MAHARSHI DAYANAND UNIVERSITY, ROHTAK

SCHEME OF STUDIES & EXAMINATIONS
B.Tech. Minor Degree in Smart Manufacturing (For all branches)
w.e.f. 2026-2027

Sr. No.	Sem-ester	Course Code	Subject	Teaching Schedule			Examination Schedule(Marks)				Duration of Exam(Hours)	No. of Hours /Week
				L	P	Total Credits	Internal Assessments	Theory	Practical	Total		
1.	3rd	26MEM-301-H	Industrial Engineering Techniques	3	-	3	25	50	-	75	3	3
2.	3rd	26MEM-303-H	Industrial Engineering Lab	-	2	1	5	-	20	25	3	2
3.	4th	26MEM-302-H	Smart Manufacturing	3	-	3	25	50	-	75	3	3
4.	4th	26MEM-304-H	Smart Manufacturing Lab	-	2	1	5	-	20	25	3	2
5.	5th	27MEM-401-H	Advanced Machining Processes	3	-	3	25	50	-	75	3	3
6.	5th	27MEM-403-H	Advanced Machining Processes Lab	-	2	1	5	-	20	25	3	2
7.	6th	27MEM-402-H	Fundamentals of Additive Manufacturing Technologies	3	-	3	25	50	-	75	3	3
8.	6th	27MEM-404-H	Additive Manufacturing Lab	-	2	1	5	-	20	25	3	2
9.	7th	28MEM-501-H	Industrial Ergonomics	3	-	3	25	50	-	75	3	3
10.	7th	28MEM-503-H	Industrial Ergonomics Lab	-	2	1	5	-	20	25	3	2
		Total				**20**				**500**	**30**	**25**

B.Tech 3rd Semester Minor in smart manufacturing
Industrial Engineering Techniques (26MEM-301-H)

L T P CREDIT **SESSIONAL:25 Marks**
3 0 0 3 **THEORY 50 Marks**
TOTAL: 75 Marks
DURATION OF EXAM.:3 Hrs.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

SM01.1	Attain the basic techniques of Industrial engineering, quality improvement, fundamental knowledge of statistics and probability.
SM01.2	Describe different sampling plans. Use control charts to analyze for improving the process quality.
SM01.3	Acquire basic knowledge of total quality management
SM01.4	Understand the modern quality management techniques

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	1.75	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.39

UNIT-I

Definition of Industrial Engineering: Objectives, Method study, Principle of motion economy, Techniques of method study - Various charts, THERBLIGS, Work measurement - various methods, time study PMTS, determining time, Work sampling.
Productivity & Workforce Management :Productivity - Definition, Various methods of measurement, Factors effecting productivity, Strategies for improving productivity, Various methods of Job evaluation& merit rating, Various incentive payment schemes, Behavioural aspects, Financial incentives.

UNIT-II

Customer Satisfaction & Employee Involvement. Service Quality, Features Of Services, The Kano Model ,Employee Motivation, Motivation Theory Of Individual Employees, Effective Communications, Training And Mentoring, Recognition And Reward. Continuous Process Improvement and Process Approach.

UNIT-III

The Seven Quality Control Tools, ,Seven Management Tools, Benchmarking, TPM,FMEA Juran's Triology, Kaizan, PDCA, Seven Quality Tools, BPR, Seven Deadly Wastes,ETXModel,LeanManufacturing,KanbanSystem,CellularManufacturi ng,Single Piece Flow, Zero Defects

UNIT-IV

Production Planning & Control (PPC) : Introduction to Forecasting - Simple & Weighted moving average methods, Objectives & variables of PPC, Aggregate planning - Basic Concept, its relations with other
Management Information Systems (MIS) : What is MIS ? Importance of MIS, Organizational & information
system structure, Role of MIS in decision making, Data flow diagram.

Text Books: 1. Production & Operations Management - Chary, TMH, New Delhi.
2. Management Information Systems - Sadagopan, PHI New Delhi.
3. Modern Production Management – S.S. Buffa, Pub.- John Wiley.
4. "Total Quality Management "by Oakland (Butter worth- HeinamannLtd.)
5. "Managing for total quality from Deming to Taguchi and SPC" by Logothetis N.(PHI)
6. "Total Quality Control" by FeigenbaumA.V.(MGH)
7. "Total Quality Management" by BesterfieldDale H (Pearson Education)

Ref.Books: 1. Operations Management - Schroeder, McGraw Hill ISE.
2. Operation Management - Monks, McGraw Hill ISE.
3. Production & Operations Management - Martinich, John Wiely SE.
4. Industrial & Systems Engineering - Turner, MIZE, CHASE, Prentice Hall Pub.

