GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3730005
Semester III
Business Analytics

Type of Course:

Prerequisite:

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Sr. No.	Topics	Teaching Hours
1	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	9
2	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology	8
3	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization	9
4	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model	10
5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making	8
6	Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism	4

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics by James Evans, persons Education

Course Outcomes:

After learning the course the students should be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Students will demonstrate knowledge of data analytics	
CO-2	Students will demonstrate the ability of think critically in making decisions based on data and deep analytics	
CO-3	Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making	
CO-4	Students will demonstrate the ability to translate data into clear, actionable insights	

Type of Course:

Prerequisite: Nil

Rationale: Safety is major issue in any industry; awareness about safety helps students from any major accidents, Different rules regulation of safety helps students apply it in industry for performance and productivity improvements. Knowledge of Maintenance, its type and application gives better work environments and helps industry from major shutdown. Different maintenance tools and techniques for different situation and industry equipment's helps students to apply it in real life industry problems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Sr. No.	Topics	Teaching Hours
1	Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	08
2	Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment	08
3	Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods	10
4	Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes	09
5	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance	10

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	10
Comprehension	20
Application	25
Analysis	25
Evaluate	10
Create	10

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services
2. Maintenance Engineering, H. P. Garg, S. Chand and Company
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

Course Outcomes:
After learning the course the students should be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Understand Importance of Safety and Important related Acts.	20
CO-2	Apply Maintenance techniques as per requirements and able to compare for with different technique for better performance.	30
CO-3	Understand wear and corrosion, its causes and remedial actions for preventions.	30
CO-4	Demonstrate fault tracing, its methods and application.	20

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3730008
Semester III
Cost Management of Engineering Projects

Type of Course:

Prerequisite:

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Sr. No.	Topics	Teaching Hours
1	Introduction and Overview of the Strategic Cost Management Process	
2	Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making	
3	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process	
4	Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing	
5	Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd

Course Outcomes:
After learning the course the students should be able to :

Sr. No.	CO statement	Marks % weightage
CO-1		
CO-2		
CO-3		
CO-4		

GUJARAT TECHNOLOGICAL UNIVERSITY
Master of Engineering
Subject Code: 3730009
Semester III
Waste to Energy

Type of Course:

Prerequisite:

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Sr. No.	Topics	Teaching Hours
1	Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors	
2	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications	
3	Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation	
4	Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors	
5	Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India	

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

Course Outcomes:

After learning the course the students should be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Understand about Agriculture waste, Industrial waste and their conversion process	20
CO-2	Design construction and operation of Gasifiers	30
CO-3	Design construction and operation of Bio combustors	30
CO-4	Applications of Biomass	20

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3730806
Semester – III
Subject Name: Mechanics and Manufacturing of Composites

Type of course: Program Elective V

Prerequisite: Nil

Rationale:
The course intents to introduce students to fundamentals of composite materials' mechanics and manufacturing techniques.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.		Total Hrs
1	**Basic concepts and characteristics:** Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.	04
2	**Constituents:** Reinforcements: Fibers- Glass, Silica, Kevlar, carbon, graphite, boron, silicon carbide, and boron carbide fibers. Matrix Materials: Particulate composites, Polymer composites, Thermosets, Thermoplastics, Metal matrix and ceramic composites.	08
3	**Macromechanics Behavior Lamina:** Stress-strain behavior for anisotropic materials; stiffness, compliance and engineering constants for orthotropic materials; Stress-strain behavior for plane stress in an orthotropic material; Stress-strain behavior for lamina of arbitrary orientation; strength of an orthotropic lamina; Biaxial strength criteria for an orthotropic materials (Maximum stress, Maximum strain, Tsai- Hill, Hoffman, Tsai-Wu).	08
4	**Micromechanical Behavior Lamina:** Determination of constants, Elasticity approach to stiffness, particulate composite, Fiber-reinforced composites, tensile and compressive strength in fiber direction, transverse stiffness and strength, prediction of shear strength, Failure modes.	06
5	**Short-Fiber Composites:** Theories of Stress Transfer, Modulus and Strength of Short-Fiber Composites, Ribbon-Reinforced Composites.	06

6	**Analysis of Laminates:** Laminate Stress-Strains behavior, Variation of Stresses in a Laminate, Resultant Forces and Moments: Synthesis of Stiffness Matrix, Laminate Description System, Construction and Properties of Special Laminates, Determination of Laminae Stresses and Strains, Analysis of Laminates after Initial Failure, Hygrothermal Stresses in Laminates, Bending and Buckling of laminated plates Special Cases: Symmetric, Antisymmetric and Unsymmetric laminates. Design of laminates.	06
7	**Performance of Composites:** Static Mechanical Properties (Tensile, Compressive, Flexural, In-plane shear, Interlaminar shear strength), Fatigue performance, Impact properties, Environmental effects, Creep and Fracture behaviour.	03
8	**Manufacturing:** Degree of Cure, Viscosity, Resin Flow, Consolidation, Gel-Time Test, Shrinkage, Voids; moulding methods, filament winding, pultrusion, Quality inspection. Joining: Pin bearing, adhesive bonding.	04

