COURSE STRUCTURE

B.TECH. MECHANICAL ENGINEERING

(Specialization in Mechatronics Engineering)

Under

Choice Based Credit System (CBCS)

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS	PRE-REQUISITES
			L	T	P	J			
Bouquet:									
THEORY									
1	BME E0206	Mechanical Vibration	3	0	0	0	3	3	
2	BME E0309	Manufacturing Systems Simulation	3	0	0	0	3	3	
3	BME E0307	Computer Integrated Manufacturing	3	0	0	0	3	3	
4	BME E0308	Design for Manufacturing & Assembly	3	0	0	0	3	3	
5	BME E0506	Sensors and Actuators	3	0	0	0	3	3	
6	BME E0505	Fundamental of Mechatronics and applications	3	0	0	0	3	3	
7	BMEE 0306	Additive Manufacturing	3	0	0	0	3	3	
8	BMEE 0507	Home Automation and Control	3	0	0	0	3	3	

BME E0206 MECHANICAL VIBRATION

Pre-requisite: *Theory of Machines*

Objective:

1. *To understand the basic concepts and behavior of vibrations in machines*
2. *To understand the determination of frequencies and other parameters in single degree and two degree vibration systems*
3. *To understand to determine the critical speeds of rotating shafts*
4. *To understand how to apply the different measures for controlling the machine vibrations and noise*

Credits: 03 **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**Unit-1: Single Degree of Freedom Systems-Free Vibrations** Introduction to vibration, definitions and basic concepts, degree of freedom, types of vibrations, S.H.M., Fourier analysis. Undamped free vibrations, spring mass system, equivalent stiffness of spring combinations, longitudinal vibrations, transverse vibrations, torsional vibrations; illustrative examples; Damped free vibrations, types of damping, free vibrations with viscous damping, logarithmic decrement, dry friction or coulomb damping, illustrative examples. **Unit-2: Single Degree of Freedom Systems-Forced Vibrations** Forced vibrations with constant harmonic excitation, magnification factor, vibrations with rotating & reciprocating unbalance, vibrations due to excitation of the support, vibrations with coulomb damping, illustrative examples.	19
II	**Unit-3: Two Degree of Freedom Systems** Introduction, principle modes of vibration, spring mass coupled systems, double pendulum, torsional systems; combined rectilinear & angular modes, systems with damping, illustrative examples. Critical speed of a light shaft having a single disc without and with damping, illustrative examples **Unit-4: Vibration Control** Vibration isolation and transmissibility, force transmissibility, motion transmissibility, vibration absorbers, measurement of vibration, vibration measuring instruments, real time frequency processing, vibration control, vibration control for noise reduction, vibration dampers and vibration isolators, illustrative examples.	19

Text Book:

- G. K. Grover," Mechanical Vibrations", Nem chand Publication, New Delhi, 1996
- G. Ambekar, "Mechanical Vibrations and Noise Engineering, PHI, New Delhi,2006
- J. D. Irwin & E. R. Graf, Industrial Noise and Vibration Control, PHI, New Delhi, 2002

Reference Books:

- Den Hartog, "Mechanical Vibrations", Dover Publication, New York, 1986
- Hand Book of Noise and Vibration Control, Trade and Technical Press Ltd., England,2014
- L. L. Faulkhar, "Industrial Noise Control", Industrial Press Inc., New York,2010

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the student will be able to:*

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Ability enhancement in analyzing the machine vibrations in various degree of freedom systems	PO2/PSO1	R&U	F&C	9
2	Determining the various causes of machine vibrations	PO3/PSO1	R&U	C	8
3	Applying the perfect compensatory system to control the vibrations	PO5/PSO1	R&U	C	9
4	Ability enhancement in practically using the different vibrations measuring instruments	PO1/PSO1	R&U	C	8
5	Identification of basic causes of machine failures	PO1/PSO1	U	C	9

BME E0309 MANUFACTURING SYSTEMS SIMULATION

Objective: *The objective of the course is to teach methods and techniques for achieving an effective transformation from requirements and business drivers to technology and product design. The ability to create various simulation models of Manufacturing systems, Job shop with material handling and Flexible manufacturing systems.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Unit-I** **Introduction:** Concepts in discrete –event simulation, Programming for discrete event simulation in GPSS/MATLAB, development of simulation. **Simulation of Material Handling Systems:** Models for various system like queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network. case studies, verification and validation of simulation models.	22
II	**Unit-II** **Simulation of Mechanical Systems:** Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic and pneumatic systems. **Simulation of Manufacturing Systems:** Job shop with material handling and Flexible manufacturing systems, Simulation software for manufacturing, Structure and development of expert systems.	23

