

**Sri Eshwar College of Engineering
(Autonomous)**

Open Electives Offered by Mechanical Engineering

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	U19ME601	Product Design and Innovation	OE	3	3	0	0	3
2.	U19ME602	3D Printing and Tooling	OE	3	3	0	0	3
3.	U19ME603	Quality Management	OE	3	3	0	0	3
4.	U19ME604	Enterprise Resource Planning	OE	3	3	0	0	3
5.	U19ME605	Micro Electro Mechanical Systems	OE	3	3	0	0	3
6.	U19ME606	Quality Control Tools and Techniques	OE	3	3	0	0	3
7.	U19ME607	World Class Manufacturing	OE	3	3	0	0	3
8.	U19ME608	Industrial Safety Engineering	OE	3	3	0	0	3
9.	U19ME609	Introduction to Industry 4.0	OE	3	3	0	0	3
10.	U19ME610	Lean Six Sigma and Supply Chain Management	OE	3	3	0	0	3
11.	U19ME611	Business Organization and Development	OE	3	3	0	0	3
12.	U19ME612	Product Distribution and Promotion Management	OE	3	3	0	0	3
13.	U19ME613	Business Ethics, Corporate Social Responsibilities and Governance	OE	3	3	0	0	3

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SYLLABUS

U19ME601	PRODUCT DESIGN AND INNOVATION	L	T	P	C
		3	0	0	3

After completion of this course, the students will be able to

Outcomes	CO1	(Understand)	Understand the various techniques adopted for stimulating creativity and innovation		K2
	CO2	(Apply)	Apply the techniques to the design and development of new products		K3
	CO3	(Analyze)	Identify and analyse the product design and development processes in manufacturing industry.		K4
	CO4	(Apply)	Apply creative process techniques in synthesizing information, problem-solving and critical thinking.		K3
	CO5	(Apply)	Use the Product Design and Development Process, as a means to manage the development of an idea from concept through to production.		K3

MODULE I INTRODUCTION 9

Need for design creativity – creative thinking for quality – essential theory about directed creativity

MODULE II MECHANISM OF THINKING AND VISUALIZATION 9

Definitions and theory of mechanisms of mind heuristics and models : attitudes, Approaches and Actions that support creative thinking - Advanced study of visual elements and principles- line, plane, shape, form, pattern, texture gradation, color symmetry. Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation – Animation aerodynamics – virtual environments in scientific Visualization – Unifying principle of data management for scientific visualization – Unifying principle of data management for scientific visualization - Visualization benchmarking

MODULE III CREATIVITY 9

Methods and tools for Directed Creativity – Basic Principles – Tools of Directed Creativity – Tools that prepare the mind for creative thought – stimulation of new ideas – Development and Actions: - Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation The Bridge between man creativity and the rewards of innovativeness – Applying Directed Creativity to the challenge of quality management

MODULE IV DESIGN 9

Process Design, Emotional Design – Three levels of Design – Viceral, Behavioral and Reflective- Recycling and availability-Creativity and customer needs analysis – Innovative product and service designs, future directions in this application of creativity thinking in quality management

MODULE V INNOVATION**9**

Achieving Creativity – Introduction to TRIZ methodology of Inventive Problem Solving - the essential factors – Innovator’s solution – creating and sustaining successful growth – Disruptive Innovation model – Segmentive Models – New market disruption - Commoditization and DE-commoditization – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth – Passing the Baton

Total: 45 Hours**REFERENCES**

1. Clayton M. Christensen Michael E. Raynor, " The Innovator’s Solution", Harvard Business School Press Boston, USA, 2003
2. Donald A. Norman, " Emotional Design", Perseus Books Group New York , 2004
3. Geoffrey Petty, " how to be better at Creativity", The Industrial Society 1999
4. Rousing Creativity: Think New Now, Floyd Hurr, ISBN 1560525479, Crisp Publications Inc. 1999
5. Semyon D. Savransky, " Engineering of Creativity – TRIZ", CRC Press New York USA, " 2000