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**20**	**20**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Agarwal, B.D. and Broutman, L. J., Analysis and Performance of Fiber Composites, Wiley India.
2. Mallick P. K., Fiber-Reinforced Composites Materials, Manufacturing and Design, CRC Press.
3. Jones R M, Mechanics of Composite Materials, CRC Press.
4. Daniel, I. M. and Ishai, O., Engineering Mechanics of Composite Materials, Oxford University Press

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Able to analyse FR composites materials of various constituents.	30
CO-2	Understand fundamentals of manufacturing of composite material.	40
CO-3	Design components for various applications using composites	30

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3730806

List of Open Source Software/learning website:

1. The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester.
2. NPTEL

Master of Engineering
Subject Code: 3730808
Semester – III
Subject Name: Robotics Engineering

Type of course: Program Elective

Prerequisite: Zeal to learn the Subject

Rationale:
This subject deals with study of robot actuators, kinematics, dynamics and motion control of robotic manipulators which is useful for proper design and selection of robot manipulators.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**General considerations of Robotic Manipulator** Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, History of robot; Application of Robot, Geometric configurations, Work volumes and Degree of freedoms; Robot actuators and drives; Analysis of Robotic inaccuracies and resolutions.	08
2	**Kinematics of Robotic Manipulator** Service Index of different configurations; Position, velocity and acceleration analysis of various robot configuration, Jacobian, Homogeneous transformation; Direct Kinematic; Inverse Kinematics; D-H representation.	08
3	**Forces in Manipulators** Statics and dynamics of robot manipulator; Considerations of forces, Moments and torques for various basic robotic configurations; Joint torque and force calculation, Counter balancing systems	10
4	**Trajectory Generation** Basics of trajectory planning, Joint space vs. Cartesian space descriptions, Joint space trajectory planning, Cubic polynomials; Higher order polynomials; Linear function with parabolic blends; Numerical based on different motion trajectories, Cartesian space trajectories.	05
5	**Motion Control of Robotic manipulators** Robotic open and closed loop control systems, Second order systems, Non –linear closed loop equation of motion, Error controlled Robotic dynamics, Control of Single axis robotic arm, Generalized motion control laws for robotic manipulators, Common control system for industrial robots, simple robotic manipulator, Independent joint PID control, Independent joint PID control with effective joint inertia, Force control of robotic manipulator, Tracking error analysis, Coordinated movement	06
6	**Machine Vision System:**	06

	Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques , Noise reduction methods, Edge detection, Segmentation. Robot Programming: - Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features of type and development of languages for recent robot systems.	

Reference Books:

1. A Robot Engineering Textbook, Mohsen Shahinpoor, Harper and Row, Publisher, New York.
2. Mechanical Design of Robots, Eugene I. Rivin, McGraw Hill Book Company, New York.
3. Introductin to Robotics: Analysis, Control, Applications, Saeed Niku, John Wiley & Sons.
4. Introduction to Robotics, S K Saha, Tata McGraw-Hill.
5. Robotics control, sensing, vision and intelligence, K S Fu, R C Gonzalez, CSG Lee, Tata McGraw Hill Edition.
6. Introduction to robotics, John J Craig, Pearson/Prentice Hall, Third edition.
7. Industrial Automation, W.P. David, John Wiley and Sons.

Course Outcome:

After learning the course:

Sr. No.	Course Outcome	Percentage weightage
CO-1	Students will able to understand the workspace and degree of freedom of various robot configurations.	20%
CO-2	Students will able to learn about forward and inverse kinematics of robotic manipulators.	20%
CO-3	Students will able to calculate static and dynamic forces and torques of manipulator. This will help in selection of robotic actuators.	20%
CO-4	Students will able understand the trajectory generation of robotic manipulators.	20%
CO-5	Students will able to select the various controllers of robotic manipulators and machine vision systems.	20%

List of Open Source Software/learning website:

NPTEL Course

RoboAnalyzer, Scilab

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3730809
Semester – III
Subject Name: Rapid Prototyping