Text Book:

- W. Bolton, "Mechatronics – Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd. 1868
- Jerry Banks and John S Carson, Barry L Nelson, David M Nicol, "Discrete event system simulation", Prentice Hall, India, 2009.
- Khoshnevi. B., "Discrete system simulation", McGraw Hill International edition,1994

Reference Books:

- Ronald G Askin and Charles R Standridge, "*Modeling and analysis of manufacturing systems"*, JohnWiley & Sons, 1993.
- Gordon G , "*System Simulation*", Prentice Hall, India, 1995.
- Thomas J Schriber., "*Simulation using GPSS*", John Wiley & Sons, 1991.
- Shannon, R.E., "*System Simulation – The art and science*", Prentice Hall, India, 1993

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the student will be able to:*

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.	PO2/PSO1	U	C	10
2	CO2: Describe the role of important elements of discrete event simulation and modeling paradigm.	PO3/PSO1	U&R	C&F	9
3	Develop skills to apply simulation software to construct and execute goal-driven system models.	PO5/PSO1	U	C	9
4	Recognize sources of errorsin MATLAB.	PO1/PSO1	U&R	C	9
5	Simulation and analysis of various manufacturing systems	PO1/PSO1	Ap	C&F	10

BMEE 0307 COMPUTER INTEGRATED MANUFACTURING

Pre – requisite: *Manufacturing Science-II*

Objective: *Acquire fundamental understanding of the principles of CAM, including CNC programming,Concept of CIM & Robotics.*

Credits: 03 Semester VI L–T–P: 3–0–0

Module No.	Content	Teaching Hours
I	**CIM** Definition, scope and elements of CIM system-benefits, Production system facilities & Manufacturing support systems. **Automation** Reasons for Automating, Automation principles and strategies, Basic elements of an automated system - Levels of automation **NC & CNC TECHNOLOGY:** Fundamental of Numerical Control, Elements of NC Machine Tools,Classification of NC Machine Tools, Advantages and Limitations of NC Machine Tools,Introduction to CNC machine tools, Designation of axis in CNC systems. Feed Back Devices **PART PROGRAMMING:** (A) Manual Programming- G&M codes, Manual part programming for Drilling, Turning and Milling; Canned Cycles.	22
II	**Group technology** Definition, GT-Part family formation Classification and coding-Opitz coding system, Applications & benefits of GT, Cellular manufacturing- Machining cell designs-Machining cell planning, **Computer aided process planning**-Approaches to CAPP-retrieval type CAPP system,generative CAPP system. Computer Aided Inspection and Computer Aided Testing **ROBOTICS:** Robot Anatomy, Laws of Robot, Coordinate system, Specifications of Robot. Power sources, actuators and Transducers, Robotic Sensors, Grippers, Robot Safety, Robot Programming and Robot Applications.	22

Text Books:

- Kundra and Rao, “Computer Aided Manufacturing”, TMH, New Delhi.
- Koren, “Computer control of Manufacturing systems”, TMH, New Delhi.
- Groover Mikell P., “Automation, Production Systems and Computer IntegratedManufacturing”, Prentice Hall Publishers.

Reference Books:

- John Stenerson and Kelly Curran, Computer Numerical Control: Operation and Programming, PHI, New Delhi, 2009
- Tien - Chien Chang, Richard A Wysk and Hsu-Pin Wang, Computer Aided Manufacturing, PHI, New Dellhi,2006

Focus: *This course focuses on Employability/Skill development and aligned with CO’s 1 and 2.*

Outcome: *Upon successful completion of this course, the student will be able to:*

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Understand the need of automation and its strategies used for development in manufacturing. (Understand).	*PO1, PO2, PO3, PO4/ PSO2*	U	C	8
2	Describe basic concepts of CAM application and CIM wheel. (Remember)	*PO1, PO6/PSO2*	U	C	8
3	Develop manual part programs for machining of complex parts. (Apply)	*PO6/ PSO2*	U	R&U	8
4	Illustrate the basic parts and necessity of Robotic system in Industries. (Understand)	*PO1, PO6 / PSO2*	An	C&S	8
5	Understand the concept of group technology & classify using optimize system. (Understand& Apply)	*PO1, PO2/PSO2*	U	R&C	6
6	Describe concept of Computer aided Process planning (Understand)	*PO1, PO2/PSO2*	U	R&U	6

