Liquid level measurement using proximity switch.
12. Study of Smart sensors.
13. Case Study of different sensors used in Automobiles.

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Text Books:

1. A course in Electrical, Electronics measurement and Instrumentation, A.K.Sawhney
2. Mechanical & Industrial measurements, Jain R.K., Khanna Publications, New Delhi.
3. Mechanical measurements & instrumentation, Rajput.R.K., S.K.Kataria and sons, New Delhi.
4. Electronic Instrumentation, H. S. Kalsi, MGH, 3rd Edition

Reference Books:

1. Electronic Instrumentation and Measurement Techniques, Welfrick Cooper.
2.Instrumentation for Engineers and Scientists, John Turner, II Edition, Wiley
3. Electronic Instrumentation and Measurements, David A Bell, Third Edition, Oxford.
4.Instrumentation for Engineering Measurements, James W Dally, II Edition , Wiley India

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Digital Electronics and Microcontrollers Laboratory

23MT2306	PCC	Digital Electronics and Microcontrollers Laboratory	0-0-2	1 Credits

Teaching Scheme	**Examination Scheme**
Lecture:2hrs/week	CA –I :15 Marks CA–II:15 Marks End Semester Examination:20Marks

Pre-Requisites: Basic Electronics, Logic Gate
Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate the truth table of logic gates and combinational circuits using logic gates.
CO3	Construct sequential circuits using logic gates or IC's.
CO4	Develop an assembly language program for arithmetic & logical operations using 8051
CO5	Design a circuit to interface stepper motor, keyboard., ADC to 8051.

List of Experiments:

Minimum 8 experiments from above list out of which at least 4 should be on 8051 Microcontroller.

1. Implementation of Boolean Logic Functions using logic gates and combinational circuits
2. Design and implement Half adder, Full Adder, Half Subtractor, Full Subtractor using basic gates.
3. Given any 4-variable logic expression, simplify using Entered 16 Variable Map and realize the simplified logic expression using 8:1 multiplexer IC.
4. Design and implement code converter I) Binary to Gray II) Gray to Binary Code using basic gates.
5. Design and verify the Truth Table of 3-bit Parity Generator and 4-bit Parity Checker using basic logic gates with an even parity bit.
6. Realize a J-K Master/Slave Flip-Flop using NAND gates and verify its truth table.
7. Write an ALP for 8051 Addition, Subtraction, Multiplication & Division

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8. Data transfer and data exchange using 8051.
9. Conditional Operations using 8051.
10. Timer Operation for square wave generation using 8051
11. Serial data transmission using 8051.
12. Toggle bits of Port.
13. LCD Interfacing, stepper motor interfacing using 8051.

Text Books:

1. Fundamentals of Digital Circuits by Anand Kumar, TMH publication.
2. M Morris Mano: Digital Logic and Computer Design, 10th Edition, Pearson, 2008
3. The 8051 Microcontroller By Ayala 3rd Edition
4. The 8051 Microcontroller & Embedded Systems By Muhammad Ali Mazidi & Janice Gillispie Mazidi Pearson Edition L.P.E

Reference Books:

1. Digital Design Principles, Wakerly, Pearson, 4th Edition, 2006
2. Digital Design, Leach, Malvino, 4th Edition, TMH,2011
3. Modern Digital Electronics, R.P. Jain, 3rd edition TMH,2011
4. Architecture Programming, Interfacing & System design By Rajkamal Pearson edition

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Course Contents:

Unit-I: Introduction to Energy Efficiency and Automation: Basic concepts of energy efficiency. Definition and significance of energy efficiency, Importance of energy conservation in the context of global sustainability goals, Overview of automation technologies and their applications. Role of automation in enhancing efficiency and productivity.	[3]
Unit-II: Energy Efficiency and Automation Technologies: Energy-efficient technologies and practices, Lighting systems, HVAC (Heating, Ventilation, and Air Conditioning), Motors and drives, building envelope improvements, role of automation in enhancing energy efficiency, Integrating renewables with existing systems	[5]
Unit-III: Automation in Energy Efficiency Basics of automation, Sensors and actuators, Building Management Systems (BMS), Industrial automation and control systems, smart grid concepts and technologies, Demand response and energy storage, Smart meters and advanced metering infrastructure (AMI)	[4]
Unit-IV: Energy Management Strategies Energy management standards (ISO 50001), Energy performance indicators, Continuous improvement and optimization techniques, Role of Internet of Things (IoT) in energy management	[5]
Unit-V: Optimization techniques for energy-efficient Automation Optimization techniques for energy-efficient operation., Process Optimization, Energy Management Systems, Energy Audits and Monitoring, Machine learning algorithms for energy prediction and optimization, Real-time energy management strategies, Energy Storage Systems	[4]
Unit-VI: Case Studies and Real-world Applications Detailed case studies from various sectors, Best practices and lessons learned, Group discussions and presentations (Articles and case studies from journals and industry reports)	[3]

Text Books:

1. D. Yogi Goswami and Frank Kreith, Energy Efficiency and Renewable Energy Handbook
2. D. Yogi Goswami and Frank Kreith, Energy Management and Conservation Handbook
3. Donald A. Coggan, Fundamentals of Industrial Control: Practical Guides for the Industrial Technician

Reference Books:

1. Fereidoon P. Sioshansi, Smart Grid: Integrating Renewable, Distributed & Efficient Energy
2. John C. Andreas, Energy Efficiency: Principles and Practices
3. Giovanni Petrecca, Industrial Energy Management and Efficiency
4. Stamatios Manesis and George Nikolakopoulos, Introduction to Industrial Automation
5. Design and Development of Efficient Energy Systems. (2021). United Kingdom: Wiley.
6. O.V. Gnana Swathika, K. Karthikeyan, Sanjeevikumar Padmanaban, Smart Buildings Digitalization Case Studies on Data Centers and Automation Edited

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Basket B: Composite Material Technology

23MTMDB1	MDM	**Composite Material Technology**	2-0-0	2 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 2 hrs/week	CA–I :10 Marks CA–II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Physics, Engineering Chemistry, Basics of Mechanical engineering.

Course Outcomes:

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

CO1	Explain the fundamentals of composites
CO2	Identify the polymer matrix composites and various processes used in making the polymer matrix composites
CO3	Identify the metal matrix composites and various processes used in making the metal matrix composites
CO4	Identify the ceramic matrix composites and various processes used in making the ceramic matrix composites
CO5	Discover, understand and make effective use of non-conventional composites
CO6	Compare, choose and make effective use of carbon-carbon composites

Course Contents:

Unit-1 Introduction to Composite Materials Introduction to Composite Materials: Definition, classification & brief history of composite materials, advantages, disadvantages. Constituent of composite materials: Reinforcements, Matrix, Coupling agents, coatings & fillers. Composites for aerospace applications. Characterization of composite materials - Mechanical Properties, Thermal Properties.	[5]
Unit-2 Polymer Matrix Composites (PMC) Polymer Matrix Composites (PMC): Processing of PMC's; Processing of Thermoset Matrix Composites, Thermoplastic Matrix Composites. Properties & applications of PMC's.	[4]

