SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3351	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2.	ME3351	Engineering Mechanics	ESC	3	0	0	3	3
3.	MR3351	Fluid Mechanics and Thermal Systems	ESC	4	0	0	4	4
4.	MR3391	Digital Electronics and Microprocessor	PCC	3	0	0	3	3
5.	MR3392	Electrical Drives and Actuators	PCC	3	0	0	3	3
6.	RA3301	Robot Kinematics	PCC	3	0	0	3	3
PRACTICALS								
7.	MR3361	Electrical Drives and Actuators Laboratory	PCC	0	0	4	4	2
8.	RA3311	Robot Modelling and Simulation Laboratory	PCC	0	0	4	4	2
9.	GE3361	Professional Development $	EEC	0	0	2	2	1
			TOTAL	**19**	**1**	**10**	**30**	**25**

$ **Skill Based Course**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	ME3493	Manufacturing Technology	PCC	3	0	0	3	3
2.	RA3401	Design of Robot Elements	PCC	3	0	0	3	3
3.	MR3491	Sensors and Instrumentation	PCC	3	0	0	3	3
4.	MR3452	Control Systems Engineering	PCC	3	0	2	5	4
5.	MR3591	Fluid Power Systems and Industrial Automation	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2#		3	0	0	3	3#
PRACTICALS								
8.	ME3382	Manufacturing Technology Laboratory	PCC	0	0	4	4	2
9.	MR3461	Sensors and Instrumentation Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**0**	**10**	**27**	**22**

NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

11. 3D modelling of 2 Wheeled skid steering Mobile Robot.
12. 3D modelling of 4 Wheeled 2 steering Mobile Robot.
13. 3D modelling of 4 Wheeled 4 steering Mobile Robot.
14. Study on Harmonic Gear drive.

(ANY 10 EXPERIMENTS)

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of this course, the students will be able to;

1. Identify components and physical features of various parts for a robot system and sub systems.
2. Model components and physical features of various parts for a robot system and sub systems.
3. Create a CAD and simulation model for a robot system and sub systems.

EQUIPMENT

1. Computers – 30no's
2. CAD modelling packages – open source/ licensed – 30 users

CO-PO MAPPING:

Mapping of COs with POs and PSOs															
COs/Pos &PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1								1	2	2	3
CO2	3	2	1	1								1	2	2	3
CO3	3	2	1	1								1	2	2	3
CO/PO & PSO Average	3	2	1	1								1	2	2	3
1 – Slight, 2 – Moderate, 3 – Substantial															

ME3493 **MANUFACTURING TECHNOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To study the concepts and basic mechanics of metal cutting and the factors affecting machinability
2. To learn working of basic and advanced turning machines.
3. To teach the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
4. To study the basic concepts of CNC of machine tools and constructional features of CNC.
5. To learn the basics of CNC programming concepts to develop the part programme for Machine centre and turning centre

UNIT I MECHANICS OF METAL CUTTING **9**

Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II TURNING MACHINES 9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle

UNIT III RECIPROCATING MACHINE TOOLS 9

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters– machining time calculation - Gear cutting, gear hobbing and gear shaping – gear finishing methods

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods

UNIT IV CNC MACHINES 9

Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to-point/continuous - Turning and machining centres – Work holding methods in Turning and machining centres, Coolant systems, Safety features.

UNIT V PROGRAMMING OF CNC MACHINE TOOLS 9

Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Apply the mechanism of metal removal process and to identify the factors involved in improving machinability.
2. Describe the constructional and operational features of centre lathe and other special purpose lathes.
3. Describe the constructional and operational features of reciprocating machine tools.
4. Apply the constructional features and working principles of CNC machine tools.
5. Demonstrate the Program CNC machine tools through planning, writing codes and setting up CNC machine tools to manufacture a given component.

TEXT BOOKS:

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2009.
2. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 3rd edition, 2013.