B. Tech 3rd Semester Minor in smart manufacturing

Industrial Engineering Lab(26MEM-303-H)

L T P CREDIT	**SESSIONAL:5Marks**
0 0 2 1	**EXTERNAL PRACTICAL :20 Marks**
TOTAL :25 Marks	**DURATION OF EXAM.:3 Hrs.**

Course Outcomes: At the end of the Course, the student will have the ability to:

SM01.1LAB	Attain the basic techniques of Industrial engineering, quality improvement, fundamental knowledge of statistics and probability.
SM01.2 LAB	Describe different sampling plans. Use control charts to analyze for improving the process quality.
SM01.3 LAB	Acquire basic knowledge of total quality management
SM01.4 LAB	Understand the modern quality management techniques

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	1.75	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.39

.Students have to perform the following activities in lab: Experiments:

1. To Study & Prepare Operation Process Chart (OPC) for given assembly.
2. To Study & Prepare Flow Process Chart and Flow Diagram for given assembly for OPC.
3. To study & Prepare Man-Machine Chart for the given situation.
4. To study & Calculate co-efficient of correlation for time study person using performance rating technique.
5. To study & Calculate standard time for given job.
6. To study & Prepare a frequency Distribution Curve for the data source given.
7. To study & Construct X bar- R Chart for given process.
8. To study & Construct P-chart for given process.
9. To study & Construct C-chart for given process.
10. To study about Sampling Plans & Decide about acceptance or rejection of a particular product using sampling plans.
11. TO draw two handed process chart for bolt, washer & nut assembly.

Note : At least six experiments are to be performed in the Semester.

B. Tech 4th Semester Minor in smart manufacturing

Smart Manufacturing(26MEM-302-H)

L T P CREDIT **SESSIONAL:25 Marks**
3 0 0 3 **THEORY :50 Marks**
TOTAL : 75 Marks DURATION
OF EXAM.:3 Hrs.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

SM02.1	Identify the different smart manufacturing technologies.
SM02.2	Apply the knowledge of smart manufacturing in different engineering and medical fields.
SM02.3	Analyse the different protocols used in smart manufacturing.
SM02.4	Design and develop smart machines in IIOT.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	1.75	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.39

UNIT-I

Introduction: Introduction to Industry 4.0, Historical Background, Nine Pillars of Smart Manufacturing, Hardware and Software for Smart Manufacturing, The Role of Advanced Process Modeling in Smart Manufacturing, Industrial AI and Predictive Analytics for Smart Manufacturing Systems, Big Data & analytics Autonomous Robots, Universal System Integration, Cloud Computing, Augmented Reality, Convergence of Nine Pillars, Business Propositions delivered with Smart Manufacturing.

UNIT-II

Industrial Internet of Things: Introduction, Network Architecture, Embedded system, Basic electronic components of IOT, LED, Resistor, capacitor, transistor, relay, switch, LDR, Buzzer, switch etc., controllers used in IIOT, Basic electronic circuits, Arduino programming, IOT communication protocols, Applications of IIOT. IoT vs IIoT, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Case Study: Agriculture, Healthcare, Activity Monitoring, power plants, inventory management & quality control, plant safety and security (including AR and VR safety applications).

UNIT-III

Smart Design and Fabrication: Digital Tools, Product Representation, Exchange Technologies and Standards, Simulation and Modeling in Smart Manufacturing, Agile (Additive) Manufacturing Systems and Standards, Mass Customization, Smart Machine Tools, Robotics and Automation (perception, manipulation, mobility, autonomy), Smart Perception, Sensor networks and Devices.

Smart Applications: Online Predictive Modeling, Monitoring and Intelligent Control of Machining, Manufacturing and Logistics, Supply Chain Processes, Smart Energy Management of manufacturing processes and facilities, Adoption, Scaling Economic Aspects, Ecosystem Required for Smart Manufacturing.

UNIT-IV

Smart and Empowered Workers: Eliminating Errors and Omissions, Deskilling Operations, Improving Speed, Agility, Improving Information Capture, Traceability, Improving Intelligent Decision Making under uncertainty Assisted, Augmented Production, Assisted, Augmented Assembly, Quality, Maintenance, Warehouse Operations and Assisted Training, Skill set Required for Smart Manufacturing, Effects on 4 M- Man, Machine, Materials & Methods in Smart Manufacturing.