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Unit-3 Metal Matrix Composites (PMC) Metal Matrix Composites: Types of metal matrix composites, Important Metallic Matrices, Processing-liquid state and solid state, Properties & Applications.	[3]
Unit-4 Ceramic Matrix Composites (CMC) Ceramic Matrix Composites (CMC): Processing of CMC's; Cold Pressing & Sintering, Hot Pressing, Reaction Bonding Processes, Infiltration, Directed Oxidation. Properties and applications of CMC's.	[4]
Unit-5 Nonconventional Composites Nonconventional Composites: Introduction, Nanocomposites; Polymer clay nanocomposites, self-healing composites, self-reinforced composites. Bio-composites. Performance/Characterization of Composites: Static Mechanical Properties; Tensile Properties, Compressive Properties.	[4]
Unit-6 Advances in Composites Carbon Fiber/Carbon Matrix Composites: Processing of Carbon/Carbon Composites, Oxidation protection of Carbon/Carbon Composites, Properties of Carbon/Carbon Composites, and application of Carbon/Carbon Composites.	[4]

Text Books:

1. Composite Material Science and Engineering Krishan K. Chawla Springer Third Edition First Indian Reprint 2015
2. Fiber-Reinforced Composites, Materials, Manufacturing, and Design P.K. Mallick CRC Press, Taylor & Francis Group Third Edition
3. Mechanics of Composite Materials & Structures Madhijit Mukhopadhay Universities Press 2004
4. Chawla K.K, Composite materials, 2/e, Springer — Verlag, 1998.
5. Mathews F.L. and Rawlings R.D., Chapman and Hall, Composite Materials: Engineering and Science, 1/e, England, 1994.

Reference Books:

1. Mechanics of Composite materials Autar K. Kaw CRC Taylor & Francis 2nd Ed, 2005
2. Stress analysis of fiber Reinforced Composites Materials Michael W, Hyer Mc-Graw Hill International 2009
3. Mechanics of Composite Materials .Robert M. Jones Taylor & Francis 1999
4. H K Shivanand, B V Babu Kiran, Composite Materials, ASIAN BOOKS, 2011.
5. A.B. Strong, Fundamentals of Composite Manufacturing, SME, 1989.
6. S.C. Sharma, Composite materials, Narosa Publications, 2000.
7. Maureen Milton, Hand Book of Bioplastics & Bio-composites for Engineering applications, John Wiley publications.

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Basket C: Computer Architecture and Organization

23MTMDC1	MDM	**Computer Architecture and Organization**	2-0-0	2 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 2 hrs/week	CA–I :10 Marks CA–II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: C Programming

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

CO1	Identify various components of computer and their interconnection
CO2	Understand basics of computer Arithmetic
CO3	Identify basic components and design of the CPU: the ALU and control unit.
CO4	Compare and select various Memory devices as per requirement.
CO5	Compare various types of IO mapping techniques
CO6	Criticize the performance issues of cache memory and virtual memory

DEPT. OF MECHATRONICS ENGINEERING · INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING · YADRAV

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Course Contents:

Unit-1 Structure of Computers Computer types, Functional units, Basic operational concepts, Von-Neumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Data representation, Fixed and Floating point, Error detection and correction codes.	[5]
Unit-2: Computer Arithmetic Addition And Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic Operations, Decimal arithmetic operations	[3]
Unit-3: Basic Computer Organization and Design Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. Central processing unit: Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC and advanced metering infrastructure (AMI)	[4]
Unit-4: Register Transfer and Micro-Operations Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit. Micro-Programmed Control: Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit.	[4]
Unit-5: Memory System Memory Hierarchy, Semiconductor Memories, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory, Performance considerations, Virtual memory, Paging, Secondary Storage, RAID.	[4]
Unit-6: Input Output and Multiprocessors I/O interface, Programmed IO, Memory Mapped IO, Interrupt Driven IO, and DMA. Characteristics of multiprocessors, Interconnection structures, Inter Processor Arbitration, Inter processor Communication and Synchronization, Cache Coherence.	[4]

Text Books:

1. M. Moris Mano (2006), Computer System Architecture, 3rd edition, Pearson/PHI, India
2. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface" 5thEdition by Elsevier.
3. John P. Hayes, Computer Architecture and Organization, 3rd Edition, WCB/McGraw-Hill.

Reference Books:

1. Carl Hamacher, Zvonks Vranesic, Safea Zaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
2. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
3. Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc,

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Dept. of Mechatronics Engineering
SIT COE,Yadrav

Aptitude Skills- I (Verbal Ability)

23HSSM01	VEC	Aptitude Skills- I	1-0-0	1 Credit

Teaching Scheme:	Examination Scheme:
Lecture: 1hr/week	CA-I:25 Marks CA-II :25 Marks

Pre-Requisites: Basic Mathematics

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

CO1	Apply sentence formation rules to spot the error
CO2	Solve the questions based on the types of tenses
CO3	Solve the questions based on Direct/Indirect Speech and Passive/active voice and Substitution and Elimination
CO4	Make use of Proverbs, Idioms and phrases in sentence construction and the vocabulary

Course Contents:

Unit 1	Structure and Types of Sentences, Conditional Sentences	[3]
Unit 2	Present tense, Past tense, Future tense, Use of Tenses in Sentence forming	[3]
Unit 3	Direct and Indirect Speech, Active and Passive Voice Use of Modal verbs in Sentence Forming, Substitution and Elimination	[3]
Unit 4	Use of Proverbs, Idioms and Phrases in Sentence Construction, Judgment and Inference Sentence Vocabulary Building in Various Situations	[3]

Text Books:

1. Raymond Murphy, Essential English Grammar with Answers, Murphy
2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition (15 March 2017)

Reference Books:

1. Rao and D,V,Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017
2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press;Second edition

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Language Skills- I

23HSSM02	VEC	Language Skills- I	0-0-2	Audit

Teaching Scheme:	Examination Scheme:
	CA-I: 25 Marks CA-II: 25 marks

Pre-Requisites: Basics of Programming

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

CO1	Develop flowchart and Algorithm to solve the given problem statements
CO2	Develops programs using Data Types and Operators
CO3	Make use of Decision Making and Looping Statements to develop conditional programs
CO4	Make use of Arrays to develop programs in C language

List of Experiment:

1. Explain basics of C such as Editing, Compiling, Error Checking, executing, testing and debugging of Programs and Deign Algorithms and Flowcharts.
2. Explain basics of Variable, Data types and operators and develop programs on arithmetic Operators.
3. Develop programs on Conditional, logical and Bitwise Operators.
4. Develop programs on Size of () and typecasting operator.
5. Develop programs on increment and decrement operator.
6. Develop programs on simple if and if-else statement.
7. Develop programs on simple if-else ladder and Nested if-else.
8. Develop programs on Switch case statement.
9. Develop programs on For-loop & Nested For-loop.
10. Develop programs on while and do-while loop.
11. Develop programs on one dimensional array.
12. Develop programs on two-dimensional array.
13. Develop programs on string handling functions.

Text Books:

1. C Programming Absolute Beginner's Guide, Que Publishing; 3rd edition (22 August 2013)
2. *C Programming Language 2nd Edition, Peasrson Publication*

Reference Books:

1. Programming in C Practical Approach by Ajay Mittal, Pearson
2. Let Us C, By Yashwat Kanetkar

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Dept. of Mechatronics Engineering
SIT COE,Yadrav

Modern Indian Language

23MILE01	AEC	Marathi	2-0-0	2 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 2 hrs/week	CA –I :25 Marks CA –II :25 Marks

Pre-Requisites: Nil

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

CO1	Develop the knowledge of local language/mother tongue and relate the same to daily life and social media.
CO2	Make use of rhetoric and verb to form sentences in Marathi Language
CO3	Identity Infinitive compounds in the given Marathi sentence.
CO4	Make use of Phrases and proverbs and form a sentence and Solve Prose Assessment/Summary Writing
CO5	Model a letter to appropriate end user in Marathi Language
CO6	Identity writing type of Marathi stanza and write appropriate writing.

