

**PG-Curriculum
(Structure and Course Contents)
Total Quality Management
With effect from July 2018**



**Centre for Total Quality Management
Punjab Engineering College
(Deemed to be University)
Chandigarh**

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PG Curriculum Structure

Semester I

Sr. No.	Course Stream	Course Code	Course Name	Credits	Segment {Fractal system (each section of 0.5 Credits and 7 contact hours)}					
					1	2	3	4	5	6
1.	Soft Computing	SCM5011	Internet of Things	1.5						
		SCM5012	Machine Learning	1.5						
2.	Soft Skills and Management	SSM5021	Communication Skills	1.5						
		SSM5022	Management Entrepreneurship and IPR	1						
		SSM5023	Professional Ethics	0.5						
3.	Program Core-I	TQM5011	Total Quality Management	1.5						
	Program Core-I	TQM5012	Business Excellence Practices and Frameworks	1.5						
4.	Program Core-II	TQM5021	Quality Management Systems & Standard	3.0						
5.	Program Elective-I: E1	TQM5101 TQM5102	<ul style="list-style-type: none"> • Problem Solving Tools & Techniques • Project Management 	1.5						
6.	Program Elective-II: E2	TQM5201 TQM5202	<ul style="list-style-type: none"> • Quality Tools & Techniques • Software Quality Management 	1.5						
7.	Engineering Mathematics (EM)	EMM5018	EM1: Statistical Techniques	1						
		EMM5013	EM2: Numerical Methods	1						
		EMM5012	EM3: Optimization Techniques and Evolutionary algorithm	1						
Total Credits				18						

Semester II

Sr. No.	Course Stream	Course Code	Course Name	Credits	Segment {Fractal system (each section of 0.5 Credits and 7 contact hours)}					
					1	2	3	4	5	6
1.	DoE & Research Methodology	DRM5011	Design of Experiments and Research Methodology	3						
2.	Program Core III	TQM5031	Statistical Process Control	1.5						
	Program Core III	TQM5032	Acceptance Sampling	1.5						
3.	Program Core-IV	TQM5041	Six Sigma Quality Management	3						
4.	Program Elective-III: E3	TQM5301 TQM5302	<ul style="list-style-type: none"> Reliability Engineering Performance Management 	1.5						
5.	Program Elective-IV: E4	TQM5401 TQM5402	<ul style="list-style-type: none"> Lean Manufacturing Measurement System Analysis 	1.5						
6.	Open Elective	Any One from the Open Elective Basket (to be offered by other branches to TQM)		3/ 2x1.5						
7.	Mini project/ Pre-dissertation	TQP5001		3						
Total Credits				18						

Summer Term *

SN o.	Course Code	Course Name	Credits
1		Industrial Visit(3 days to 1 week of visit, Submission and presentation of visit report)	Satisfactory/ Non-satisfactory

*After Examination of second semester, in the first week of summer vacation industry visit can be undertaken.

Semester-III

Course No.	Course Name	Credits	When it runs in a semester						
			1	2	3	4	5	6	
1.	Dissertation/Industry Project	14							

Semester-IV

Course No.	Course Name	Credits	When it runs in a semester						
			1	2	3	4	5	6	
1.	Dissertation/Industry Project	18							

Total credits – 68

- *20% courses/ semester can be offered in blended mode MOOC's/Industry.*
- *MOOC's/Industry offered course is having fractional credits. Industry offering course content will be designed by industry will be as per expert availability. Industry person will deliver and evaluate this subject. As per the duration of MOOC's/industry offered course, credits of this course can be decided (fractional credits).*

SEMESTER – I

SOFT COMPUTING

Course Name	:	Internet of Things
Course Code	:	SCM5011
Credits	:	1.5
L T P	:	2-0-2
Segment	:	1-3

Total No. Lectures: 14
Total no. of Lab Hrs: 14

Course Objectives:

The main objectives of this course are:	
1.	Understanding of core technology, applications, sensors used and IOT architecture along with the industry perspective.
2.	Principles and operations of different types of sensors commonly used on mobile platform will be taught in a manner that by the end of the course the students will be able to design and implement real time solutions using IOT.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	Introduction to IOT What is IoT, how does it work? Difference between Embedded device and IoT device, Properties of IoT device, IoT Ecosystem, IoT Decision Framework, IoT Solution Architecture Models, Major IoT Boards in Market , Privacy issues in IOT	2
2.	Setting Up Raspberry Pi/Arduino to Create Solutions Explore Raspberry Pi, Setting up Raspberry Pi, Showing working of Raspberry Pi using SSH Client and Team Viewer, Understand Sensing actions, Understand Actuators and MEMS.	3
3.	Communication Protocols used in IoT Types of wireless communication, Major wireless Short-range communication devices, properties, comparison of these devices (Bluetooth, WIFI, ZigBee, 6LoWPAN), Major wireless Long-range communication devices, properties, comparison of these devices (Cellular IoT, LPWAN)	3
4.	IoT Applications IoT Applications: Industrial Internet 4.0, Applications such as: Smart home, wearables, smart city, smart grid, , connected car, connected health(digital health, tele health, telemedicine), smart retail	3
5.	Sensors Applications of various sensors: Google Maps, Waze, WhatsApp, Ola Positioning sensors: encoders and accelerometers, Image sensors: cameras Global positioning sensors: GPS, GLONASS, IRNSS, Galileo and indoor localization systems, Motion & Orientation Sensors: Accelerometer, Magnetometer, Proximity Sensor, Gyroscope, Calibration, - noise modelling and characterization, and - noise filtering and sensor data processing, Privacy & Security, Selection of Sensors for Practical Applications	3

Lab Work:

Sr. No.	Lab contents	No. of Hours
1.	Setting up Raspberry Pi and Arduino	2
2.	Build small scale wireless communicating IOT device	4
3.	Integrate positioning sensors to IOT device	4
4.	Integrate motion and orientation sensors to IOT device	4

Course Outcomes:

At the end of the course, students will be able to:	
1.	Understand the concept of IOT
2.	Study IOT architecture and applications in various fields
3.	Study the security and privacy issues in IOT.
4.	Understand various applications of sensor in Industrial, healthcare, commercial, and building automation.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Vijay Madiseti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", VPT, 1st Edition	2014
2.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, 1st Edition	2013
3.	CunoPfister, "Getting Started with the Internet of Things", O'Reilly Media	2011
4.	Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing	2015

Course Name	:	Machine Learning
Course Code	:	SCM5012
Credits	:	1.5
L T P	:	2 0 2
Segment	:	4-6

Total No. Lectures: 14

Total No. of Lab hrs. 14

Course Objectives:

The main objectives of this course are:	
1.	To formulate machine learning problems corresponding to different applications.
2.	To understand a range of machine learning algorithms along with their strengths and weaknesses.
3.	To develop reasoning behind Model selection, model complexity, etc.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	BASICS OF MACHINE LEARNING: Applications of Machine Learning, processes involved in Machine Learning, Introduction to Machine Learning Techniques: Supervised Learning, Unsupervised Learning and Reinforcement Learning, Real-life examples of Machine Learning.	2
2.	Artificial Intelligence and its applications in relevant engineering branch.	2
3.	SUPERVISED LEARNING: Classification and Regression: K-Nearest Neighbour, Linear Regression, Logistic Regression, Support Vector Machine (SVM), Evaluation Measures: SSE, MME, R ² , confusion matrix, precision, recall, F-Score, ROC-Curve.	5
4.	UNSUPERVISED LEARNING: Introduction to clustering, Types of Clustering: Hierarchical-Agglomerative Clustering and Divisive clustering; Partitional Clustering - K-means clustering, Principal Component Analysis, ICA.	5

Lab Work:

Sr. No.	Lab contents	No. of Hours
1.	Python Introduction: Loops and Conditions and other preliminary stuff, Functions, Classes and Modules, Exceptions, Database access, Mathematical computing with Python packages like: numpy, Matplotlib, pandas Tensor Flow, Keras	8
2.	Application Oriented Project Work	6

Course Outcomes:

At the end of the course, students will be able to:	
1.	Design and implement machine learning solutions to classification, regression and clustering problems
2.	Evaluate and interpret the results of the different ML techniques

3.	Design and implement various machine learning algorithms in a range of Real-world applications.
4.	Use Python for various applications.