U19ME602**3D PRINTING AND TOOLING**

L	T	P	C
3	0	0	3

After completion of this course, the students will be able to

	CO1	(Understand) Understand history, concepts and terminology of additive manufacturing	K2
	CO2	(Apply) Apply the reverse engineering concepts for design development	K3
Outcomes	CO3	(Understand) Understand the variety of additive manufacturing techniques	K2
	CO4	(Apply) Design and develop newer tooling models	K3
	CO5	(Analyze) Analyse the cases relevant to mass customization and some of the important research challenges associated with AM and its data processing tools	K4

MODULE I INTRODUCTION**9**

Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits- Applications.

MODULE II REVERSE ENGINEERING AND CAD MODELING**9**

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation Software for AM- Case studies.

MODULE III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS**9**

Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes,

photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

MODULE IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 9

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications- Case Studies.

MODULE V TOOLING 9

Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications Case studies automotive, aerospace and electronics industries

Total: 45 Hours

REFERENCES

1. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.
2. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003
3. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
4. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
5. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.
6. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.

U19ME603	QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

After completion of this course, the students will be able to

CO1 **(Understand)** Acquire the basic concepts of total quality management and contributions by deming, juran and crossby. K2

CO2 **(Understand)** Acquire the knowledge of total quality management principles and apply the same in manufacturing and service organizations. K2

Outcomes

CO3 **(Apply)** Explain the various tools and techniques of total quality management and solve various quality related problems. K3

CO4 **(Apply)** Explain the various tools and techniques and apply the concepts of six sigma in the manufacturing & service sectors. K3

CO5 **(Apply)** Apply ISO 9000-2000 & iso 14000 quality systems in a K3

product and service organization.

MODULE I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

MODULE II TQM PRINCIPLES 9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

MODULE III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

MODULE IV TQM TOOLS AND TECHNIQUES II 9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

MODULE V QUALITY MANAGEMENT SYSTEM 9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration- Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

Total: 45 Hours

REFERENCES

1. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
4. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
5. ISO 9001-2015 standards

U19ME604	ENTERPRISE RESOURCE PLANNING	L	T	P	C
		3	0	0	3

Outcomes After completion of this course, the students will be able to
 CO1 **(Understand)** Provide an integrated view of the various facets of K2

business, including planning, manufacturing, sales, finance and marketing.

CO2	(Understand) Understand the development of software to integrate business activities such as inventory management and control, order tracking, customer service, finance and human resources.	K2
CO3	(Apply) Become aware of the software applications and tools that are available to business to use to drive out costs and improve efficiency.	K3
CO4	(Apply) Identify the important business functions provided by typical business software such as enterprise resource planning and customer relationship management	K3
CO5	(Analyze) Develop skills necessary for building and managing relationships with customers, and stakeholders.	K4

MODULE I ENTERPRISE RESOURCE PLANNING 10

Principle – ERP framework – Business Blue Print – Business Engineering vs Business process Re-Engineering – Tools – Languages – Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models –Process Models.

MODULE II TECHNOLOGY AND ARCHITECTURE 10

Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework.

MODULE III ERP SYSTEM PACKAGES 10

SAP, People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organisational and social issues.

MODULE IV ERP ARCHITECTURE 7

Overview – Architecture – AIM – applications – Oracle SCM.SAP: Overview – Architecture – applications - Before and after Y2k – critical issues – Training on various modules of IBCS ERP Package-Oracle ERP and MAXIMO, including ERP on the NET

MODULE V ERP PROCUREMENT ISSUES 8

Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies.