BMEE 0308 DESIGN FOR MANUFACTURING ASSEMBLY

Objective: *the aim of present course is to introduce and aware students about the basic design process which based on different aspects of manufacturing as well as assembly.*

Credits: 03 **Semester VI** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hours
I	**DFMA**: History of DFMA, Steps for applying DFMA during product design, Advantages of applying DFMA during product design, Reasons for not implementing DFMA. **Introduction to Manufacturing Process**: Classification of manufacturing process, Basic manufacturing processes & Mechanical properties of material, Classification ofengineering materials. **Design for machining** Introduction to machining, Recommended materials for machinability, Design recommendations, Design for tuning operation: Process description, Typical characteristics and applications, Suitable materials, Design recommendations, Design for machining round holes: Introduction, Suitable materials, Design recommendations. Parts produced by milling: Process description, Characteristics and applications of parts produced on milling machines, Design recommendations for milling,	22
II	**Sand casting**: Introduction to sand casting, Typical characteristics of a sand cast part, Design recommendation for sand casting, Investment casting: Introduction, Steps in investment casting, Design consideration of Investment casting, Typical characteristics and applications. Design for powder metal processing: Introduction to powder metal processing, Typical characteristics and applications, Limitations, Design recommendations. **Metal Extrusion**: Process, Suitable material for extrusion, Design recommendation for metal extrusion, Metal stamping: Process, Characteristics and application of metal stamping, Suitable materials for stamping, Design Recommendations for metal stamping. **Introduction to Assembly:** The assembly process, Characteristics and applications, Design for Assembly: Introduction, Design consideration, Design for Fasteners: Introduction, Design recommendation for fasteners.	22

Reference Books:

- J. Lesko, (1999) Industrial Design, Materials and Manufacture Guide, John Willy and Sons, Inc
- George E. Dieter and Linda C. Schmidt (2009), Engineering Design, Fourth edition, McGraw-Hill companies, New York, USA
- Geoffrey Boothroyd, Peter Dewhurst and Winston Knight (2002) Product Design for Manufacture and Assembly, Second Edition, CRC press, Taylor & Francis, Florida, USA
- O. Molloy, S. Tilley and E.A. Warman (1998) Design for Manufacturing and assembly, FirstEdition, Chapman & Hall, London, UK.
- D.E. Whitney, (2004) Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development, Oxford University Press, New York
- A.K. Chitale and R.C. Gupta, (1999) Product design and Manufacturing, Prentice Hall of India, New

Delhi.

- James G. Bralla (1998) Design for Manufacturability Handbook, Second Edition, McGraw- Hill, companies, New York, USA
- Geoffrey Boothroyd (2005) Assembly Automation and Product Design, Second Edition, CRC press, Taylor & Francis, Florida, USA

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2.*

Outcome: *Upon successful completion of this course, the student will be able to:*

CO	CO Statement	*POs/PSOs*	*CL*	*KC*	*Duration*
1	Studentswillhaveknowledgeondesignprinciplesformanufacturability.	*PO1, PO2,PO3,PO4 / PSO1,PSO2*	R&U	F&C	8
2	Students will have knowledge on Machining consideration while design	*PO1,PO3/PSO 1,PSO2*	R&U	C	9
3	Students will have knowledge on casting consideration while design	*PO1,PO3/ PSO1,PSO2*	R&U	C	9
4	Illustrate the basic Forming consideration while design	*PO1,PO6,/ PSO1,PSO2*	R&U	C	9
5	Understand contemporary issues and their impact on design for manufacturing and assembly	*PO1,PO2/PSO 1,PSO2*		C	9