Text/Reference Books

1. Industry 4.0 and Hyper-Customized Smart Manufacturing Supply Chains, S.G. Ponnambalam, Nachiappan Subramanian, Manoj Kumar Tiwari and Wan Azhar Wan Yusoff, IGI Global
2. Smart Manufacturing: Concepts and Methods by Masoud Soroush, McKetta Michael Baldea, Thomas F. Edgar, Elsevier Science Publishing Co In
3. Smart Manufacturing: The Lean Six Sigma Way, Anthony Tarantino, Wiley
4. Smart Automation to Smart Manufacturing: Industrial Internet of Things, by Uthayan Elangovan, Momentum Pr
5. Smart Manufacturing: Applications and Case studies by Masoud Soroush, McKetta Michael Baldea, Thomas F. Edgar, Elsevier Science Publishing Co In.

B. Tech 4th Semester Minor in smart manufacturing

Smart Manufacturing Lab (26MEM-304-H)

L T P CREDIT **SESSIONAL:5Marks**

0 0 2 1 **EXTERNAL PRACTICAL :20 Marks**

TOTAL :25 Marks **DURATION OF EXAM.:3 Hrs.**

Course Outcomes: At the end of the Course, the student will have the ability to:

SM02.1 LAB	Understand the different microcontrollers, processors and automation.
SM02.2 LAB	Apply the concepts of Artificial Intelligence in maintenance and overhauling.
SM02.3 LAB	Analyse the maintenance of the machines
SM02.4 LAB	Design and develop smart machines and intelligent systems.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	1.75	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.39

Students have to perform the following activities in lab: Experiments:

1. To study the different microcontroller/processors like Arduino/ Raspberry Pi/ BeagleBone Black/ etc.,
2. AI for maintenance and overhauling.
3. Machine maintenance analysis.
4. Converting existing machine into smart machine.
5. Development of Smart Machinery like FDM printer.
6. Design and develop GPS- and GSM-Based Vehicle Tracking System
7. Design and develop home automation using Arduino wifi module ESP8266
8. Design and develop temperature data-logging system based on PIC16F887 microcontroller (MCU), Wi-Fi and Thing Speak application programming interface (API).

Note :

1. At least six experiments are to be performed in the Semester.

B. Tech 5th Semester Minor in smart manufacturing

Advanced Machining Processes(27MEM-401-H)

L T P CREDIT **SESSIONAL:25Marks**
3 0 0 3 **THEORY :50 Marks**
TOTAL :75 Marks
DURATION OF EXAM.:3 Hrs.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

SM03.1	Understand the basic features of EDM
SM03.2	Understand the basic features of ECM.
SM03.3	Understand the basic feature of AJM, USM etc.
SM03.4	Learn the MRR of various micro machining process.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	1.75	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.39

UNIT-I

Introduction to New Machining Technologies : Micro electromechanical Systems (MEMS),Non Conventional Machining Process, Comparison of conventional machining processes and new technologies.

UNIT-II

Micro-electro-mechanical System Description, System Process, Micro Electromechanical systems paradigms, Materials for MEMS, Future trends: Mechanical Transducers, Optical Transducers,andMultiDisciplinaryApplications.

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UNIT-III

Ultrasonic machining, Whirling jet machining, fundamental principles, process parameters characteristics, tool design, metal removal rate analysis, important part design,analysis ofprocess. Machining Accuracyand Surface Finish Optimization.

ElectroChemical Machining-Introduction,principles,scheme, process parameters, metal removal rate, Electrochemical grinding: Introduction,tools,process parameters, metal removalrate,Honing,Accuracy and Surfacefinish Optimization.

UNIT-IV

EDM- Introduction – basic principles, metal removal rate, machining accuracy and surfacefinishoptimization,selectionof toolmaterialanddielectric,analysisofprocess. Wire electric dischargemachining: Principle,Processvariables.

ReferenceBooks:

1. Manufacturing Sciences byGhosh & Malik.
2. Newer machiningprocesses; H.S.Shan
3. Advancemachining processes by B.Bhushan
4. Fundamentals of Micro-machiningby M.J Madou CRC Press.

B. Tech 5th Semester Minor in smart manufacturing

Advanced Machining Processes Lab (27MEM-403-H)

L	T	P	CREDIT	
0	0	2	1	

SESSIONAL:5 Marks
Practical :20 Marks

TOTAL : 25 Marks
DURATION OF EXAM.:3 Hrs.