Course Contents:

अध्याय 01: भाषा परीचय भाषा आणि व्यक्तिमत्व सहसंबंध, भाषा, जीवनव्यवहार आणि नवमाध्यमे व समाजमाध्यमे, चिन्ह व्यवस्था-विरामचिन्हे, संवाद कौशल्य (तोंडी परीक्षा), सर्वनाम-पुरुषात्मक, दर्शक, संबंधी, प्रश्नार्थक, सामान्य व आत्मवाचक सर्वनाम, विशेषण-गुण विशेषण, संख्या विशेषण, सार्वनामीक विशेषण	[4]
अध्याय 02: मराठी व्याकरण नाम, सर्वनाम, विशेषणे, क्रियापद, क्रियाविशेषण अव्यय, शब्दयोगी अव्यय, उभयान्वयी अव्यय, केवलप्रयोगी अव्यय, विभक्ती व त्याचे प्रकार, काळ व प्रकार	[4]
अध्याय 03: अलंकार व क्रियापदे **अलंकार**-शब्दलांकर- अनुप्रास, यमक, श्लेष उदाहरणे, अर्थालंकार-उपमा, उत्प्रेक्षा, व्यक्तिरेक, अपदुनती, रूपक, व्यक्तिरेक, अननव्य, अतिशयोक्ती उदाहरणे	[4]

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

प्रयोग-कर्तरी, कर्मणी, भावे **वाक्यप्रकार**-केवल वाक्य, मिश्रवाक्य, संयुक्तवाक्य **समास**-अव्ययीभाव, तत्पुरुष, द्वंद्व, बहूवृही **क्रियापदे**- कर्ता व कर्म, क्रियापदाचे प्रकार- अकर्मक, सकर्मक, उभयविध, संयुक्त, क्रियाविशेषण- कालवाचक, स्थळवाचक, रितीवाचक, संख्यावाचक, प्रश्नार्थक, निषेधार्थक	
अध्याय 04: वाक्प्रचार व म्हणी व गद्य आकलन/सारांश लेखन अर्थ सांगून वाक्यात उपयोग करणे (कमीत कमी ३० वाक्य प्रचार व म्हणी), गद्य आकलन - अपठित गद्य उतारा व त्यावरील प्रश्न उत्तरे (कमीत कमी ०५ उतारे व त्यावरील प्रश्न उत्तरे), सारांश आकलन	[5]
अध्याय 05: लेखन प्रकार पत्रलेखन व त्याचे प्रकार-निमंत्रण, आभार, अभिनंदन, मागणी, कोटुंबिक, विनंती, तक्रार संधी -स्वरसंधी, व्यंजनसंधी, विसर्गसंधी, वृत्त लेखन, जाहिरात लेखन, कथा लेखन, अहवाल लेखन, आवेदन पत्र, अभिप्रायलेखन	[5]
अध्याय 05: कल्पनाविस्तार व मुलखात कल्पना विस्तार, मुलाखत कौशल्ये, मुलाखतीचे वैशिष्ट्ये, मुलाखतीचे स्वरूप, मुलाखत घेताना घ्यावयाची काळजी, मुलाखत देताना आवश्यक बाबी उदा.आत्मविश्वास, व्यक्तिमत्व विकास, भाषा कौशल्ये इ.	[4]

Text Books:

1. व्यावहारिक मराठी, डॉ.ल.रा.नसिराबादकर, फडके प्रकाशन, कोल्हापूर.
2. व्यावहारिक मराठी, डॉ.लीला गोविलकर, डॉ.जयश्री पाटणकर, स्नेहवर्धन प्रकाशन, पुणे
3. सुगम मराठी व्याकरण लेखन, मो.रा. वाळंबे, नितीन प्रकाशन पुणे

Reference Books:

1. अनिवार्य मराठी व्याकरण, लेखन व आकलन, डॉ. प्रल्हाद लुलेकर, केदार काळवणे, Pearson पब्लिकेशन्स
2. मराठी व इंग्रजी अत्यावश्यक निबंध, प्रा.विजयकुमार वेधपाठक, K'Sagar पब्लिकेशन
3. उपयोजित लेखन, मराठी, प्राची शेंडे, सावली म्हात्रे, टार्गेट पब्लिकेशन्स

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Modern Indian Language

23MILE02	AEC	Hindi	2-0-0	2 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 2 hrs/week	CA–I :25 Marks CA–II :25 Marks

Pre-Requisites: Nil

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

CO1	Develop the awareness of Hindi language and relate the same to daily life and social media.
CO2	Identity Infinitive compounds in the given Marathi sentence.
CO3	Make use of Phrases and proverbs and form a sentence in Hindi language.
CO4	Identity the mistakes in grammar of Hindi language and corrections in it
CO5	Make use of rhetoric to form sentences in Hindi Language
CO6	Illustrate the prose and verse in the given literature

Course Contents:

अध्याय 01: हिंदी भाषा परीचय हिन्दी भाषा और उसका विकास, हिन्दी साहित्य का इतिहास, भाषा के विभिन्न मौखिक भाषा, लिखित भाषा, रूप-वर्णमाला, विराम चिन्ह, शब्द रचना, अर्थ, वाक्य रचना, वर्णो का उच्चारण और वर्गीकरण	[5]
अध्याय 02: समास समास, क्रियाएँ, अनेकार्थी शब्द, विलोम शब्द, पर्यायवाची शब्द,	[5]
अध्याय 03: मुहावरे एवं लोकोक्ति मुहावरे एवं लोकोक्ति, तत्सम एवं तद्भव, देशज, विदेशी, वर्तनी, अर्थबोध	[4]
अध्याय 04: हिन्दी भाषा में प्रयोग होने वाली अशुद्धियाँ हिन्दी भाषा में प्रयोग होने वाली अशुद्धियाँ, अनेक शब्दों के लिए एक शब्द, रस	[5]
अध्याय 05: अलंकार अलंकार, छन्द, विशेषण और विशेष्य, भाषा-विज्ञान	[4]

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

अध्याय 06: भाषा-विज्ञान भाषा-विज्ञान, हिन्दी पद्य/गद्य रचना व रचनाकार, संज्ञा से अवयव तक, रिक्त स्थानों की पूर्ति, क्रमबद्धता.	[4]

Text Books:

1. हिंदी व्याकरण- पं कमताप्रसद गुरु, प्रकाशन संस्था, नई दिल्ली
2. हिंदी साहित्यिक का विद्ग्नानिक इतिहास-डॉ गणपतिचंद्र गुप्त, लोकभारती प्रकाशन, नई दिल्ली.

Reference Books:

1. हिंदी भाषा शिक्षण - संपा हिंदी अध्ययन मंडल, सावित्रीबाई फुले पुणे विश्विद्यालय पुणे, राजकमल प्रकाशन

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Constitution of India

23MT2307	VEC	Constitution of India	2-0-0	Audit

Teaching Scheme	**Examination Scheme**
Lectures: 2hrs/week	CA – I: 25 marks CA – II: 25 marks

Pre-Requisites: Nil

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

CO1	Define the meaning and features of constitution of India.
CO2	Interpret right to life and fundamental rights to certain freedom under article 19 and 21.
CO3	Outline the federal structure of power and directive principles of state policy.