Total: 45 Hours

REFERENCES

1. ERPWARE, ERP Implementation Framework, Garg&Venkitakrishnan, Prentice Hall, 1999.
2. Jose Antonio Fernandez , The SAP R/3 Handbook, Tata Mcgraw Hill, 1998.
3. Sadagopan.S , ERP-A Managerial Perspective, Tata Mcgraw Hill, 1999.
4. Thomas E Vollmann and BeryWhybark , Manufacturing and Control Systems, Galgotia Publications, 1998.
5. Vinod Kumar Crag and N.K.Venkitakrishnan ,Enterprise Resource Planning –Concepts and

Practice, Prentice Hall of India, 1998.

U19ME605	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

After completion of this course, the students will be able to

CO1	(Understand)	Use mechanics principles to analyze the mechanical performance of microsystems.	K2
CO2	(Understand)	Be familiar with the tools and processes used in micromaching of microelectromechanical systems (MEMS).	K2
Outcomes	CO3	(Understand) Explain MEMS technology, present, future and challenges.	K2
	CO4	(Understand) Explain micro sensors, micro-actuators, their types and applications.	K2
	CO5	(Understand) Explain about fabrication processes for producing micro-sensors and actuators.	K2

MODULE I INTRODUCTION 9

Overview of MEMS and Microsystems: MEMS and Microsystems, Evolution of Micro fabrication, Microsystems and Microelectronics, Microsystems and miniaturization-Materials for MEMS and Microsystems: substrates and wafers, active substrate materials, Silicon, Gallium Arsenide, Piezoelectric Crystals, Polymers, Packaging materials-Working principles of Microsystems: micro sensors, micro actuation, MEMS with micro actuators, Micro accelerometers, micro fluidics-Applications of Microsystems in various industries.

MODULE II MECHANICS, SCALING AND DESIGN 9

Engineering Mechanics for Microsystems design: Introduction, Static bending of Thin Plates, Mechanical Vibration, Thermomechanics, Thermofluid, Engineering and micro system design, Laminar fluid flow, Incompressible fluid Flow, Heat conduction in solids-Scaling Laws in Miniaturization, Introduction to scaling, Scaling in (Electrostatic forces electromagnetic forces, Electricity, fluid mechanics, heat transfer)- Microsystems Design: Design Consideration, Process design, Mechanical Design, Design of Micro fluidic Network systems

MODULE III MICRO SYSTEM FABRICATION PROCESSES 9

Introduction- Photolithography- Ion implantation- Chemical Vapor Deposition-Physical Vapor Deposition - clean room- Bulk micromachining :etching, isotropic and anisotropic etching, wet and dry etching- Surface micro machining :process, mechanical problems associated with surface micro machining- LIGA process :general description, materials for substrates and photo resists-SLIGA process-Abrasive jet micro machining-Laser beam micro machining- Micro Electrical Discharge Micro Machining –Ultrasonic Micro Machining- Electro chemical spark micro machining- Electron beam micro machining-Focused Ion Beam machining

MODULE IV MICROSYSTEMS PACKAGING 9

Introduction - Microsystems Packaging-Interfaces in Microsystems Packaging-Essential Packaging

Technologies- Die preparation, surface bonding, wire bonding, sealing- Three dimensional Packaging- Assembly of Microsystems, Signal Mapping and Transduction

MODULE V MICROMETROLOGY AND CHARACTERIZATION 9

Microscopy and visualization- Lateral and vertical dimension- optical microscopy, Scanning white light interferometry, Confocal Laser scanning microscopy, Molecular measuring machine, Micro coordinate measuring machine- Electrical measurements – Physical and chemical analysis – XRD- SEM - Secondary Ion mass spectrometry- Auger Electron Spectroscopy, SPM

Total: 45 Hours

REFERENCES

1. Franssila, S., "Introduction to Micro Fabrication" John Wiley & sons Ltd, 2004.ISBN:470- 85106-6
2. Hsu, T.R., "MEMS & Microsystems Design and Manufacture", Tata McGraw Hill, 2002, ISBN: 9780070487093.
3. Hak M.G., "MEMS Handbook", CRC Press, ISBN: 8493-9138-5, 2006.
4. Jackson, M.J., "Microfabrication and Nanomanufacturing" Taylor and Francis 2006.
5. Jain, V.K., "Introduction to Micromachining" Narosa Publishing House, 2010.
6. McGeough, J.A., "Micromachining of Engineering Materials", CRC Press, ISBN: 0824706447, 2001.