BMEE 0506 SENSORS AND ACTUATORS

***Objective**: Sensors and Actuators is the combination of mechanical and electronics automation system. Nowadays all the mechanical machines have been made computer controlled / automated. The Subject, details the basic structure, design and working of sensors and actuators for proper and successful operation of various equipment in automated system. The knowledge of this subject will be helpful to students while working in industries.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Overview of measurement systems:** Measurement devices; Difference between sensor, transmitter and transducer; Smart device; Primary measuring element selection and characteristics: Range; Response time; Accuracy; Precision; Sensitivity; Dead band; Dead time; Signal transmission: Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Standard signal ranges, Principles of Sensors: Classification of sensors. Characteristics and calibration of different sensors. **Displacement, position and motion sensors:** Principles of variable resistance, variable inductance, variable reluctance, and variable capacitance type sensors. Position and Motion sensors: Limit switches; Proximity sensors: Pneumatic Proximity sensor; Optical Proximity sensor; Inductive Proximity sensor; Capacitive Proximity sensor; Ultrasonic Proximity sensor. LVDT: construction; Working principle; signal conditioning; use of LVDT. Synchros and resolver. Encoders: types of encoder; Hall sensors: Working principle; Hall effect gear tooth sensor. Distance sensors. Light Sensor: Photovoltaic; Photoconductive (Photo resistors). Accelerometer: Definition; General Construction; Working Principle; Types of Accelerometer; Force, Torque, Tactile sensor, Different types of load cells and its application, Piezoelectric transducer, Torque measurement: Tactile sensors. **Strain Gauges:** Working principle; construction; poisson's ratio; Gauge factor, Piezo resistance Coefficient; strain sensing alloys; characteristics; gauges length, rosettes; Types of Strain Gauge. **Pressure sensor**: Few Definition on pressure; static, head, dynamic pressure. Classification of pressure; Pressure Measurement method: U Tube manometer, well type; inclined tube manometer; dead weight; electric strain method. Mechanical pressure measuring elements: Bourden tube. Design and construction of different types of pressure sensing elements. Application of Diaphragm. Electrical and Piezoelectric pressure transducers, McLeod gage, Pirani gage and Ionisation gage.	26
II	**Flow sensors:** The flow pioneers; principle of flow measurement. Types of Flow meter: Differential pressure type; positive displacement type; velocity type; mass meter type. Differential pressure type: orifices; venturi tubes; flow tubes; flow nozzles; pitot tubes; elbow-tap meters; target meters and variable area meters. **Temperature sensor:** Mechanical and Resistance type temperature sensors, Thermocouples, Thermistor, Optical pyrometer, Smart Sensor **Actuators: Definition of Actuators:** Example; selection; Types of Actuators; linear; Rotary; Logical and Continuous Actuators. Pneumatic Hydraulic system: Pneumatic actuator; Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator; Control valves; Construction; Valve coefficient or valve sizing; valve characteristics; types of valves; valve selection. Electrical actuating systems: Solid-state switches, Solenoids, Voice Coil; Electric Motors; D.C. motors, AC motors, Single phase Motor; 3 Phase Motor; Induction Motor; Synchronous Motor; Stepper motors; half stepper; full stepper; linear motor, Piezoelectric actuator.	20

Text Books:

- Sundaram K. Shanmuga, "Hydraulic and Pneumatic Controls", S Chand & Company; 1st Edition2006
- Nathan Ida, "Sensors, Actuators, and their Interfaces: A multidisciplinaryintroduction" SciTech Publishing Inc (15 June 2011)

Reference Books:

- Robert H. Bishop, "Mechatronic Systems, Sensors, and Actuators Fundamentals and Modeling"CRC press 2007
- D.A. Hall, "Sensors and Actuators" CRC Press, 2020
- Clarence W. de Silva, "Sensors and Actuators: Engineering System Instrumentation", SecondEdition 2015

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2.*

Outcome: *Upon successful completion of this course, the student will be able to:*

	CO Statement	PO/PSO	CL	KC	Duration
1	Explain fundamental physical and technical base of sensors and actuators.	PO1,PO2/PSO3	U&Ap	F	6
2	Describe basic laws and phenomena on which operation of sensor transformation of energy is based**.**	PO1/ PSO3	U	C	7
3	Analyses various premises, approaches, procedures and results related to sensors and actuators.	PO3/PSO3	R&U	C	6
4	Create analytical design and development solutions for sensors and actuators.	PO3/PSO3	R&U	P	6
5	Design and implement electro-pneumatic/ hydraulic solutions for automated systems.	PO1.PO6/PSO3	Ap	C&S	8
6	Conduct experiments and measurements in laboratory and on real components, sensors and actuators.	PO1,PO4/PSO3	U	C	6
7	Describe development and application of sensors and actuators.	PO2,PO6/PSO3	R&U	C	7