REFERENCES:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. GeofreyBoothroyd, “Fundamentals of Metal Machining and Machine Tools”, McGraw Hill, 1984. Rao. P.N “Manufacturing Technology,” Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2003.
3. A. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.
4. Peter Smid, CNC Programming Handbook, Industrial Press Inc.,; Third edition, 2007

Mapping of COs with POs and PSOs															
COs/Pos &PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	1	1	1	3			3		2	3	3	2
CO2	3	3	3	1	1	1	3			3		2	3	2	2
CO3	3	3	3	1	1	1	3			3		2	3	2	2
CO4	3	3	2	1	1	1	3			3		2	3	2	2
CO5	3	3	3	1	1	1	3			3		2	3	2	3
CO/PO & PSO Average	3	3	3	1	1	1	3			3		2	3	2	3
1 – Slight, 2 – Moderate, 3 – Substantial															

RA3401 **DESIGN OF ROBOT ELEMENTS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To introduce the students to the fundamentals of machine design, material selection and to solve the basic design problems.
2. To learn to derive various parameters for modelling links and joints in a robot.
3. To learn about Fundamentals of Computer Graphics
4. To learn and understand curves and surfaces in robot modelling.
5. To learn to derive various parameters for modelling end-effectors of a robot

UNIT I FUNDAMENTALS OF MECHANICAL DESIGN **9**

Fundamentals of Machine Design-Engineering Design, Phases of Design, Design Consideration - Standards and Codes - Design against Static and Dynamic Load –Modes of Failure, Factor of Safety, Principal Stresses, Theories of Failure-Stress Concentration, Stress Concentration Factors, Variable Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria.

UNIT II DESIGN OF LINKS AND JOINTS **9**

Loads and Forces on Links and Joints - Design of solid and hollow shafts - Rigid and flexible couplings -Threaded fasteners - rolling contact bearings— Links Design: Path and Motion Synthesis – Cognate Linkages – Design of Spherical Joints.

UNIT III FUNDAMENTALS OF COMPUTER GRAPHICS **9**

Product cycle- Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation.

UNIT IV CURVES AND MODELLING **9**

Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Fundamentals of solid modeling, Different solid representation schemes, Half -spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation, Analytic solid modeling, Perspective, Parallel projection, Hidden line removal algorithms.

UNIT V DESIGN OF GRIPPERS **9**

Grippers – Types of Grippers Mechanisms – Gripping Methods – Gripping Force analysis – Gripper Design – Two Finger gripper – Three Finger Gripper – Magnetic Gripper Design – Vacuum Gripper Design – Hooks – Scoops – Spools – Miscellaneous Grippers

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. State the design parameters for designing the components of a robot.
2. Apply the CAD modelling techniques in designing a Robot
3. Analyse the design parameters for designing the components of a robot.
4. Formulate the methods for designing the entire robot assembly
5. Create a Robot CAD Model.

Mapping of COs with POs and PSOs															
COs/Pos &PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1								1	2	2	3
CO2	3	2	1	1								1	2	2	3
CO3	3	2	1	1								1	2	2	3
CO4	3	2	1	1								1	2	2	3
CO5	3	2	1	1								1	2	2	3
CO/PO & PSO Average	3	2	1	1								1	2	2	3
1 – Slight, 2 – Moderate, 3 – Substantial															

TEXT BOOKS:

1. Joseph Edward Shigley, Charles R. Mischke "Mechanical Engineering Design", McGraw Hill, International Edition, 1992
2. Sharma. C.S. and Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India Private Limited, 2003
3. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 2nd edition, 2008
4. Ashby. M.F., "Materials Selection in Mechanical Design", Third edition, Butterworth-Heineman, New York, 16th edition, 2012

REFERENCES:

1. Bhandari. V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Limited, 2003.
2. Robert L. Norton, "Machine Design – An Integrated Approach", Prentice Hall International Edition, 2000.
3. Charles. J. A. and Crane. F. A. A, "Selection and Use of Engineering Materials", second edition, Butterworth-Heinemann Ltd., 3rd edition 2005.
4. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, 7th Reprint, 2011.
5. Mikell P. Groover, "Industrial Robotics", McGraw Hill, 2nd edition, 2012.
6. Dragomir N. Nenchev, Atsushi Konno, Teppei Tsujita, "Humanoid Robots: Modelling and Control", Butterworth-Heinemann, 2018
7. Zeid, I., CAD/CAM, McGraw Hil , 2008.

3 0 0 3

COURSE OBJECTIVES:

1. To understand the concepts of measurement technology.
2. To learn the various sensors used to measure various physical parameters.
3. To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development
4. To learn about the optical, pressure and temperature sensor
5. To understand the signal conditioning and DAQ systems

UNIT I INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 8

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 10

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Recognize with various calibration techniques and signal types for sensors.