Course Outcomes: At the end of the Course, the student will have the ability to:

SM03LAB.1	Understand the basic features of EDM
SM03LAB.2	Understand the basic features of ECM.
SM03LAB.3	Understand the basic feature of AJM, USM etc.
SM03LAB.4	Learn the MRR of various micro machining process.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	2.00	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.42

LISTOFEXPERIMENTS

1. Study and applications of Abrasive Jet Machining.
2. Study and applications of Electrical Discharge Machining
3. Study and applications of Electrochemical Grinding
4. Study and applications of Ultrasonic Machining
5. Study and applications of Electrochemical Machining
6. Study and applications Jet Machining
7. Study and applications wire Electrical Discharge Machining

Note : At least six experiments are to be performed in the Semester.

B. Tech 6th Semester Minor in smart manufacturing

Fundamentals of Additive Manufacturing Technologies(27MEM-402-H)

L T P CREDIT **SESSIONAL:25 Marks**
3 0 0 3 **THEORY :50 Marks**
TOTAL : 75 Marks DURATION
OF EXAM.:3 Hrs.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

SM04.1	Understand the working principles and applications of additive manufacturing processes.
SM04.2	Demonstrate the different additive manufacturing processes in real life.
SM04.3	Analyse the performance and applicability of additive manufacturing processes. Select the suitable additive manufacturing process for particular application.
SM04.4	Design and develop a working model like FDM printer using additive manufacturing Processes.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	2.00	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.42

UNIT-I

Introduction to Additive Manufacturing, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM. Vat Photopolymerization AM Processes, Material Jetting AM Processes, Binder Jetting AM Processes: Extrusion-Based AM Processes, Sheet Lamination AM Processes, Powder Bed Fusion AM Processes, Directed Energy Deposition AM Processes.

UNIT-II

Principle of FDM/FFF printing, Basic steps to perform FDM printing, Significant process parameters of FDM printing, layer height, raster angle, raster width, build temperature, Nozzle temperature, orientation, printing speed etc Types of FDM printer Cartesian, Polar, delta, Robotic (SCARA), continuous FDM Materials PLA, ABS, PETG, Nylon, PVA, PC, TPU, Carbon reinforced nylon, ceramics, metals, Dual and multi material etc

UNIT-III

Main Parts and Construction of FDM printer Frame, Linear rods, Linear motion bearings, Slider/Carriage, V slot extrusion, Pulley, belt, Lead screw Arduino processor, Controller board, Limit Switch, Hot end, Extrusion system: Direct Drive, Bowden type, Power Supply, Heat Beds etc

Materials science for AM - Multifunctional and graded materials in AM, Role of solidification rate, Post Processing of AM Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement.

UNIT-IV

Applications of Additive Manufacturing Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Rehabilitation, Visualization of Biomolecules.

Text/Reference Books

1. Ian Gibson, Ian Gibson. "Additive manufacturing technologies 3D printing, rapid prototyping, and direct digital manufacturing." Springer International Publishing

2. Harshit K. Dave, J. Paulo Davim Fused Deposition Modeling Based 3D Printing, Springer International Publishing

3. Manu Srivastava, Sandeep Rathee, Sachin Maheshwari, TK Kundra Additive Manufacturing Fundamentals and Advancements CRC press

4. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2015, 4th Edition

B. Tech 6th Semester Minor in smart manufacturing

Additive Manufacturing Lab (27MEM-404-H)

L T P CREDIT **SESSIONAL:5Marks**

0 0 2 1 **EXTERNAL PRACTICAL :20 Marks**

TOTAL :25 Marks **DURATION OF EXAM.:3 Hrs.**

Course Outcomes: At the end of the Course, the student will have the ability to:

SM04.1 LAB	Understand the working of slicing software to convert .stl file in to .gcode file.
SM04.2 LAB	Apply the knowledge of handheld 3D scanner to scan body/face/parts.
SM04.3 LAB	Demonstrate the knowledge of Fused deposition modeling (FDM) printer, SLA/resin 3D printer for modeling, prototyping, and production applications
SM04.4 LAB	Design and develop the different product using AM technologies.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	2.00	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.42

Students have to perform the following activities in lab: Experiments:

1. Slicing Software basics-I. Setting up the build temperature, nozzle temperature, speed, material, layer height
2. Slicing Software basics-II Setting up infill density, infill pattern, orientation of object, support material wall thickness, converting .stl file to .G-code file etc.
3. Download a .stl file of simple object from internet, convert into G-code and print with FDM 3D Printer at 30% infill density.
4. Download a .stl file of simple object which require support material from internet, convert into G-code and print with FDM 3D Printer.
5. Design the Coupling in Creo software/3d user friendly software and print it using PLA material.
6. Design the key ring of your own name and print it using PLA.
7. Emboss / engrave your name on a 3D object and print it with PLA material.
8. Reverse engineering- Scan human face by 3D Scanner and print using 3D printer.
9. Fabricate a dice of suitable dimension using SLA/resin 3D printer.
10. Fabricate a key ring of your own name and print using SLA/resin 3D printer.