Type of course: Program Elective V

Prerequisite: Nil

Rationale:
The idea of building a three dimensional object using two dimensional cross sections is done by Rapid Prototyping (RP). Rapid Prototyping is present demand of Industry that defined as a group of techniques used to quickly fabricate a scale model of a part or assembly using three-dimensional computer aided design (CAD) data. Many designers and companies use prototypes and models for the purpose of product and functionality testing of new designs they can also be used to obtain customer feedback for new products. This subject helps students to visualize product and its features and analysis for new product development.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Contents	Total Hrs
1	**Product Development Cycle and Influence of Innovations on Product Development:** Impact on economy, export competitiveness, design as a strategy to win international market and Innovation process	08
2	**Rapid Product Development - As Overview** virtual prototyping and testing technology, Physical Prototyping and Rapid Manufacturing technologies and Synergic Integration Technologies	08
3	**Virtual Pro-typing and Testing:** Geometric modeling: Types of Geometric models and Solid Models Reverse engineering: Acquiring Point Data, Constructing 3D model and Applications. Virtual augmented reality: Requirement of devices and technologies and applications Computer Aided Engineering: Application of FEA in Engineering, the concept of discretization, steps in FEA and automatic mesh generation. Design for X: Design for manufacture and design for assembly and other facets of DFX.	08
4	**Physical Prototyping and Rapid Manufacturing** **Computer Numerical Control:** Comparison between NC and conventional machines, features of CNC Machine Tool and programming **Robotics:** classification, programming, sensors and applications **Computer Aided Process Planning:** Methodology, evaluation, types, CAD/CAM Integration and CAPP Features	08

w.e.f. AY 2018-19

	Rapid Prototyping: dawn of slice age, benefits, applications, important issues and popular RP process **Rapid Tooling:** Indirect rapid tooling process	
5	**Synergic Integration:** **Concurrent Engineering:** Benefits, methodology, integration and transactions **Product Data Management:** Product data classifications, Process Management and benefits **Computer Integrated Manufacturing:** Components, barriers to CIM. Implementation, case study, development and research	06
6	**Rapid Prototyping and Rapid Tooling:** Methods, Stereo-lithography, Fused-deposition modeling, Selective laser sintering, Laminated-object manufacturing, Ballistic particle Manufacturing, Solid base curing and Direct manufacturing and rapid tooling	07
	Total Hours	**45**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**10**	**30**	**20**	**20**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

(1) Rapid Product Development- Synergic integration of time-compression technologies K. P. Karunakaran, V. P. Bapat, Sreenath Babu Akula P. D. Solanki Gaurav Gupta, V.R. Prasanth, Saket Anand, Arnab Sarkar and S. Venkatkrishnan
(2) Manufacturing Processes for Engineering Materials Serope Kalpakjion and Steven R. Schmid- Pearson Education

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Able to Understand virtual prototyping and testing of technology.	30
CO-2	Able to understand the importance of Physical Prototyping,	40

CO-3	Able to understand Rapid Manufacturing technologies and Synergic Integration Technologies in the present technological era	30

Term Work: Nil

List of Experiments: Nil

Major Equipment: Nil

List of Open Source Software/learning website:

1. The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester.
2. NPTEL
3. https://en.wikipedia.org/wiki/Rapid_prototyping
4. http://www.factoryoffactories.com/rapidprotot.htm

w.e.f. AY 2018-19

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3730810
Semester – III
Subject Name: Micro and Nano Manufacturing System

Type of course: Program Elective V

Prerequisite: Nil

Rationale:
Subject is designed to understand the principles of various micro and Nano manufacturing methods. This subject aims for the student to acquire knowledge of the fundamentals of micro and nano-products and of the manufacturing of such products and knowledge of micro and Nano-materials processing methods and techniques.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Contents	Total Hrs
1	**Scope of Nano Technology:** Nano technology Concepts and Applications, Micro- and Nanofabrication, Nano technology in India, Scope for Micro-fabrication, Rise Nano technology Fields, Commercialization Issues of Micro-Nano Technology	08
2	**Micro-fabrication:** Mechanical Micromachining, Physical Fabrication Methods, Lithography, Processing Setup, Nano Lithography & Manipulation, Precision Micro- and Nano grinding , Use of Spectrometers & Microscopes	12
3	Laser-Based Micro and Nanofabrication, Pulsed Water Drop Micromachining, Nano Materials, Synthesis of Nano materials, Bio Materials, Nano Composites, Development of Nano Particles	10
4	**Innovative Applications on Present Devices:** Nano chips, Nanotubes and Nanowires, Integration of chips and microprocessors, Technology Support, Meeting Social Needs	08
5	**Nano Design & CAD:** Computer Aided Nano Design, VLSI product detailing Finite Element Analysis of Microstructures, 3-D Molecular Modelling	07
	Total Hours	**45**

w.e.f. AY 2018-19

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**10**	**30**	**30**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Micro fabrication & Nano manufacturing by Mark J. Jackson
2. ASM handbook on machining
3. Springer's Hand book of Nano-technology - Bharat Bhusan (Ed.)
4. Nanotechnology and Nano electronics – WR Fahrner, Springer International Z. Cui, Nanofabrication, Springer, 2008
5. Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, and John J. Moore, Introduction to Nano science and Nanotechnology, CRC Press, Boca Raton, 2009.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Able to apply the knowledge in mechanics, scaling, design, fabrication and characterization of Micro and Nano systems.	50
CO-2	Able to understand innovative application of Nano technology	50

Term Work: Nil

List of Experiments: Nil

Major Equipment: Nil

List of Open Source Software/learning website:

1. The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester.
2. NPTEL

w.e.f. AY 2018-19