Course Contents:

Unit 1: Introduction to Constitution	
Meaning of the constitution law and constitutionalism, Historical perspective of Constitution of India, Fundamental Rights and Duties and its legal status.	[4]

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Unit 2: Organization structure and their functions Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions	[5]
Unit 3: Constitutional Powers The directive principles of state policy – importance and implementation, federal structure and distribution of legislative and financial powers between the union and the states, parliamentary form of government in India – The constitution powers and status of the president of India.	[5]
Unit 4: Provisions in Constitution Amendment of constitutional powers and procedure, the historical perspective of the constitutional amendments in India, Emergency provisions: National emergency, President rule, financial emergency.	[5]
Unit 5: Fundamental Rights Scheme of the fundamental rights to certain freedom under Article 19, Scope of the right to life and personal liberty under Article 21. Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners.	[4]

Text Books:

1. Constitution of India published by government of India, ministry of law and justice (legislative department), 2020.
2. Textbook on constitution of India by S. R. Bhansali.
3. Constitution of India by Bakhshi P. M., January 2014.

DEPT. OF MECHATRONICS ENGINEERING SIT COE YADRAV

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Mini Project -II

23MT2308	CEP	Mini Project -II	0-0-2	Audit

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs/week	CA –I :25 Marks CA –II :25 Marks

Pre-Requisites: NA

About Ideathon

The project is a part of addressing societal and industrial needs. An ideathon is a brief, intense event where students can work on some of the most important problems that the world is facing today. Ideations are brainstorming events where people with diverse knowledge backgrounds, skill sets and interests get together to predetermined problems, and come up with substantive, innovative and comprehensive solutions. An ideathon's output might be ideas, a roadmap or an actionable plan. Teams leverage design thinking and cutting-edge techniques to brainstorm and collaborate on potential solutions within a given time frame.

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

CO1	Identify problems based on societal /research needs
CO2	Apply Knowledge and interpersonal skills to solve societal problems in a group.
CO3	Draw the proper inferences from available results through theoretical/ experimental/simulations.
CO4	Analyze the impact of solutions in societal and environmental context for sustainable development.
CO5	Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
CO6	Demonstrate project management principles during project work.

DEPT. OF MECHATRONICS ENGINEERING

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Course Contents:

Week 1: Higher Education and Case Study Pedagogy • Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity. • Allocation of mentor	[2]
Week 2: Topic Selection • Briefly interact with students to provide hand-holding for topic selection. • Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor • **Illustrative Examples: Any Industry or Societal Problem** • Finalization of Title.	[2]
Week 3: Case Study Design/Ideathon: Part 1 • If needed, provide hand-holding to students for finalizing objectives. • Review the objectives of the case study groups. • Identify what can be quantified related to your topic and how. • Decide objectives for your case study. • Continue reading especially recent work specific to your topic.	[2]
Week 4: Case Study Design/Ideathon: Part 2 • Prepare a roadmap of your case study, identify what is to be measured on the field. • Ensure student groups have finalized the objectives.	[2]
Week 5: Survey Design • Prepare a questionnaire and try it out with your group members as mock. • Decide sampling strategy.	[2]
Week 6: Analysis Phase-1 • Students in a group shall understand problem effectively, propose multiple solution. • The students have to work on different approaches and search for the different methodology to solve the problem in consultation with the project guide.	[2]

DEPT. OF MECHATRONICS ENGINEERING · SIT · INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING, YADRAV

Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Week 7 Analysis Phase-2 • The students have to finalize the best methodology to solve the problem in consultation with the project guide. • 25% Presentation has to be conducted by mentor/guide based on above activity.	[2]
Week 8: Analysis-3 • Identify appropriate data visualization tools for your case study. • Analyze the data	[2]
Week 9: Analysis-4 • Identify appropriate data visualization tools for your case study. • Analyze the data	[2]
Week 10: Report writing Part:1 • Prepare an outline of the report and start organizing the write-up for the first draft. • Prepare and submit the first draft of the report to the course coordinator.	[2]
Week 11: Report writing Part:2 • Make necessary corrections if any as per the suggestions of course coordinator. • Submit the final draft of the case study	[2]
Week 12: Final Presentation • 50% Presentation has to be conducted by mentor/guide based on above activity.	[2]

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SIT COE,Yadrav

Semester IV

Analytical Skills for Mechatronics

23MT2401	VSEC	Analytical Skills for Mechatronics	2-0-0	2 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week	CA –I :25 Marks CA –II :25 Marks

Pre-Requisites: Engineering Mathematics-I & II

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

CO1	Apply the definition & properties of Laplace Transform to evaluate the integral & to find Laplace transform of elementary functions and special functions like periodic function, Dirac-delta function & unit step function.
CO2	Apply the knowledge of Laplace transformation to find solution of linear differentiation equations with constant coefficient.
CO3	Solve partial differential equations & use of separation of variable method to solve heat and Laplace equations.
CO4	Develop the concept of Fourier series expansion of different periodic functions so as to use them in harmonic analysis.
CO5	Solve problems related to Fourier transform and inverse Fourier transform.
CO6	Solve finite difference equation using Z- transform.

Unit 1: Laplace Transform Definition – conditions for existence; Transforms of elementary functions; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of derivatives; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function., Heaviside-unit step function, Dirac delta function.	[8]
Unit 2: Inverse Laplace Transform Introductory remarks; Inverse transforms of some elementary function, General methods of finding inverse transforms, Partial fraction method and Convolution Theorem for finding inverse Laplace transforms, Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.	[7]

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Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

Unit 3: Partial Differential Equations and Their Applications Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation ($\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$), and two dimensional heat flow equation (i.e. Laplace equation ; $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).	[8]
Unit 4: Fourier series Definition, Euler's formulae, Conditions for a Fourier expansion, Functions having points of discontinuity, change of interval, expansions of odd and even periodic functions and half range series.	[7]
Unit 5: Fourier Transforms Fourier Transforms, Fourier Sine and Cosine Transforms, Complex form of Fourier Integral, Finite Fourier Sine and Cosine Transform.	[6]
Unit 6: Z Transform Definition, properties of z transform, Z Transform of basic sequences, Z transform of some standard discrete function inverse Z transform.	[6]

Textbook/s

1. P. N. Wartikar & J. N. Wartikar, A Text Book of Applied Mathematics (Vol I & II), Pune Vidyarthi Griha Prakashan, Pune.
2. N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publications, New Delhi.

Reference Books

1. C. R. Wylie & L. C. Barrett, Advanced Engineering Mathematics, McGraw Hill Publishing Company Ltd.
2. B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publications, New Delhi.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
5. Peter O" Neil, A Text Book of Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore.

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23MT2402	PCC	Material and Manufacturing Technology	3-0-0	3 credits

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs/week	CA –I :10 Marks CA –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Physics, Engineering Chemistry, Basics of mechanical engineering.

Course Outcomes:

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

CO1	Understand basics of material science and classify them.
CO2	Apply suitable testing technique and analyze properties of materials
CO3	Identify and apply material for different applications
CO4	Understanding of material casting techniques
CO5	Understanding of material forming and joining techniques
CO6	Understanding of basic material cutting techniques

Unit 1. Introduction to Materials Science Overview of Materials Science: Historical perspective, importance in engineering. Classification of Materials: Metals, ceramics, polymers, composites. Atomic Structure and Bonding: Atomic structure, types of bonds, crystal structures.	[6]
Unit 2. Material Properties and Testing Mechanical Properties: Stress-strain behavior, hardness, toughness, fatigue. Thermal Properties: Heat capacity, thermal expansion, thermal conductivity. Electrical Properties: Conductivity, semiconductors, dielectric properties. Testing Methods: Tensile testing, hardness testing, impact testing, nondestructive testing.	[7]
Unit 3. Basic Engineering Materials **Ferrous Alloys**: Steels, cast irons, application, heat treatment of steels, Iron-carbon	[8]