U19ME606	QUALITY CONTROL TOOLS AND TECHNIQUES	L	T	P	C
		3	0	0	3

After completion of this course, the students will be able to

Outcomes	CO1	(Understand) Familiar with details of quality costs, economies and planning	K2
	CO2	(Understand) Control the quality of processes using control charts for variables in manufacturing/service industries.	K2
	CO3	(Understand) Good understanding and in depth knowledge has been imparted in the process capability study.	K2
	CO4	(Apply) Control the occurrence of defects in product or services industries	K3
	CO5	(Apply) Determine the acceptance sampling procedures are practiced.	K3

MODULE I QUALITY FUNDAMENTALS 9

Importance of quality- evolution of quality- definitions of quality- dimensions of quality- quality control- quality assurance- areas of quality- quality planning- quality objectives and policies- quality costs- economics of quality- Quality loss function- quality Vs productivity- Quality Vs reliability

MODULE II CONTROL CHARTS FOR VARIABLES 9

Process variation- preliminary decisions- control limits and their computation- construction and application of X bar, R and S charts - warning and modified control limits- process adjustment for trend- Comparison of process variation with specification limits- O.C. curve for X bar chart.

MODULE III STATISTICAL PROCESS CONTROL 9

Process stability- process capability study using control charts- capability indices- Cp, Cpk and Cpm – capability analysis using histogram and normal probability plot- machine capability study-gauge capability study- setting statistical tolerances for components and assemblies- individual measurement charts- X-chart, moving average and moving range chart, multi-variable chart.

MODULE IV CONTROL CHARTS FOR ATTRIBUTES 9

Limitations of variable control charts- Control charts for fraction non-conforming- p and np charts, variable sample size, operating characteristic function, run length- Control chart for nonconformities (defects)- c, u, ku charts, demerits control chart- applications.

MODULE V ACCEPTANCE SAMPLING 9

Need- economics of sampling- sampling procedure- single and double sampling- O.C. curves - Average outgoing quality- Average sample number- Average total inspection- Multiple and sequential sampling- Standard sampling plans- MIL Standards, Dodge-Roming, IS 2500.

Total: 45 Hours

REFERENCES

1. Douglas C. Montgomery, "Introduction to Statistical Quality Control", Wiley-India, Seventh Edition, 2013.
2. Krishnaiah K., "Applied Statistical Quality Control and Improvement", PHI, 2014.
3. AmitavaMitra, "Fundamentals of Quality Control and Improvement", Wiley, Third Edition, 2008.
4. Dale H. Besterfield, Quality Control, Pearson Education Asia, Eighth Edition, 2008.
5. Eugene L. Grant and Richard S. Leaven Worth, "Statistical Quality Control", McGraw-Hill Education, Seventh Edition, 2000.

U19ME607	WORLD CLASS MANUFACTURING	L	T	P	C
		3	0	0	3

After completion of this course, the students will be able to

Outcomes	CO1	(Understand) Understand the concept and the importance of manufacturing strategy for industrial enterprise competitiveness.	K2
	CO2	(Apply) Apply appropriate techniques in the analysis an devaluation of company's opportunities for enhancing competitiveness in the local regional and global context.	K3
	CO3	(Understand) Identify formulation and implement strategies for manufacturing and therefore enterprise competitiveness.	K2
	CO4	(Analyze) Analyzing how World Class Manufacturing technique can create value generation for organization.	K4
	CO5	(Apply) Apply smart techniques to bring competitive business culture for improving organization performance	K3