CO2: Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.

CO3: Apply the various sensors and transducers in various applications

CO4: Select the appropriate sensor for different applications.

CO5: Acquire the signals from different sensors using Data acquisition systems.

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co, 12th edition New Delhi, 2013.

REFERENCES

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001.

2. Hans Kurt Tönshoff (Editor), Ichiro, "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
4. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

Mapping of COs with POs and PSOs															
COs/POs & PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	2	2	1						1	2	1	3
CO2	3	2	1	2	2	1						1	2	1	3
CO3	3	2	1	1	2	1						1	2	1	3
CO4	3	2	1	3	2	1						1	2	1	3
CO5	3	2	1	3	2	1						1	2	1	3
CO/PO & PSO Average	3	2	1	2.2	2	1						1	2	1	3
1 – Slight, 2 – Moderate, 3 – Substantial															

MR3452 **CONTROL SYSTEMS ENGINEERING** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

1. To introduce the components and their representation of control systems
2. To learn various methods for analyzing the time response, frequency response and stability of the systems.
3. To learn the various approach for the system frequency analysis
4. To understand the concept of stability analysis
5. To know about the state variable methods of control system analysis

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs

UNIT II TIME RESPONSE ANALYSIS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot-Design of compensators using Bode plots- Cascade lead, lag and lag-lead compensation.

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability

TOTAL: 45 PERIODS

CONTROL SYSTEMS LABORATORY

Experiments

1. Mathematical Modelling and Simulation of a Physical Systems and Simulation and Reduction of Cascade and Parallel, and Closed Loop Sub-System.
2. Simulation and Analysis of First and Second Order System Equations in Time and Frequency Domain.
3. Simulation and Analysis of System using Root-Locus and Bode Plot.
4. Simulation and Implementation of PID Combination for First Order Systems.
5. Simulation and Implementation of PID Combination Second Order Systems.
6. Auto tuning of PID parameters and analysis of PID Control.

TOTAL : 30 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: State the various control terminologies and concepts.

CO2: Know the procedures in developing the transfer function, state space models and time and frequency domain analysis methods.

CO3: Apply the procedures on developing the systems in transfer function and state space approach and apply to evaluate the performance of system in time and frequency domain techniques.

CO4: Illustrate the time and frequency response characteristics of system response.

CO5: Analyze the performance of system using various time and frequency domain techniques.

TEXT BOOKS:

1. M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
2. K.Ogata, "Modern Control Engineering", PHI, 5 th Edition, 2012.

REFERENCES:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.
2. S.K.Bhattacharya, "Control System Engineering", Pearson, 3 rd Edition, 2013.
3. Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition,1995.
4. Nagoor Kani, "Conrol Systems", RBA Publications, 2017.
5. Norman. S. Nise, "Control Systems Engineering", Wiley India edition, 2018.

TOTAL : 45(L) + 30(P) = 75 PERIODS

Mapping of COs with POs and PSOs															
COs/POs & PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1	2	1						1	2	1	3
CO2	3	2	1	1	2	1						1	2	1	3
CO3	3	2	1	1	2	1						1	2	1	3
CO4	3	2	1	1	2	1						1	2	1	3
CO5	3	2	1	1	2	1						1	2	1	3
CO/PO & PSO Average	3	2	1	1	2	1						1	2	1	3
1 – Slight, 2 – Moderate, 3 – Substantial															

MR3591 FLUID POWER SYSTEMS AND INDUSTRIAL AUTOMATION L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To recognize the standard symbols and to understand the functions of basic fluid power generation and actuation elements.
2. To realize the functions of fluid regulation and control elements and its typical uses in fluid power circuit and to acquire the practice on assembling the various types of pneumatic circuits.
3. To familiar and exercise the design procedure of various types of pneumatic and hydraulic fluid power circuits and to provide a training to create the various types of hydraulic circuits.
4. To learn about the fundamentals of Programmable Logic Controller.
5. To familiarize the Data Communication and Supervisory Control Systems.