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Head
Dept. of Mechatronics Engineering
SIT COE,Yadrav

diagram. **Non-Ferrous Alloys**: Aluminum, titanium, copper, magnesium alloys. **Polymers**: Structure, polymerization, types of polymers, mechanical behavior. **Ceramics:** Structure, types of ceramics, mechanical properties, applications. Material selection criteria.	
Unit 4. Metal Casting Process Sand Casting, Sand Mould, Type of patterns, Pattern Materials, Pattern allowances, Molding sand Properties and testing, Cores, Types and applications, Molding machines, Types and applications, Melting furnaces. Defects in Sand casting process-remedies	[8]
Unit 5. Metal Forming and Joining Process Elastic and plastic deformation, Hot and cold working, Rolling, Principle and operations, Forging Principle, Forging operations, Extrusion, Wire and tube drawing processes. Principle of welding, soldering, Brazing. Types of welding	[7]
Unit 6. Fundamental of Machining Process Mechanics of chip formation, Types of chips, Types of cutting tools, Tool materials, Tool geometry and nomenclature, Turning – Milling – Drilling operations.	[6]

Textbook/s

1. Material Science and Metallurgy for Engineers- by Dr. V.D Kodgire and S.V Kodgire and B.B Chopane Director of Technical Education, Maharashtra State | 1 January 2017
2. Manufacturing Processes for Engineering Materials, 6e Paperback – 30 June 2018 by Serope Kalpakjian Steven R. Schmid

Reference Books

1. Campbell, J.S., "Principles of Manufacturing Materials and Processes", McGraw-Hill, New York.
2. Rao, P.N., "Manufacturing Technology", Vol. 2, McGraw-Hill Education, New Delhi.
3. Workshop Technology Vol. I, II & III, WAJ Chapman.
4. Workshop Technology Vol. II, Hajra & Choudhari
5. Manufacturing Processes, O.P. Khanna.
6. Production Technology, R. K. Jain.

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Advanced Embedded Systems

23MT2403	PCC	Advanced Embedded Systems	3-0-0	3Credits

Teaching Scheme	**Examination Scheme**
Lecture:3hrs/week	CA –I :10 CA–II:10Marks Mid Semester Exam: 30 Marks End Semester Exam:50Marks

Pre-Requisites: Digital Electronics & Microcontrollers

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

CO1	Outline about design issues & components of embedded systems, RISC architecture design philosophy of ARM7.
CO2	Develop embedded C program for interfacing I/O device like LEDs, DC Motors using LPC2148.
CO3	Make use of LPC2148 of extended features of I/Os, Timers, ADC for interfacing peripherals.
CO4	Explain real time operating concepts.
CO5	Explain hardware – software co design issues and testing methodology for embedded system.
CO6	Explain Semaphores, Mutex, Mail Box & Message Queue in µCOSII.

Course Contents:

Unit1: Introduction to Embedded systems & ARM7 architecture Embedded systems (ES) definition, ES components, ES design flow, ES designing & development tools, Characteristics of Embedding Computing, ARM7 registers bank, status registers, pipelining concept, exceptions and vector table, data flow model.	[6]

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Unit 2: ARM instruction set with assembly & C programming ARM assembly instruction set and programming, ARM C programming, LPC2148 pin layout, Input/ Output programming in C using LPC2148 port pins.	[6]
Unit3: LPC2148 microcontroller architecture & programming LPC2148 architecture details, SFRs, Interrupts in ARM7 (ref: LPC2148), Timer/Counter module, PWM module, A/D convertor module, Serial communication module (UART), I2C and SPI communication protocols (ref: LPC2148).	[8]
Unit4: Operating System Basic Features of an Operating System, Kernel Features: Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System Processes and Threads, Context Switching: Cooperative Multi-tasking, Pre-emptive Multi- tasking.	[6]
Unit 5: Scheduling and Inter-process Communication Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault Tolerant Scheduling Signals, Shared Memory Communication, Message-Based Communication	[6]
Unit 6: Semaphore, Mutex, Mail box, and Message queue in µCOSII: Creating and deleting a semaphore, waiting and signaling semaphore, Creating and Deleting Mutex, waiting and signaling mutex, Creating and deleting a mail box, sending and receiving a message using mail box (mail box as a binary semaphore), creating and deleting a message queue, sending and receiving a message using message queue	[6]

Text Books:

1. Embedded/ Real-Time Systems: Concepts, Design & Programming By Dr.K V K K Prasad, Dreamtech Press
2. An Embedded Software Primer, David E. Simon Pearson Education, Asia Publication
3. ARM System Developers Guide Designing & Optimizing System Software By Andrew N., Dominic Sloss, and Chris Wright.
4. Embedded Systems Architecture Programming and Design by Raj Kamal, II edition, Tata MC Graw-Hill.

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Reference Books:

1. Embedded System Design A Unified Hardware/ Software Introduction By Frank Vahid/ Tony Givargis , Wiley publication
2. Real- Time Systems Design and Analysis by Phillips A. Laplante, Wiley insia Edition.
3. Embedded System Design: Peter Marwedel, Springer publication.
4. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996

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Material and Manufacturing Technology Lab

23MT2404	PCC	Material and Manufacturing Technology Lab	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hr/week	CA –I :15 Marks CA –II :15 Marks End Semester Examination: 20 Marks

Pre-Requisites: Workshop Practice -I

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

CO1	Discover microstructure of metals and alloys and investigate the properties of materials
CO2	Perform wood and metal working operations
CO3	Inspect various properties of molding sand
CO4	Demonstrate the various Manufacturing Process like Milling, Drilling etc.

List of Experiments:

The term work shall consist of the report on any eight experiments from the following:

1. Prepare sample for microscopic examination and examine microstructure of given sample
2. Test hardness of metals and alloys with instrument available like Rockwell Hardness tester, Vickers Hardness tester, etc.
3. Carpentry shop: one Job of Pattern Making
4. Different Sand Testing Properties like Permeability test and Moisture content etc.
5. One job of plain turning, taper Turning, external threading and knurling operation.
6. One job of drilling-on-drilling Machine.
7. One job of machining on milling machine.
8. One job of welding operation on Arc welding/ Gas welding.
9. Industrial visit to study manufacturing practices. - Visit to foundry/machine shop – study of automation processes, Layout, Material handling equipment & other processes with preparation of report.
10. Industrial visit to study manufacturing practices- Study of the extrusion and drawing process – visit to industry with report presentation

DEPT. OF MECHATRONICS ENGINEERING INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING

Head
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Text Books:

1. Elements of Workshop Technology (Volume -1 & 2) by S. K. Hajra Choudhary, A. K. Hajra Choudhary, Nirjhar Roy, Media promoters (2010).
2. A Course in Workshop Technology (Vol. I & II) by B. S. Raghuwanshi, Dhanpat Rai & CO. (2001).
3. Workshop Technology Part 1, 2 and 3. By W. A. J. Chapman, Taylor & Francis (1972).

Reference Books:

1. Production Technology – HMT, Tata McGraw-Hill (1980).
2. Manufacturing, Engineering and Technology, 4th Edition, by SeropeKalpakjian, Steven R. Schmid, published by Pearson (2005).
3. Manufacturing Processes for Engineering Materials, 4th Edition, by SeropeKalpakjian, Steven R. Schmid, published by Pearson (2007).
4. V.D. Kodgire and S.V. Kodgire, —Material Science and Metallurgy for Engineers, Everst publishing house, pune, 2008

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Advanced Embedded Systems Laboratory

23MT2405	PCC	Advanced Embedded Systems Laboratory	0-2-0	1 Credits

Teaching Scheme	Examination Scheme
Lecture:2hrs/week	CA–I :25 Marks CA–II:25 Marks

Pre-Requisites: Digital electronics & Microcontroller laboratory

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

CO1	Develop an assembly language program using ARM LPC2148 for different applications.
CO2	Interface external devices and I/O with ARM cortex M3
CO3	Develop C language program and library functions for embedded system applications.