MODULE I INDUSTRIAL DECLINE AND ASCENDANCY 9

Manufacturing excellence - US Manufacturers - French Manufacturers - Japan decade – American decade - Global decade

MODULE II BUILDING STRENGTH THROUGH CUSTOMER – FOCUSED PRINCIPLES 9

Customer - Focused principles - General principles - Design - Operations - Human resources - Quality and Process improvement - Promotion and Marketing

MODULE III VALUE AND VALUATION 9

Product Costing - Motivation to improve - Value of the enterprises QUALITY - The Organization : Bulwark of stability and effectiveness - Employee stability – Quality Individuals Vs. Teams - Team stability and cohesiveness - Project cohesiveness and stability

MODULE IV STRATEGIC LINKAGES 9

Product decisions and customer service - Multi-company planning - Internal manufacturing planning - Soothing the demand turbulence

MODULE V IMPEDIMENTS 9

Bad plant design - Mismanagement of capacity - Production Lines - Assembly Lines – Whole Plant Associates - Facilitators - Teamsmanship - Motivation and reward in the age of continuous Improvement

Total: 45 Hours

REFERENCES

1. By Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacobs – “Operations Management for Competitive Advantage”, McGraw-Hill Irwin, ISBN 0072323159
2. Moore Ran, “Making Common Sense Common Practice: Models for Manufacturing Excellence”, Elsevier Multiworth
3. Narayanan V. K., “Managing Technology & Innovation for Competitive Advantage”, Pearson Education Inc
4. Korgaonkar M. G., “Just In Time Manufacturing”, MacMillan Publishers India Ltd.,
5. Sahay B. S., Saxena K. B. C., Ashish Kumar, “World Class Manufacturing”, MacMillan Publishers

U19ME608	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

After completion of this course, the students will be able to

	CO1	(Apply) Explain the fundamental concept and principles of industrial safety	K3
	CO2	(Apply) Apply the principles of maintenance engineering.	K3
Outcomes	CO3	(Analyze) Analyze the wear and its reduction.	K4
	CO4	(Evaluate) Evaluate faults in various tools, equipments and machines.	K5
	CO5	(Apply) Apply periodic maintenance procedures in preventive maintenance	K3

MODULE I INDUSTRIAL SAFETY 9

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.

MODULE II MAINTENANCE ENGINEERING 9

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.

MODULE III WEAR AND CORROSION AND THEIR PREVENTION 9

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.

MODULE IV FAULT TRACING 9

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.

MODULE V PERIODIC AND PREVENTIVE MAINTENANCE 9

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.

Total: 45 Hours

REFERENCES

1. L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005
2. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.
3. Edward Ghali, V. S. Sastri, M. Elboudjaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007.
4. Garg, HP, Maintenance Engineering, S. Chand Publishing.
5. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.

U19ME609	INTRODUCTION TO INDUSTRY 4.0	L	T	P	C
		3	0	0	3

Outcomes After completion of this course, the students will be able to

CO1	(Understand) Understand the basics of Industrial Revolution	K2
CO2	(Understand) Understand the basic concepts of Industry 4.0	K2
CO3	(Understand) Understand the Concepts of Industrial IOT in various sectors	K2
CO4	(Understand) Understand the applications of Industrial IOT	K2
CO5	(Understand) Understand the Business issues in Industry 4.0	K2

MODULE I INTRODUCTION TO INDUSTRY 4.0 9

The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - The Journey so far: Developments in USA, Europe, China and other countries - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

MODULE II ROAD TO INDUSTRY 4.0 9

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics

MODULE III IIOT 9

Fourth Revolution – Sustainability assessment of Manufacturing Industry – Lean Production system – Smart and connected business perspective – smart factories – cyber-physical systems – collaboration platform and PLM

MODULE IV APPLICATIONS 9

Inventory Management and Quality Control – Plant security and safety – Facility management – oil, chemical and Pharmaceutical Industry – Milk processing and packaging industries