BMEE 0505: FUNDAMENTALS OF MECHATRONICS AND APPLICATIONS

Objective: *The combination of mechanical and electronics automation and computers. Nowadays all the mechanical machines have been made computer controlled. The Subject details the basic hardware and software elements used for proper and successful operation of various equipment. The knowledge of this subject will be helpful to students while working in industries.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Automated Manufacturing System, need of Automation, elements of Automation, levels of Automation. Elements of Mechatronics system, levels of Mechatronics system, Measurement Systems, Control Systems, Microprocessor-based controllers, The Mechatronics Approach., Mechatronics Design Process, real time Mechatronics system and application, advantages and disadvantages of Mechatronics system. **Mechanical Actuating Systems:** Types of motion, Degrees of freedom, constraints, Kinematic Chains, Cam, Gear and gear trains, Ratchet and pawl Belt drive, chain drive, bearing, pre loading. Hydraulic & Pneumatic Actuation Systems: Fluid power systems, hydraulic systems, Pneumatic systems, system structure and signal flow, hydraulic pumps and Pressure Control Valves, air compressors and treatment, Cylinders, Direction Control Valves, Rotary Actuators.	20
II	**Electrical Actuation Systems:** Switching Devices, Mechanical Switches – SPST, SPDT, DPDT, Relays, solenoid operating Valve, Solenoid Operated Hydraulic and Pneumatic Valves, Open and Close loop control system, Control of DC Motors, Permanent Magnet DC Motors, braking of DC Motors, AC Motors, Stepper Motors and Controls. **Sensors, transducers and application:** Performance Terminology, Static and Dynamic Characteristics, Displacement, Position and Proximity Sensors, Potentiometer Sensors, LVDT, Optical Encoders, Hall Effect Sensors. **Programmable logic controllers:** Programmable logic controllers (PLC) Structure, Input / Output Processing, principles of operation, PLC versus computer, selecting a PLC. **Case studies:** Mechatronic approach to design, Possible Design Solutions, Case Studies of Mechatronic Systems. (i.e. Boat Auto pilot, high speed tilting train, automatic car park system, coin counter, engine management system, autonomous mobile system, antilock brake system control, Using PLC	24

Text Books:

- W. Bolton, "Mechatronics – Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd., 2003.
- K. P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics - Integrated Mechanical Electronic Systems, Wiley.

Reference Books:

- Joji P, "Pneumatic Controls", Wiley.
- Dan Necsulescu, "Mechatronics", Pearson
- David g Alciatore, Michael B Histand, "Introduction to Mechatronics and measurement
- systems", Mc Graw Hill Education.
- A Smaili, F Mrad, "Mechatronics – Integrated Technologies for Intelligent Machines,

OxfordHigher Education.
- Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts & Application", Tata McGraw Hill
- Publishing Co. Ltd., 2003.

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the student will be able to:*

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Knowledge of troubleshoot, maintain and repair mechatronic systems using industry-standard tools, practices, and procedures.	PO1/PSO2/ PSO3	U	C	7
2	Knowledge of mechanical actuating systems and their applications in automations.	PO1/PO2/P O12/PSO3	An	C&PC	8
3	Understand the use of electrical and mechanical operated actuators to troubleshoot manufacturing processes and procedures.	PO1/PSO2/ PSO3	An	C&PC	7
4	Identify the use of Sensors, transducers for flexible and automated manufacturing. Design of Mechatronic system for industry automation.	PO1/PO2/P O12/PSO3	Ap	C&P	5
5	Demonstratetheabilitytoadheretopersonalandindustrysafetystand ards.	PO1/PSO2/ PSO3	Ap	C&P	5
6	Communicate effectively across a variety of audiences' technicians, engineers, management, and customers.	PO1/PO2/P O12/PSO3	U	C	6
7	Knowledge of troubleshoot, maintain and repair mechatronic systems using industry-standard tools, practices, and procedures.	PO1/PO2/P O12/PSO3	An	C&PC	6

BMEE 0306 ADDITIVE MANUAFCTURING

Objective: *The knowledge of this subject will be helpful to students while working in industries. To exploit technology used in additive manufacturing. Objectives of the subjects are to understand importance of additive manufacturing in advance manufacturing process. Ease in the selection of techniques and skills to perform relevant additive manufacturing process.*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM, AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removaland clean up, post processing. Classification of AM processes: Liquid polymer system, discrete particle system, molten material systems, solid sheet system. Design for AM: Motivation, DFMA concepts and objectives, AMunique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features.	23
II	Guidelines for process selection: Introduction, selection methods for a part, challenges of selection, example system for preliminary selection,production planning and control AM Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries	23

Text Books:

- Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010

Reference Books:

- Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006
- Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.
- D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2.*