Bibliography:

Sr. No.	Book Detail	Year of Publishing
1.	Tom Mitchell, Machine Learning, McGraw Hill	2017
2.	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer	2011
3.	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e	2008
4.	Yuxi (Hayden) Liu, “Python Machine Learning By Example”, Packet Publishing Limited	2017

MOOCs on this course are available at:

- 1) Data Science: Machine Learning -<https://www.edx.org/course/data-science-machine-learning>
- 2) Machine Learning - <https://www.coursera.org/learn/machine-learning>

SOFT SKILLS
&
MANAGEMENT

Course Name	:	Communication Skills
Course Code	:	SSM5021
Credits	:	1.5
L T P	:	0-1-4
Segment	:	1-3

Total No. Tutorials-7
Total No. of Lab hrs – 28

Course Objectives:

The main objectives of this course are:	
1.	To enhance competence in communication skills: verbal and nonverbal.
2.	To provide orientation in technical communication skills: spoken and written.
3.	To sensitize students to attitude formation and behavioural skills.

Course Contents:

Sr. No	Course contents	No. of Tutorials
1.	Introduction to Communication Skills, Soft Skills and Interpersonal Communication	1
2.	Speech: Structure, Elements, Content, Organization and Delivery, J-a-M	1
3.	Writing Skills: Letters, Minutes of Meeting	1
4.	Technical Report Writing: Concept and Structure	1
5.	Research Writing: Concept and Structural Framework	1
6.	Power Point Presentation: Project Presentation	1
7.	Interviews	1

Lab Work:

Sr. No.	Lab contents	No. of Hours
1.	Self- Introduction	2
2.	Negotiation Skills & Role Play	2
3.	J-a-M Session	2
4.	Building Word Power through Reading	2
5.	Group Discussion and Case Study	4
6.	Writing Skills: Letters, Minutes of Meeting	2
7.	Technical Report Writing: Concept & Structure	4
8.	Research Writing: Concept and Structural Framework	4
9.	Power Point Presentation: Project Presentation	4
10.	Interviews	2

Course Outcomes:

At the completion of this course, students will be able:	
1.	To show enhanced competence in communication skills and technical communication.
2.	To develop awareness of attitude formation and behavioural appropriateness
3.	To gain self-confidence and perform better in their academic and professional life.

Bibliography:

Sr. No	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1.	“Technical Communication”, Raman Meenakshi and Sharma Sangeeta, Oxford University Press.	2015
2.	“English for Research Paper Writing”, Wallwork Adrian, Springer, London.	2011
3.	“English Vocabulary In Use: Advanced+ CD”, Michael McCarthy, CUP, Cambridge.	2004
4.	“Advanced English Grammar”, Hewings Martin, CUP, Cambridge.	2003
5.	“Study Listening”, Tony Lynch, CUP, Cambridge.	2004
6.	“Study Speaking”, Kenneth Anderson, CUP, Cambridge.	2010
7.	“Study Reading”, Glendenning H. Eric, CUP, Cambridge.	2004
8.	“Study Writing”, Hamp Lyons Liz & Heasley Ben, CUP, Cambridge.	2004
9.	“Study Skills in English”, Wallace Michael J., CUP, Cambridge.	2004

MOOCs on this course are available at:

- 1) “Take Your English Communication Skills to the Next Level”. Available at Coursera (Offered by Georgia Institute of Technology), 4 weeks, Starts on September 10, 2018. <https://www.coursera.org/learn/english-communication-capstone>
- 2) “Effective Communication in Globalised Workplace- The Capstone”. Available at Coursera (Offered by National University of Singapore), 3 weeks, Starts on August 06, 2018. <https://www.coursera.org/specializations/effective-communication>

Course Name	:	Management Entrepreneurship and IPR
Course Code	:	SSM5022
Credits	:	1
L T P	:	0-3-0
Segment	:	4-5

Total No. Tutorials – 14

Course Objectives:

The main objectives of this course are:	
1.	To make students familiar with the concepts of Management, Entrepreneurship and Intellectual Property Rights (IPRs).
2.	To make students understand how to initiate a new Start-up and manage it effectively.
3.	To enable students to convert their innovative ideas into different forms of IPRs.