UNIT I FLUID POWER SYSTEM GENERATION AND ACTUATORS 9

Need For Automation, Classification of Drives - Hydraulic, Pneumatic and Electric – Comparison – ISO Symbols for their Elements, Selection Criteria. Generating Elements- Hydraulic Pumps and Motor Gears, Vane, Piston Pumps – Motors - Selection and Specification - Drive Characteristics – Utilizing Elements - Linear Actuator – Types, Mounting Details, Cushioning – Power Packs – Accumulators.

UNIT II CONTROL AND REGULATIING ELEMENTS 9

Control and Regulating Elements — Direction, Flow and Pressure Control Valves -Methods of Actuation, Types, Sizing of Ports. Spool Valves - Operating Characteristics -Electro Hydraulic Servo Valves - Types - Characteristics and Performance.

UNIT III CIRCUIT DESIGN FOR HYDRAULIC AND PNEUMATICS 9

Typical Design Methods – Sequencing Circuits Design - Combinational Logic Circuit Design - Cascade Method – KV Mapping - Electrical Control of Pneumatic and Hydraulic Circuits - Use of Relays, Timers, Counters and PLC in pneumatics and hydraulics

UNIT IV PROGRAMMABLE LOGIC CONTROLLER 9

Industrial Automation - Programmable Logic Controller - Functions of PLCs - Features of PLC - Selection of PLC - Architecture – IEC61131-3 programming standard and types - Basics of PLC Programming – Ladder Logic Diagrams – Communication in PLC – Programming Timers and Counters – Data Handling - PLC modules – Advanced motion controlled Multi Axis PLC

UNIT V DATA COMMUNICATION AND SUPERVISORY CONTROL SYSTEMS 9

Industrial Data Communications — Modbus – HART – DeviceNet – Profibus – Fieldbus – RS232- RS485- Modbus/ Modbus TCP/IP - mechatrolink – CAN – Ether CAT - Introduction to Supervisory Control Systems – SCADA - Distributed Control System (DCS) – Safety Systems – human machine interfaces - Total Integrated Automation (TIA) – Industry 4.0.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Recognize the various concepts of fluid power and PLC systems.
CO 2: Comprehend functions of fluid power and PLC systems.
CO 3:Explain the various standard fluid power circuits, functions, communication and IO details of PLC.
CO 4: Demonstrate the standard fluid power circuits and PLC based interfaces.
CO 5: Construct the fluid power circuits and PLC based automation system.

TEXT BOOKS:

1. Antony Esposito, "Fluid Power Systems and Control", Prentice-Hall, 2006.
2. Peter Rohner, "Fluid Power Logic Circuit Design", the Macmillan Press Ltd., London, 1979.
3. Frank D, Petruzella, "Programmable Logic Controller" McGraw – Hill Publications, Fourth Edition, 2016.

REFERENCE BOOKS:

1. Lucas, M.P., "Distributed Control System", Van Nastrand Reinhold Company, New York, 1986.
2. Mackay S., Wrijut E., Reynders D. and Park J., "Practical Industrial Data Networks Design, Installation and Troubleshooting", Newnes Publication, Elsevier, First Edition, 2004.
3. Patranabis. D, "Principles of Industrial Instrumentation", Tata McGraw-Hill Publishing Ltd., New Delhi, 1999.

Mapping of COs with POs and PSOs

COs/POs & PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	2							1	3	2	3
CO2	3	2	1	1	2							1	3	2	3
CO3	3	2	1	1	2							1	3	2	3
CO4	3	2	1	1	2							1	3	2	3
CO5	3	2	1	1	2							1	3	2	3
CO/PO & PSO Average	3	2	1	1	2							1	3	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

GE3451 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY L T P C 2 0 0 2

COURSE OBJECTIVES:

1. To study the nature and its impacts on human life.
2. To study the environmental pollution, its types, control methods and protection acts
3. To provide the knowledge of about the energy management and energy resources
4. To study the concepts of Sustainability, global warming and Management
5. To study the Sustainability Practices and socio economical changes

UNIT I ENVIRONMENT AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 9

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY 9

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 9

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 9

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1.Understand the nature and its impacts on human life.
2.The students have the knowledge and awareness of Environmental Pollution.
3.Understanding of the energy sources and scientific concepts/principles behind them
4.Understand the concepts of the Sustainability and Management
5. Understand the Sustainability Practices and socio economic changes

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38, 2008.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

ME3382	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

1. To Selecting appropriate tools, equipment's and machines to complete a given job.
2. To Performing various welding process using GMAW and fabricating gears using gear making machines.
3. To Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling and analyzing the defects in the cast and machined components.