MODULE V BUSINESS ISSUES IN INDUSTRY 4.0 9

Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world

Total: 45 Hours

REFERENCES

1. "The Fourth Industrial Revolution" by Klaus Schwab, World Economic Forum
2. "Internet of Things: A Hands-On Approach" by Arsheep Bahga and Vijay Madiseti, University Press
3. NOC: Introduction to Industry 4.0 and Industrial Internet of Things

U19ME610	LEAN SIX SIGMA AND SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

After completion of this course, the students will be able to

Outcomes	CO1 (Understand) Understand issues & challenges in implementing & developing lean manufacturing techniques from TPS & its contribution for improving organizational performance.	K2
	CO2 (Apply) Apply lean techniques to bring competitive business culture	K3

for improving organization performance

CO3	(Analyze) Analyze how lean techniques can be applied to manufacturing & service industry	K4
CO4	(Apply) Developing lean management strategy for Supply chain management	K3
CO5	(Analyze) Analyzing how lean technique can create value generation for organization.	K4

MODULE I INTRODUCTION TO LEAN AND SIX-SIGMA 9

Introduction to Lean- Definition, Purpose, features of Lean ; top seven wastes, Need for Lean, Elements of Lean Manufacturing, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six-sigma, origin of six-sigma, six-sigma concept, and Critical success factors for six-sigma. Evolution of lean six-sigma, the synergy of Lean and six sigma, Definition of lean six-sigma, the principles of lean six-sigma, Scope for lean six sigma, Features of lean sixsigma, the laws of lean six-sigma, Benefits of lean six-sigma.

MODULE II TOOLS FOR LEAN SIX- SIGMA 9

Define tools- Project Definition Form(PDF) and SIPOC; Measure tools- Process mapping, Parato chart, cause and effect matrix, FMEA, Brain-storming, NGT, Multi-voting, Cause & Effect diagram, Check sheets, Gauge R&R, Run charts, Control charts and process capability analysis; Analyze tools- scatter plots, ANOVA, Regression analysis and time trap analysis; Improve tools- Mistake proofing, KAIZEN, Reducing congestions and delays, SMED, TPM, Design of Experiments and the pull system; Control tools-SPC.

MODULE III DESIGN FOR LEAN SIX-SIGMA 9

Predicting and improving team performance, nine team roles, Team leadership, Team building & Team exercise. DMAIC process and toll gate reviews - Need for institutionalizing Lean Six- Sigma, Comply, commit, embed and encode; Steps in institutionalizing the Lean Six- Sigma; Objectives of Design for Lean Six-Sigma,Improving design velocity,Reducing product line complexity, Design for Lean Six-Sigma-QFD,TRIZ, Robust design.

MODULE IV CONCEPTS OF SUPPLY CHAIN 9

Service and manufacturing supply chain dynamics - Evolution of supply chain management -Multiple views and flows - Service supply chains -Manufacturing supply chains - Measures of supply chain performance - Differentiation-Bullwhip effect

MODULE V SUPPLY CHAIN PROCESSES AND STRATEGIES 9

Integrated supply chains design - Customer relationship process - Order fulfilment process - Supplier relationship process - Supply chain strategies - Strategic focus - Mass customization - Lean supply chains - Outsourcing and offshoring - Virtual supply chains.

Total: 45 Hours

REFERENCES

1. Forrest W. Breyfogle III, Implementing Six Sigma: Smarter solutions Using Statistical Methods, 1999
2. James P. Womack, Daniel T. Jones, Lean Thinking, Free press business, 2003
3. Michael L. George, Lean Six Sigma, McGraw-Hill, 2002.

4. Ronald G. Askin and Jeffrey B. Goldberg, Design and Analysis of Lean Production Systems, John Wiley & Sons, 2003.
5. Rother M. and Hook J., Learning to See: Value Stream Mapping to add value and Eliminate Muda, Lean Enterprise Institute, Brookline, MA.