Course Contents:

Sr. No	Course contents	No. of Tutorials
1.	Introduction to Management: Concepts and Principles of Management	1
2.	Functions of Management: Planning Process - Hypothetical Planning of an Event/Activity, Form of Organization Structure - Case Study, Human Resource Planning and Process, Elements of Directing and Effective Control Mechanism, Activity: Role Playing/Management Game	4
3.	Introduction to Entrepreneurship: Concepts of Entrepreneurship and Characteristics of Entrepreneurs	1
4.	Development Phases of Entrepreneurship: Innovation and Idea Generation, Project Formulation and Validation (Feasibility Analysis), Business plan	2
5.	Ecosystem for Entrepreneurship Development: Government Schemes and Initiatives, Financial and Non-Financial Institutional Support, Legal Framework, Role of Incubator, Venture Capitalist, Angel Investor, Crowd Funding Accelerator etc.	2
6.	Intellectual Property Rights (IPRs): Concept and Relevance of IPRs, Process for filing IPR	2
7.	Different Forms of IPRs: Patents, Copyright, Trademarks, Industrial Designs and Geographic Indicator	2

Course Outcomes:

At the completion of this course, students will be able to:	
1.	Develop and manage new project/Start-up.
2.	Apply managerial skills for success of entrepreneurial/business venture.
3.	Make effective use of IPR practices in their ventures.

Bibliography:

Sr. No	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1.	“Management Principles and Practice”, Srinivasan R. and Chunawalla S.A., Himalaya Publishing House.	2017
2.	“Introduction to Management”, Schermerhorn John R. Jr. And Bachrach Daniel G., 13 th Edition, Wiley Publications	2016
3.	“Principles & Practice of Management”, Prasad L.M., 8 th Edition, Sultan Chand & Sons.	2015
4.	“The New Era of Management”, Daft R.L., 11 th Edition, Pubs: Cengage Learning.	2014
5.	“Case Studies in Management”, Pandey Chandra Akhilesh, 2 nd Edition, I.K. International Publishing House Pvt. Ltd.	2015
6.	“Harvard Business Review: Manager’s Handbook”, Harvard Business School Press.	2018
7.	“Entrepreneurship”, TrehanAlpana, Dreamtech Press.	2016
8.	“Entrepreneurship and Small Business” Schaper Michael, Volery Thierry, Weber Paull and Lewis Kate, 3 rd Asia-Pacific Edition, Wiley Publications	2018
9.	“Harvard Business Review: Entrepreneur’s Handbook”, 1 st Edition, Harvard Business Review Press	2018
10.	“Take Me Home”, BansalRashmi, 1 st Edition, Westland.	2014
11.	“Intellectual Property Law”, Narayanan P., 3 rd Edition, Eastern Law House	2017
12.	“Intellectual Property Rights”, PandeyNeeraj and DharniKhushdeep, PHI Learning	2014
13.	“Intellectual Property Rights”, Rosedar S.R.A., LexisNexis (Quick Reference Guide – Q&A Series)	2016
14.	MSME Annual Publications (www.msme.gov.in)	Annual
15.	WIPO Annual Publications (www.wipo.int)	Annual

MOOCs on this course are available at:

- 1) “Entrepreneurship: Do Your Venture”, Available at edx (Offered by IIM Bangalore), Self-Paced (6 weeks).
<https://www.edx.org/course/entrepreneurship-do-your-venture>
- 2) “Becoming an Entrepreneur”, Available at edx (Offered by MIT), Self-Paced (6 weeks).
<https://www.edx.org/course/becoming-entrepreneur-mitx-launch-x-4>
- 3) “How to Build a Start-up”, Available at Udacity, Self-Paced (One Month).
<https://in.udacity.com/course/how-to-build-a-startup--ep245>
- 4) “Intellectual Property Rights: A Management Perspective”, Available at edx (Offered by IIM Bangalore), Starts on 1 August 2018 (6 weeks).
<https://www.edx.org/intellectual-property-rights-a-management-perspective>

Course Name	:	Professional Ethics
Course Code	:	SSM5023
Credits	:	0.5
L T P	:	0-3-0
Segment	:	6-6

Total No. Tutorials -7

Course Objectives:

The main objectives of this course are:	
1.	To imbibe ethical values and understanding.
2.	To develop moral thinking that will help students to recognize their potential.
3.	To engage and motivate the students to perform ethically in their professional life.

Course Contents:

Sr.No	Course contents	No. of Tutorials
1.	Introduction to Ethics: Concept of Ethics – Nature, Scope, Sources, Types, Functions and Factors influencing Ethics, Ethics in Engineering	2
2.	Ethics in Profession: Concepts of Honesty, Integrity, Reliability, Risk, Safety and Liability, Responsibilities and Rights of Professionals, Professional accountability.	2
3.	Ethics and Business: Concept of Business Ethics – Nature and Objectives, Ethical dilemmas in business ethics.	1
4.	Self-Development: Concept of Self-Assessment – SWOT Analysis, Self-Concepts, Self-Confidence, Self-Esteem, Managing Time and Stress, Human values.	2

Course Outcomes:

At the completion of this course, students will be able to:	
1.	Demonstrate knowledge and better understanding of self and to manage time and stress effectively.
2.	Have subjective well-being.
3.	Have ethical decision making ability in their personal and professional life.