LIST OF EXPERIMENTS

1. Fabricating simple structural shapes using Gas Metal Arc Welding machine.
2. Preparing green sand moulds with cast patterns.
3. Taper Turning and Eccentric Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
6. Drilling and Reaming using vertical drilling machine.
7. Milling contours on plates using vertical milling machine.
8. Cutting spur and helical gear using milling machine.
9. Generating gears using gear hobbing machine.
10. Generating gears using gear shaping machine.
11. Grinding components using cylindrical and centerless grinding machine.
12. Grinding components using surface grinding machine.
13. Cutting force calculation using dynamometer in milling machine
14. Cutting force calculation using dynamometer in lathe machine

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1.	Centre Lathes	7 Nos.
2.	Shaper	1 No.
3.	Horizontal Milling Machine	1 No.
4.	Vertical Milling Machine	1 No.
5.	Surface Grinding Machine	1 No.
6.	Cylindrical Grinding Machine	1 No.
7.	Radial Drilling Machine	1 No.
8.	Lathe Tool Dynamometer	1 No.
9.	Milling Tool Dynamometer	1 No.
10.	Gear Hobbing Machine	1 No.
11.	Gear Shaping Machine	1 No.
12.	Arc welding transformer with cables and holders	2 Nos.
13.	Oxygen and Acetylene gas cylinders, blow pipe and other welding outfit	1 No.
14.	Moulding table, Moulding equipments	2 Nos.

TOTAL:60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Demonstrate the safety precautions exercised in the mechanical workshop and join two metals using GMAW.
2. The students able to make the work piece as per given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.
3. The students become make the gears using gear making machines and analyze the defects in the cast and machined components

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3						1		2			1	1	2	2
2	3						1		2			1	1	2	2
3	3						1		2			1	1	2	2
Low (1) ; Medium (2) ; High (3)															

MR3461 SENSORS AND INSTRUMENTATION LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES

1. To learn about various force, pressure and vibration measuring sensors.
2. To learn about various Temperature, light and magnetic field measuring sensors
3. To learn about various displacement and speed measuring sensors.

LIST OF EXPERIMENTS:

SENSORS AND INSTRUMENTATION

1. Determination of Load, Torque and Force using Strain Gauge.
2. Determination of the characteristics of Pressure Sensor and Piezoelectric Force Sensor
3. Determination of Displacement using LVDT.
4. Determine the Characteristics of Various Temperature Sensors.
5. Determine the Characteristics of Various Light Detectors (Optical Sensors).
6. Distance Measurement using Ultrasonic and Laser Sensor.
7. Determine angular velocity of gyroscope,
8. Vibration measurement using Accelerometer.
9. Direction measurement using Magnetometer.
10. Speed, Position and Direction Measurement Using Encoders.
11. Force measurement using 3 axis force sensor.
12. Force Measurement using tactile sensors.
13. Data acquisition, visualization and analysis of signals.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon the completion of this course, the students will be able to;
CO1: Demonstrate the various contact and non-contact sensors.
CO2: Analyze and Identify appropriate sensors for given applications.
CO3: Create a sensor system for given requirements.

Mapping of COs with POs and PSOs

COs/POs & PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	2	1						1	2	1	3
CO2	3	2	1	1	2	1						1	2	1	3
CO3	3	2	1	1	2	1						1	2	1	3
CO/PO & PSO Average	3	2	1	1	2	1						1	2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial

Equipment List

1. Load, Torque and Force using Strain Gauge – 3 Nos
2. Pressure Sensor and Piezoelectric Force Sensor- 1 No's
3. LVDT setup – 1 No.
4. Temperature Sensors measurement setup with RTD, Thermocouple and Thermistor -1 No.
5. Measurement setup Optical Sensors LDR, Photo transistor, photo diode – 1 each
6. Measurement setup -Ultrasonic and Laser Sensor- 1 No.
7. Gyroscope measurement setup - 1 No.
8. Accelerometer measurement setup - 1 No.