U19ME611 BUSINESS ORGANIZATION AND DEVELOPMENT L T P C
3 0 0 3

After completion of this course, the students will be able to

Outcomes	CO1	(Understand) Explain the basic fundamentals of the business environment, organisational theory and marketing, including capacity to recognise and use relevant terminology	K2
	CO2	(Understand) Read, understand and critically evaluate the information contained in relevant academic texts.	K2
	CO3	(Understand) Organise and present information to a satisfactory standard in oral presentations, essays and reports.	K2
	CO4	(Understand) Give an idea about organisation structure and different types of organisation	K2
	CO5	(Understand) Provide idea about motivation, importance of foreign trade and Principles of coordinating the import and export	K2

MODULE I BUSINESS ENVIRONMENT 9

Nature and purpose of business, classification of business activities: industry, commerce and trade, objective of business and essential of successful business, economic environment –basic problems of scarcity and choice, allocation of resources ,opportunity cost, Business growth and measurement of size ,International Environment-balance of trade ,the trade gap ,and balance of payments, role and methods of trade protectionism, Business Ethics.

MODULE II BUSINESS STRUCTURE AND ORGANIZATION 9

Historical view of business development forms of business organization: sole proprietorship, partnership, joint stock companies, co-operative societies, public enterprise-Definition, Meaning, characteristics, Advantages and Disadvantages, Role of Government in business activity, organization charts.

MODULE III ELEMENTS OF BUSINESS ACTIVITY 9

Purchasing-choosing suppliers, overview of stock control, production-scale of production, main features of job, mass, and batch production systems, Marketing-concept and role of marketing, marketing mix, channels of distribution, Finance-sources of finance, assessing business performance.

MODULE IV HUMAN RESOURCES 9

Demographic trends and their impact on business concerns, unemployment-effects and types of unemployment, local trends in employment in various sectors, selection, recruitment, training of workers, motivation, basic knowledge of working age, contract of work, minimum wage, statutory hours of work, statutory benefits

MODULE V FOREIGN TRADE AND BANKING 9

Foreign trade-meaning, nature, importance, procedure of export and import, globalization, MNC, MNE,

Introductory idea about commercial banks-functions and services, Insurance-meaning, types, principles, benefits.

Total: 45 Hours

REFERENCES

1. Joel Dean - Managerial Economics, Prentice Hall/Pearson, 2007
2. Rangarajan - Principles of Macro Economics, Tata McGraw Hill
3. Marketing Management - Philip Kotler - Pearson Education- Millennium Edition
4. Gary Dessler, "Human Resource Management", Seventh edition, Prentice-Hall of India P.Ltd., Pearson

U19ME612	PRODUCT DISTRIBUTION AND PROMOTION MANAGEMENT	L	T	P	C
		3	0	0	3

After completion of this course, the students will be able to

Outcomes	CO1 (Understand) Understand the concepts of marketing management	K2
	CO2 (Understand) Learn about marketing process for different types of products and services	K2
	CO3 (Understand) Understand the tools used by marketing managers in decision situations	K2
	CO4 (Understand) Understand the marketing environment	K2
	CO5 (Understand) Demonstrate effective understanding of relevant functional areas of marketing management and its application.	K2

MODULE I INTRODUCTION 9

Marketing – Definitions - Conceptual frame work – Marketing environment : Internal and External - Marketing interface with other functional areas – Production, Finance, Human Relations Management, Information System. Marketing in global environment – Prospects and Challenges.

MODULE II PRODUCT DISTRIBUTION STRATEGY 9

Marketing strategy formulations – Key Drivers of Marketing Strategies - Strategies for Industrial Marketing – Consumer Marketing -- Services marketing – Competitor analysis - Analysis of consumer and industrial markets – Strategic Marketing Mix components.