List of Experiments:

Minimum 8 experiments from above list.

1. Introduction to Embedded System
2. Program for turning ON LEDs sequentially.
3. Program for controlling DC Motor.
4. Program for controlling stepper Motor.
5. Program for generating saw-tooth wave using DAC.
6. Program for generating sine wave using DAC.
7. Program for Polled Loops
8. Program for Rate Monotonic Scheduling
9. Program for Earliest Deadline Scheduling
10. Program for Shared Memory Communication

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Text Books:

1. Embedded/ Real-Time Systems: Concepts, Design & Programming By Dr.K V K K Prasad, Dreamtech Press
2. An Embedded Software Primer, David E. Simon Pearson Education, Asia Publication
3. ARM System Developers Guide Designing & Optimizing System Software By Andrew N., Dominic Sloss, and Chris Wright.
4. Embedded Systems Architecture Programming and Design by Raj Kamal, II edition, Tata MC Graw-Hill.

Reference Books:

1) 1.Embedded System Design A Unified Hardware/ Software Introduction By Frank Vahid/ Tony Givargis , Wiley publication
2) Real- Time Systems Design and Analysis by Phillips A. Laplante, Wiley insia Edition.
3) Embedded System Design :Peter Marwedel, Springer publication.
4) K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996

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Object oriented programming Using C++ Laboratory

23MT2406	PCC	Object oriented programming Using C++ Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Evaluation Scheme:**
Practical: 2 hours/week/batch	CA –I :15 Marks CA–II :15 Marks End Semester Examination: 20 Marks

Pre-Requisites: Computer Programming in C

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

CO1	Make use of Class, Object and Constructor-Destructor features of OOP.
CO2	Experiment with Inheritance, Virtual Function and Polymorphism operations in OOPs.
CO3	Develop code to illustrate File Handling and Exception Handling.
CO4	Demonstrate use of Friend Function, Data Abstraction and Data Encapsulation with suitable example.

List of Experiments:

1. Write a C++ program to demonstrate classes.
2. Class Templates C++ programs using class templates to implement the following using an array
   a) Stack ADT b) Queue ADT
3. Write a C++ program to demonstrate on constructors and destructors
4. Write a C++ program to demonstrate Function Overloading.
5. Write a C++ program to demonstrate operator '+' overloading to find the addition of two complex numbers.
6. Write a C++ program to demonstrate inheritance
7. Write a C++ program to demonstrate Friend Function.
8. Write a C++ program to demonstrate Polymorphism (Virtual Function).
9. Write a C++ program to demonstrate Exception Handling.
10. Write a C++ program to demonstrate File Handling

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Text Books:

1.Object Oriented Programming with C++, E.Balagurusamy (McGraw Hill Publication)

2.Programming Prinicples and Practice using C++, B.Stroustrup, Addition-Wiesly (Pearson Education)

Reference Books:

1. Object Oriented Programming in C++ by Robert Lafore Techmedia Publication.
2. The complete reference C – by Herbert shieldt Tata McGraw Hill Publication.
3. Object Oriented Programming in C++ Saurav Sahay Oxford University Press.
4. Object Oriented Programming in C++ R Rajaram New Age International Publishers 2nd.
5. OOPS C++ Big C++ Cay Horstmann Wiley Publication.
6. The Art, Philosophy and Science of OOP with C++, Rick Miller,SPD.
7. C++ for Programmers, P.J.Deitel and H.M.Deitel,PHI/Pearson.

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Basket A: Human robot interaction

23MTMDA2	MDM	Human robot interaction	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA –I :10 Marks CA –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic physics, Basic mathematics

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

CO1	Understand basic knowledge of robotics
CO2	Grasp basic knowledge of Human robot interaction
CO3	Explain the need and various systems of the Humanoid / Social robots.
CO4	Use the applications and developments of the Internet of Robotic Things

Course Contents:

Unit 1: Introduction to Human robot interaction Concept and scope of Human robot interaction Robot: Introduction, Classification of robot, Robot Performance Parameters.	[6]
Unit 2: Basics of Human robot interaction Definition, History, Need of HRI, Ethical Issues for HRI, Multi-Modal Perception, Social, Service, and Assistive Robotics	[6]
Unit 3: HRI Architecture, Collaborative Robots HRI Architecture, Collaborative Robots, Definition, Types of Collaboration, Applications of collaborative robots, collaborative Robot Technology.	[6]
Unit 4: Humanoid Robotics Technology and Social Robots Sensors in Humanoid Robot, Control of Humanoid Robot, actuation types for humanoid Robot, System Integration in Humanoid Robot, Social Robot, Need of Social Robots.	[6]

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Unit 5: Industry 4.0, Internet of Robotic things (IORT) and Natural Language Processing Introduction, Internet of Things and Robotics, Applications and developments of the Internet of Robotic Things; Introduction, Classical Approaches to Natural Language Processing	[6]
Unit 6: Robot Morphology and HRI Application Introduction, Importance of Robot Morphology, HRI Application in Manufacturing Industry, Healthcare, Etc.	[6]

Text Books:

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi,2014.
2. Mikell P Groover, "Automation Production Systems and ComputerIntegrated Manufacturing"Pearson Education, New Delhi, 2001.
3. Automation and Collaborative Robotics, Springer Publication, 2020.

Reference Books:

1. AshitavaGhoshal, Robotics-Fundamental Concepts and Analysis,,, Oxford University Press,Sixth impression, 2010.
2. Elmer P. Dadios, "Humanoid Robot: Design and Fuzzy Logic Control Technique for Its Intelligent Behaviors", 2012.
3. Iñaki Navarro and Fernando Matía, "An Introduction to Swarm Robotics", ISRN Robotics, 2013.
4. Jeff Faneuff, Jonathan Follett, "Designing for collaborative robotics", O'Reilly Media, 2016.
5. David Feil-Seifer, "Human-Robot Interaction", 2010

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Basket 2: Material Handling Equipment

23MTMDB2	MDM	Material Handling Equipment	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture:3 hrs/week	CA –I :10 Marks CA –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Mechanical Engineering.
Course Outcomes: At the end of the course, students will be able to:

CO1	Understand principles of Material handling systems.
CO2	Explain various components of Material handling systems.
CO3	Understand the working of different conveying machineries.
CO4	Appreciate the different hoisting machinery and equipment.
CO5	Understand the ergonomics of material handling equipment's.
CO6	Explain the basics of process and product layout.