Note :

1. At least six experiments are to be performed in the Semester.

B. Tech 7th Semester Minor in smart manufacturing

INDUSTRIAL ERGONOMICS (28MEM-501-H)

L T P CREDIT **SESSIONAL:25 Marks**
3 0 0 3 **THEORY :50Marks**
TOTAL :75 Marks
DURATION OF EXAM.:3 Hrs.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes: At the end of the Course, the student will have the ability to:

SM05.1	Address issues related to productivity assessment and improvement.
SM05.2	Analyse the operations and using systematic approach to improving shop floor operations.
SM05.3	Determine time standards and conditions of work. Use tools for analysis and design of operations.
SM05.4	Redesign layout of a shop floor.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	2.00	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.42

UNIT-I

Introduction to industrial engineering and productivity, measurement of productivity, Introduction to work study, methods study principles and motion economy, Filming Techniques and micro-motion analysis, Introduction to work measurement. Time study, performance allowances, work sampling.

UNIT-II

Introduction of Ergonomics, system approach to ergonomic model, .Area of study covered under ergonomics, man/machine systems, characteristics of man machine system, limitationofman&machinewithrespecttoeachother.Designapproach:Work
Design consideration, General principles for carrying out the physical activities, Design of workplace, machine at workplace, seat for workplace.

UNIT-III

Controls: Criteria for control design, Hand controls and foot controls, Relationship between controls and display instruments, Controls for high precision work (Push Buttons, switches, knobs etc.), Layout of panels and machine

Displays:-Types of displays, Design recommendation for quantitative displays.

UNIT-IV

Climates:-Heat Humidity-Fundamentals of human thermal regulation, measuring the thermal environment, work in hot climate, work in cold climate protection against climatic extremes, effect to climate on performance.

Noise:-Terminology, physiological effects of noise, annoyance of noise, speed interference, hearing loss, temporary and permanent threshold shift, effect of noise on performance reduction of noise, personal noise protection.

Text Books:

1. Method Engineering study–Krick, S.V.
2. Work study and Ergonics–Suresh Dalela, Saurabh.

Reference books:

1. IntroductionofErgonomics-Bridger-TataMcGrawHill1995
2. WorkStudy-Khanna–DhanpatRai&Sons-1995

B. Tech 7th Semester Minor in smart manufacturing
Industrial Ergonomics Lab(28MEM-503-H)

L	T	P	CREDIT	SESSIONAL:5 Marks
0	0	2	1	Practical :20 Marks

TOTAL : 25 Marks
DURATION OF EXAM.:3 Hrs.

Course Outcomes: At the end of the Course, the student will have the ability to:

SM03LAB.1	Understand the 3D Motion Analysis system - Biomechanical analysis of human movement.
SM03LAB.2	Understand Foot Pressure Measurement systemand other systems.
SM03LAB.3	Understand the basic feature of AJM, USM etc.
SM03LAB.4	Learn the Ergomaster software.

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	-	-	-	2	3	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3	3	3
CO3	3	2	3	2	3	2	1	-	-	-	2	3	3	3
CO4	3	2	2	2	2	3	1	-	-	-	2	3	2	3
WT.AVG	3.00	2.25	2.25	2.00	2.25	2.25	1.00	-	-	-	2.00	3.00	2.50	3.00

Overall Mapping of Subject: 2.42

LISTOFEXPERIMENTS

a. To study 3D Motion Analysis system - Biomechanical analysis of human movement
b. To study Foot Pressure Measurement system- Static and Dynamic Foot Pressure Measurement and analysis
c. To study Biopac Data Acquisition Systems – Recording and analysis of Electromyography (EMG) and Electroencephalography (EEG)
d. To study Lumbar Motion Monitor- Recording and analysis of movement of human lower back to predict the probability of Low Back Disorder (LBD)
e. To study Ergomaster software – Analysis of working posture
f. To study Dynamometers – Recording of strength of back muscle, hand and pinch grip of an individual.
g. <="" li="" style="box-sizing: border-box;">
h. To study David Back Concept- Measurement of flexibility and isometric strength of back muscles.
i. To study Medical Treadmills- Design of exercise protocol for measurement of cardiorespiratory efficiency
j. To study Bicycle Ergometer - Design of exercise protocol for measurement of cardiorespiratory efficiency
k. To study Polar Heart Rate Monitor – Recording of heart rate responses during rest and activity
l. To study Lux Meter- Measurement of illumination level at work place

Note : At least six experiments are to be performed in the Semester.