MODULE III MARKETING MIX DECISIONS 9

Product planning and development – Product life cycle – New product Development and Management – Market Segmentation – Targeting and Positioning – Channel Management – Advertising and sales promotions – Pricing Objectives, Policies and methods.

MODULE IV BUYER BEHAVIOUR 9

Understanding industrial and individual buyer behavior - Influencing factors – Buyer Behaviour Models – Online buyer behaviour - Building and measuring customer satisfaction – Customer relationships management – Customer acquisition, Retaining, Defection.

MODULE V MARKETING RESEARCH & TRENDS IN MARKETING 9

Marketing Information System – Research Process – Concepts and applications : Product – Advertising – Promotion – Consumer Behaviour – Retail research – Customer driven organizations - Cause related marketing - Ethics in marketing –Online marketing trends.

Total: 45 Hours

REFERENCES

1. Philip Kotler and Kevin Lane Keller, Marketing Management, PHI 14th Edition, 2012
2. KS Chandrasekar, "Marketing management-Text and Cases", Tata McGraw Hill, First edition,2010
3. Lamb, hair, Sharma, Mc Daniel– Marketing – An Innovative approach to learning and teaching-A south Asian perspective, Cengage Learning -- 2012
4. Paul Baines, Chris Fill and Kelly Page, Marketing, Oxford University Press, 2nd Edition,2011.

U19ME613	BUSINESS ETHICS, CORPORATE SOCIAL RESPONSIBILITIES AND GOVERNANCE	L	T	P	C
		3	0	0	3

After completion of this course, the students will be able to

Outcomes	CO1 (Understand) Understand the importance of different perspectives of CSR in the business world	K2
	CO2 (Understand) Understand the importance of making informed, practical judgments based upon knowledge of sound ethical principles and motivations	K2
	CO3 (Understand) Understand CSR approach of multi-national companies	K2
	CO4 (Understand) Understand the ethical implications of business policies and decisions	K2
	CO5 (Understand) Understand the role of different stakeholders with regards to national systems of employment relations	K2

MODULE I INTRODUCTION 9

Definition & nature Business ethics, Characteristics, Ethical theories; Causes of unethical behavior; Ethical abuses; Work ethics; Code of conduct; Public good.

MODULE II ETHICS THEORY AND BEYOND 9

Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice-ethics for managers; Role and function of ethical managers- Comparative ethical behaviour of managers; Code of ethics; Competitiveness, organizational size, profitability and ethics; Cost of ethics in Corporate ethics evaluation. Business and ecological / environmental issues in the Indian context and case studies.

MODULE III LEGAL ASPECTS OF ETHICS 9

Political – legal environment; Provisions of the Indian constitution pertaining to Business; Political setup – major characteristics and their implications for business; Prominent features of MRTP & FERA. Social – cultural environment and their impact on business operations, Salient features of Indian culture and values

MODULE IV ENVIRONMENTAL ETHICS 9

Economic Environment; Philosophy of economic grow and its implications for business, Main features of

Economic Planning with respect to business; Industrial policy and framework of government contract over Business; Role of chamber of commerce and confederation of Indian Industries.

MODULE V CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE 9

Definition- Evolution- Need for CSR; Theoretical perspectives; Corporate citizenship; Business practices; Strategies for CSR; Challenges and implementation; Evolution of corporate governance; Governance practices and regulation; Structure and development of boards; Role of capital market and government; Governance ratings; Future of governance- innovative practices; Case studies with lessons learnt.

Total: 45 Hours

REFERENCES

1. S.A. Sherlekar, Ethics in Management, Himalaya Publishing House, 2009.
2. William B. Werther and David B. Chandler, Strategic corporate social responsibility, Sage Publications Inc., 2011
3. Robert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons, 2011.
4. W.H. Shaw, Business Ethics, Cengage Learning, 2007.
5. Beeslory, Michel and Evens, Corporate Social Responsibility, Taylor and Francis, 1978.