Course Contents:

Unit 1: Introduction to Material Handling Requirements of good material handling system, Objectives and principles of Material handling, Classification of material handling equipment's, Selection of material handling equipment's, Guidelines for effective utilization of material handling equipment's, Characteristics and classification of materials.	[7]

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Unit 2: Components of material handling Flexible hoisting appliances - fastening methods - Load handling attachments , Classification of hooks, forged - eye hook - Appliances for suspending hooks- crane grab for unit and piece loads- electric lifting magnet - vacuum lifter - Grabbing attachment for loose materials - crane attachment for handling liquids - Arresting gear – brakes - construction - working - electromagnetic shoe brakes	[7]
Unit 3: Conveyor Equipments Classification of conveyor systems, Types of Belt conveyor, Chain conveyor, Roller conveyor, Pneumatic conveyors. Parts of conveyor, Surface transport equipment - functions - working of trackless equipment - hand operated trucks - powered trucks - tractors, AGV (Automatic Guided Vehicle), Industrial trailers.	[6]
Unit 4: Hoisting machinery and equipments Working of different type of hoists - Working of different types of cranes - Working of elevating equipments.	[6]
Unit 5: Maintenance and Ergonomics of material handling equipments. Methods to minimize cost of material handling- Maintenance of material handling equipments, safety in handling & ergonomics of material handling equipment. Design, miscellaneous equipments.	[6]
Unit 6: Plant Layout Introduction – Objectives of plant layout, classification of layout, advantages and limitations of different layouts, layout design procedures, over view of the plant layout. Process lay out and product lay out selection, Factors influencing layout.	[6]

Text Books:

1. Material Handling Equipment -R.B. Chowdary & G.N.R.Tagore (Khanna Publishers,Delhi)
2. Material Handling - Immer J.R (McGraw Hill, Newyork)
3. Materials Management: Text and Cases, 3rd ed. - Chitale & Gupta
4. Handbook of Materials Management, 2nd ed. - Gopalakrishnan & Haleem
5. Plant layout & Material Handling- Apple J.M (John Wiley Publishers

Reference Books:

1. Allegri, T.H., ''Materials Handling: Principles and Practice'', CBS Publishers Distributors, N. Delhi.
2. Apple, J.A., ''Material Handling System Design'', John Wiley & Son

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Basket C: Data Structure

23MTMDC2	MDM	Data Structure	3-0-0	3 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs/week	CA –I :10 Marks CA –II :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: *Computer Architecture and Organization, C Programming*

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

CO1	Explain struct, enum data types
CO2	Interpret linear and circular linked lists
CO3	Make use of stack & queue ADTs
CO4	Demonstrate searching and sorting methods
CO5	Illustrate various terminologies and traversals of trees and use them for various applications
CO6	Analyze graph terminologies and graph traversals

Course Contents:

Unit 1: Introduction to Data Structures Enumerated, Structure Types– The Type Definition (typedef), Enumerated types, Structures – Declaration, initialization, accessing structures, operations on structures	[6]
Unit 2: Linked Lists Introduction to Data Structures, abstract data types. Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, circularly linked lists- Operations for Circularly linked lists.	[7]

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SIT COE,Yadrav

Unit 3: Stacks and Queues Stack ADT- definition, operations, array, applications-infix to postfix conversion, Postfix expression evaluation Queue ADT- definition and operations, Circular queues Insertion and deletion operations	[7]
Unit 4: Searching and Sorting Searching-linear and binary search methods Sorting- selection sort, bubble sort, insertion sort Comparison of sorting and searching methods.	[6]
Unit 5: Trees Definition, tree representation, properties of trees, Binary tree, Binary tree representation, binary tree properties, binary tree traversals, applications of trees.	[6]
Unit 6: Graphs Basic Concepts & terminology, Sequential representation of graphs; Adjacency matrix, Path matrix, Operations on graph	[6]

Text Books:

1. Seymour Lipschutz, Data Structure with C, Schaum's Outlines, Tata Mc Graw Hill. ISBN10: 1259029964
2. E Balgurusamy - Programming in ANSI C, Tata McGraw-Hill, Third Edition. ISBN-10: 1259004619.
3. Yedidyah Langsam, Moshe J Augenstein, Aaron M Tenenbaum – Data structures using C and C++ - PHI Publications, Second Edition). ISBN 10: 8120311779.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Books Source. ISBN 10: 0716782928.
2. Richard F. Gilberg & Behrouz A. Forouzan, Data Structures A Pseudocode Approach with C, Cengage Learning, second edition. ISBN-10: 0534390803.

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Aptitude Skills II- (Numerical Ability)

23HSSM03	VEC	Aptitude Skills- II	1-0-0	1 Credit

Teaching Scheme:	**Examination Scheme:**
Lecture: 1hr/week	CA-I:25 Marks CA-II:25 Marks

Pre-Requisites: English Communication

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

1	Make use of multiplications, squares, square roots, cubes and cube roots to solve aptitude problems
2	Solve questions based on Number system
3	Solve questions based on percentage, average, ratio, proportion, Speed, Time and Distance
4	Solve questions based on Profit & Loss and mensuration.

Course Contents:

Unit 1	**Speed Math Techniques** Multiplication, Squares, Square roots, Cubes, Cube roots	[3]
Unit 2	**Number System** Types of Number System, Last Digit Method, BODMAS Calculation, HCF and LCM, Progressions	[3]
Unit 3	**Basic Aptitude** Percentage, Average, Ratio and Proportion, Fraction, Partnership **Speed- Time- Distance** Speed, Time, and Distance, Trains, Boats, Streams, Races	[3]
Unit 4	**Business Aptitude** Profit & Loss, Simple Interest, Compound Interest **Geometry and Venn Diagram** 2D and 3D Mensuration, Venn diagram	[3]

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Text Books:

1. Arun Shrama - Quantitative aptitude for CAT.
2. RS Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publisher; 2016 edition

Reference Books:

1. Fast Track Objective Arithmetic Paperback, by Rajesh Verma – 2018
2. Teach Yourself Quantitative Aptitude, Arun Sharma
3. The Pearson Guide To Quantitative Aptitude For Competitive Examination by Dinesh Khattar

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Language Skill- II

23HSSM04	HSMC	Language Skill- II	0-0-2	1 Credit

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs./week	*CA-I: 25* CA-II: 25

Pre-Requisites: Language Skill I

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

CO1	Develop programs using Functions.
CO2	Make use of Structures & Union to develop programs in C language
CO3	Make use of Pointers to develop programs in C language
CO4	Develop programs to perform various operations on files using File Handling.

List of Experiments:

1.Develop programs on using different built-in functions.

2.Develop programs on using function without argument and without return category.

3.Develop programs on using function with argument and without return category.

4.Develop programs on using function without argument and with return category.

5.Develop programs on using function with argument and with return category.

6.Develop programs using more than one used defined functions.

7.Develop programs on recursion.

8.Develop programs on Structure using various entities and size of structure.

9.Develop programs on array of structure.

10.Develop programs on structures and functions and compare structure and union.

11.Develop programs to display different data type of data and their addresses using pointer

12.Develop programs on pointer to array, pointer to structure, pointer to functions and pointer expressions.

13.Develop program to read, write and append data from a file.

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Text Books:

1. C Programming Absolute Beginner's Guide, Que Publishing; 3rd edition (22 August 2013)
2. C Programming Language 2nd Edition, Peasrson Publication

Reference Books:

1. Programming in C Practical Approach by Ajay *Mittal, Pearson*
2. Let Us C, By Yashwat Kanetkar

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Environmental Sciences

23MT2407	VEC	Environmental Sciences	2-0-0	2 Credit

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week	CA-I: 25 Marks CA-II: 25 Marks

Pre-Requisites: NA

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

CO1	Explain nature of environmental studies
CO2	Explain various natural resources and associated Problems
CO3	Summarize various ecosystems
CO4	Explain the importance of conservation of biodiversity and its importance in balancing the earth.
CO5	Recognize various causes of environmental pollution along with various protection acts in India to limit the pollution
CO6	Interpret the information based on field study and prepare a report.