Outcome: *Upon successful completion of this course, the student will be able to:*

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Importance of AM in Manufacturing	PO1/PSO2/PSO3	U		6
2	Knowledge of Different AM Technologies.	PO1/PO2/PO12/PSO3	An		10

3	Design for manufacture using AM Techniques.	PO1/PSO2/PSO3	U		6
4	Identify the use of suitable materials for Additive manufacturing.	PO1/PO2/PO12/PSO3	U		6
5	Different methods for Post-processing of AM parts.	PO1/PSO2/PSO3	U		6
6	Demonstrate the ability to adhere to personal and industry safety standards.	PO1/PO2/PO12/PSO3	R&U		6
7	Understand the Applications of AM in Automobile, Aerospace, Bio-medical sectors etc.	PO1/PO2/PO12/PSO3	R&U		6

BME E0507- HOME AUTOMATION AND CONTROL

Objective:

- *To explain the relation between Automation and Information Technology*
- *To underline the basic objectives of a manufacturing industry and explain how automation and control technologies relate to these*
- *To introduce the concept of a Product Life Cycle and explain how Automation and*
- *Control technologies relate to the various phases of the cycle*
- *To classify Manufacturing plants and categories the different classes of AutomationSystems that are appropriate for these*

Credits: 04 **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems., Introduction to sensors and measurement systems, Temperature measurement Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques, Measurement of level, humidity, pH etc , Signal Conditioning and Processing, Estimation of errors and Calibration, Introduction to Process Control, PID Control, Controller Tuning, Implementation of PID Controllers, Special Control StructuresFeedforward and Ratio Control. Special Control Structures: Predictive Control, Control of Systems with Inverse Response, Special Control Structures: Cascade Control, Overriding Control, Selective Control, Split Range Control Introduction to Sequence Control, PLCs and Relay Ladder Logic,Sequence Control: Scan Cycle, RLL Syntax, Sequence Control: Structured Design Approach, Sequence Control: Advanced RLL Programming, Sequence Control: The Hardware environment, Controlof Machine tools: Introduction to CNC Machines, Control of Machine tools: Analysis of a control loop.	23
II	Introduction to Actuators: Flow Control Valves, Hydraulic Actuator Systems: Principles, Components and Symbols, Hydraulic Actuator Systems : Pumps and Motors, Proportional and Servo Valves, Pneumatic Control Systems : System Components, Pneumatic Control Systems : Controllers and Integrated Control Systems Electric Drives : Introduction, Energy Saving with Adjustable Speed Drives, Step motors : Principles, Construction and Drives, DC Motor Drives : Introduction, DC--DC Converters, Adjustable Speed Drives Induction Motor Drives: Introduction, Characteristics, Adjustable Speed Drives Synchronous Motor Drives Motor Principles, AdjustableSpeed and Servo Drives Networking of Sensors, Actuators and Controller, Introduction to Production Control Systems	23

Text Books:

- Sundaram K. Shanmuga, “Hydraulic and Pneumatic Controls”, S Chand & Company; 1st Edition 2006
- Nathan Ida, “Sensors, Actuators, and their Interfaces: A multidisciplinary introduction” SciTech Publishing Inc (15 June 2011)

Reference Books:

- Robert H. Bishop, “Mechatronic Systems, Sensors, and Actuators Fundamentals and Modeling”CRC press 2007
- D.A. Hall, “Sensors and Actuators” CRC Press, 2020
- Clarence W. de Silva, “Sensors and Actuators: Engineering System

Instrumentation", SecondEdition 2015
- Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010

Focus: *This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

Outcome: *Upon successful completion of this course, the student will be able to:*

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Explain fundamental physical and technical base Industrial Automation.	PO1, PO2/PSO3	R&U	F&C	8
2	Describe basic laws and phenomena on which operation of sensor transformation of energy is based**.**	PO1/ PSO3	R&U	C	8
3	Analyses various premises, approaches, procedures and results related to Home automation	PO3/PSO3	R&U	C	6
4	Create analytical design and development tsolutions for sensors and actuators.	PO3/PSO3	R&U	C	6
5	Design and implement electro-pneumatic/ hydraulic solutions for automated systems.	PO1.PO6/PSO3	U	C	6
6	Conduct experiments and measurements in laboratory and on real components.	PO1, PO4/PSO3	R&U	C	6
7	Describe development and application of sensors and actuators.	PO2, PO6/PSO3	U	C	6