Course Contents

Unit 1: Nature of Environmental studies: Definition, scope and importance, Multidisciplinary nature of environmental studies. Need for public awareness.	[3]
Unit 2: Natural Resources and Associated Problems **Forest resources:** Use and over-exploitation, deforestation, dams and their effects on forests and tribal people. **Water resources:** Use and over-utilization of surface and ground water, floods, conflicts over water. **Mineral resources:** Usage and exploitation. Environmental effects of extracting and using mineral resources. **Energy resources:** Growing energy needs, renewable and nonrenewable energy resources, use of alternate energy sources. Solar energy, Biomass energy, Nuclear energy. **Land resources:** land degradation, man induced landslides, soil erosion and desertification. Role of individuals in conservation of natural resources.	[5]
Unit 3: Ecosystems Concept of an ecosystem, types of ecosystem, structure and function of an ecosystem, producers, consumer and decomposers. Energy flow in the ecosystem, food chain, food web and ecological pyramids, ecological succession. Different types of ecosystem a) Forest ecosystem b)Grassland ecosystem c)Desert ecosystem d)Aquatic ecosystem	[4]

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Unit 4: Biodiversity Introduction-Definition: genetic, species and ecosystem diversity, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Western Ghats as a biodiversity region Hot spot of biodiversity. Threats to biodiversity, man and wildlife conflicts. Conservation of biodiversity. In-situ conservation and Ex-situ conservation.	[4]
Unit 5: Environmental Pollution and Environmental Protection Definition: Causes, effects and control measures of various types of pollution. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, Concept of sustainable development : From Unsustainable to Sustainable development. Environmental Protection Act. Air (Prevention and Control of pollution) Act. Water (Prevention and Control of pollution) Act. Forest conservation Act. Wildlife Protection Act. Human Rights.	[4]
Unit 6: Field work Visit to a local area to document Environmental assets-River ,Forest ,Grassland Visit to local polluted site Study of common plants, insects, birds Study of ecosystem river, ponds etc	[4]

Text Books :

1. P. N. Wartikar & amp; J. N. Wartikar, A Text Book of Applied Mathematics (Vol I & II), Pune Vidyarthi Griha Prakashan, Pune.
2. 2. N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publications, New Delhi.

Reference Books:

1.C. R. Wylie & L. C. Barrett, Advanced Engineering Mathematics, McGraw Hill Publishing Company Ltd.
2. B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publications, New Delhi.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
5. Peter O" Neil, A Text Book of Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore.

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Account and Finance Management

23MT2408	HSSM	Account and Finance Management	2-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: -2 hrs./week	*CA-I:* 25 Marks CA-II: 25 Marks

Pre-Requisites: None

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

CO1	Understand and define basic terminology used in finance and account
CO2	Prepare and analyze financial statements and evaluate company in the light of different
CO3	Analyze risk and return of alternative sources of financing
CO4	Estimate cash flows from a project, including operating, net working capital, and capital spending
CO5	To estimate the required return on projects of differing risk, to estimate the cash flows from an investment project, calculate the appropriate discount rate, determine the value added from the project, and make a recommendation to accept or reject the project
CO6	To describe and illustrate the important elements in project finance Using financial calculator and Excel in a variety of problems

Course Contents:

Unit 1: Introduction to Financial Accounting, Book keeping and Recording: Meaning, Scope and importance of Financial Accounting. Financial Accounting – concepts and conventions, classification of accounts, Rules and principles governing Double Entry Book-keeping system, Meaning, Preparation of Journal, Ledger , Cash book and Trial balance. (Practical application on tall)	[4]
Unit 2: Financial Statement Preparation, analysis and Interpretation: Preparation of financial statement and Profit and Loss Account, Balance Sheet, Ratio Analysis - classification of various ratios. (Calculation on Excel)	[4]

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Unit 3: Introduction To Financial Management: Concept of business finance, Goals and objectives of financial management, Sources of financing – LONG TERM: shares, debentures, term loans, lease and hire purchase, retained earnings, public deposits, bonds (Types, features and utility), SHORT TERM: bank finance, commercial paper, trade credit and bills discounting, INTERNAL: Retained earnings.	[4]
Unit 4: Working Capital Management: Concept of Working Capital, significance, types. Adequacy of working capital, Factors affecting working capital needs, Financing approaches for working capital, Methods of Forecasting working capital requirements ,mini and importance of accounts receivable	[4]
Unit 5: Time value of money and capital budgeting: Concept of time value of money, compounding and discounting; future value of single amount and annuity ,present value of single amount and annuity; practical application of time value techniques. capital budgeting -nature and significance, technique of capital budgeting- Pay back method, accounting rate of return, internal rate of return ,DCF, net present value and profitability index(application on excel)	[4]
Unit 6: Project financing: Details of the company, its promoters and project finance required ,etc. loan documentation- appraisal of terms loans by finance institution. Basic components of project finance	[4]
Text Books 1. Financial ,cost and management accounting by Dr.P.Pariasamy,HH Publication 2. Financial management by Khan and Jain Tata McGraw Hill 3. Financial management by Dr.P.C.Tulsian and, S. Chand 4. Financial management by Ravi Kishore Taxmann	

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Mini Project-III

23MT2409	CEP	Mini Project III	0-0-2	01 Credit

Teaching Scheme	Examination Scheme
Practical: 2 hrs/week	CA-I: - 25 Marks CA-II: -25 Marks

Pre-Requisites: Mini Project I, Mini Project II

About Hackathon

The project is a part of addressing societal and industrial needs. Hackathon is one of the platforms where students will solve real world challenges. This Course focuses on the selection of methods/engineering tools/analytical techniques for problem solving.

Through this course, students will gain the understanding of engineering basics and ideas, gain practical experience, have the opportunity to display their skills and learn about teamwork, financial management, communication skills and responsibility

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

CO1	Select the appropriate method for solving the problem
CO2	Make use of various engineering techniques and tools to give a solution
CO3	Justify the methods /tools used to develop the solution
CO4	Design / simulate the model/ project work
CO5	Describe the solution with help of a project report and presentation
CO6	Conclude the outcomes of project.

Course Contents:

Week 1: Survey Design-1 • Ensure case study group students have made necessary communication and done a preparatory visit. • Watch the lecture on survey design and study the notes. • Prepare a questionnaire and try it out with your group members as mock.	[2]

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Week 2: Survey Design-2 • Review survey questionnaire prepared by case study groups. • Decide sampling strategy. • Prepare a detailed schedule for fieldwork	[2]
Week 3: Fieldwork • Data Collection: Collect quantitative data (e.g., statistics, usage metrics) and qualitative data (e.g., user stories, testimonials). • Use data collection tools like questionnaires, observation checklists, and digital analytics. • Ensure data accuracy and reliability through proper sampling and recording methods.	[2]
Week 4: Trails and Experimentation-1 • Initial Setup and Configuration • Concept Validation • Feasibility Testing	[2]
Week 5: Trails and Experimentation-2 • Prototyping • Functionality Testing	[2]
Week 6: Trails and Experimentation-3 • Bug Identification and Fixing • Integration Testing • Security Testing • 75% Presentation has to be conducted by mentor/guide based on above activity.	[2]
Week 7: Results • Coordinator has to check and verify below points in term of result: • Functional Performance • Accuracy and Precision • Efficiency • Safety	[2]
Week 8: Validation • Coordinator has to check and verify below points in term of validation: • Testing and Verification • Compliance with Standards	[2]
Week 9: Integration Testing • Validate that the hardware integrates seamlessly with other systems or components as intended • Perform compatibility tests with software, other hardware, and network systems.	[2]

Week 10: Documentation and Reporting • Maintain comprehensive documentation of design, development, testing, and validation processes • Provide detailed reports on test results, issues found, and corrective actions taken.	[2]
Week 11: Final Presentation • 100% Presentation has to be conducted by mentor/guide based on above activity. • Prototype/Final Software solution is mandatory at the time of final presentation along with report	[2]
Week 12: Exhibition • Mini project exhibition will be schedule with interdepartmental evaluation.	[2]

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