Bibliography:

Sr.No	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1.	“Professional Ethics”, Subramaniam R., 2 nd Edition, Oxford University Press.	2017
2.	“Introduction to Psychology”, Kalat James W., 11 th Edition, Cengage Learning.	2017
3.	“Business Ethics – Text and Cases”, Murthy C.S.V., 1 st Edition, Himalaya Publishing House.	2014

4.	“A Foundation Course in Human Values and Professional Ethics”, Gaur R.R., Sangal R. and Bagaria G.P., Excel Books.	2010
5.	“Issues and Ethics in the Helping Professions”, Corey G., Corey M.S. and Callanan P., 8 th Edition, Brooks/Cole, Cengage Learning.	2010
6.	“The Curse of Self: Self-awareness, Egotism and the Quality of Human Life”, Leary M.R., 1 st Edition, Oxford University Press.	2007
7.	“Business Ethics”, Hartman L.P. and Chatterjee A., 3 rd Edition, Tata McGraw Hill.	2006
8.	“Business Ethics and Professional Values”, Rao A.B., Excel Books.	2006
9.	“Business Ethics – Concepts and Cases”, Velasquez M.G., 5 th Edition, Prentice Hall.	2001
10.	“Theories of Personality”, Hall C.S., Lindzey D. and Cambell J.B., 4 th Edition, Hamilton Printing Company.	1997

MOOCs on this course are available at:

1. “Ethics in Engineering Practice”. Available at SWAYAM(Offered by IIT Kharagpur), 8 weeks, Starts on August 27, 2018.
<https://swayam.gov.in/courses/4799-july-2018-ethics-in-engineering-practice>
2. “Ethics, Technology and Engineering”. Available at Coursera (Offered by EindhovenUniversity of Technology), 8 weeks, Starts on July 16, 2018.
<https://www.coursera.org/learn/ethics-technology-engineering>

PROGRAM CORE

Course Name	Total Quality Management
Course Code	TQM5011
Credits	1.5
L-T-P	2 1 0
Segment	1-3

Total No. of lectures -14
Total No. Tutorials - 07

Course Objectives:

The main objectives of this course are:	
1.	To introduce the importance of quality in improving competitiveness
2.	To develop competency in assessment of Cost of Poor Quality
3.	To sensitize students in role of leadership & employee engagements in building quality culture in organization

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Evolution of Global Quality movement, Post war scenario of quality: Japanese revolution – American response, Globalisation and quality, Competition & Customer expectations: Key drivers of Quality, Penetration of quality movement in Indian industry, Vision of Make In India – Zero Defect Zero Effect Basic Definitions of Quality, Definition and pillar of Total Quality Management (TQM), Basic philosophies and principles	4
2.	Various Quality Gurus & their contributions - Early Americans: Pioneering Efforts of Walter Shewhart & Edward Deming, Other Quality Gurus Joseph Juran, Philip Crosby, Armand Feigenbaum; Japanese Approach to TQM, Contribution of Japanese Gurus: Kaoru Ishikawa, Taiichiohno, Shigeo Shingo and Genichi Taguchi	4
3.	Economics of quality, Concept of right first time and its effect on income, Cost of Poor Quality: hidden losses and quality iceberg, Elements of Cost of Poor Quality, Objectives of calculating COPQ, Relating CoPQ to business measures	3
4.	Role of Leadership and Commitment in Quality Deployment, Quality Culture, Total Employee Involvement –Team Dynamic, Methods for employee engagements: Suggestion Schemes, Kaizen groups, cross functional teams, Quality Circles and other small group activities	3

Tutorials	No. of hours
Case Studies:- <ul style="list-style-type: none"> • TQM in manufacturing/Process Industries • TQM in service industry <ul style="list-style-type: none"> • Infrastructure, Health, Banking & Finance, IT & ITES (IT Enabled Services) • TQM in Government & Public Utilities 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Prioritize quality goals based on customer expectations & competition
2.	Identify improvement areas based on cost of poor quality
3.	Organize for quality and development of quality culture through small group activities

Bibliography:

Sr. No	Book Detail	Year of Publication
1.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
2.	Total Quality Management by Dale H. Besterfield	2011
3.	Quality Planning and Analysis for Enterprise Quality by Juran, J.M. and Gryna, F.M.	2007
4.	Total Quality Management: Text with Cases, John S. Oakland, Butterworth - Heinemann	2003
5.	Juran's Quality Handbook (5th Edition); Juran, J.M.; Godfrey, Blanton A; McGraw-Hill	2010
6.	Principles of Quality Costs: Principles Implementation and Use by Campanella, Jack;; American Society for Quality (ASQ), Quality Costs Committee; Signet	1999

Course Name	Business Excellence Practices and Frameworks
Course Code	TQM5012
Credits	1.5
L-T-P	2 1 0
Segment	4-6

Total No. of lectures -14

Total No. Tutorials - 07

Course Objectives:

The main objectives of this course are:	
1.	To introduce the system approach to quality management
2.	To develop competencies in performance measurement
3.	To enhance knowledge in business excellence frameworks and models

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Defining Business excellence, System approach to quality management; Strategic Planning: Vision, Mission, Objectives, Goals, Targets & Action Plans; Leveraging Quality and Business results	2
2.	Balanced Score Card Approach; Framework for Performance Excellence – Strategic Objectives- Financial Perspective, Customer Perspective, Internal Process Perspective, Learning & Growth Perspective Hoshin Kanri (Policy Deployment) - Japanese Framework for communicating strategic goals	3
3.	Using metrics for benchmarking and goal setting; Benchmarking: -Internal Benchmarking, Competitive Benchmarking, Process Benchmarking, Performance Benchmarking, Product Benchmarking, Strategic Benchmarking; Process of Benchmarking	2
4.	Business Excellence framework: Malcolm Baldrige Award, European Foundation Quality Model (EFQM), Deming Prize, Capability Maturity Model (CMM), Assessment for continuous improvement	4
5.	National Awards and Models: Rajiv Gandhi Award, CII Exim Award, Jamna Lal Bajaj Award, Golden Peacock Award, ZED (Zero Effect Zero Defect) maturity model	3

Tutorials	No. of hours
Case Studies:- <ul style="list-style-type: none"> • Balanced Score Card • Benchmarking • Business Excellence Frameworks • ZED maturity Model 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Relate vision, mission and organizational objectives with action plans and business results
2.	Develop plans for cascading strategic objectives to different layers of management using Balanced Score Card Approach and Policy Deployment.
3.	Develop plans for Benchmarking and assessment as per various excellence models

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	From Quality to Business Excellence by Charles G. Cobb, ASQ Publication	2003
2.	HoshinKanri: Policy Deployment for Successful TQM, YojiAkao, Productivity Press	2017
3.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
4.	Total Quality Managementby Dale H. Besterfield	2011
5.	Quality Planning and Analysis for Enterprise Quality by Juran, J.M. and Gryna, F.M.; 5 th Edition; Tata McGraw-Hill	2007
6.	Juran's Quality Handbook (5th Edition); Juran, J.M.; Godfrey, Blanton A; McGraw-Hill	2010
7.	Quality is Free by Philip B Crosby	2000
8.	Strategy Maps: Converting Intangible Assets Into Tangible Outcomes by David P. Norton, Harward Business School Publishing Corporation	2003
9.	Benchmarking: The Search for Industry Best Practices that Lead to Superior Performance, by Robert C. Camp, Taylor & Francis	2006

Course Name	Quality Management Systems & Standards
Course Code	TQM5021
Credits	3
L-T-P	21 0
Segment	1-6

Total No. of lectures -28
Total No. Tutorials - 14

Course Objectives:

The main objectives of this course are:	
1.	To introduce the principles of quality management
2.	To introduce new developments in ISO 9000: 2015 and overview of other sector specific quality standards
3.	To develop risk based thinking

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Introduction to modern Quality Management System, Historical Development of Quality standards leading to evolution of ISO; Objectives, principles and benefits of standardization and certification, ISO 9000 Quality Management System & Related Standards & Guidelines	3
2.	ISO 9000: 2015 series of standards: ISO 9001:2015: Quality Management System (QMS) - Requirements, ISO 9000:2015 QMS - Fundamentals and Vocabulary, ISO 9004:2009 QMS Managing for Sustained Success of Organization (Continuous Improvement), ISO 19011:2011: Guidelines for auditing management systems, Introduction to ISO: 9000:2015, Principals of Quality Management, Alignment of PDCA cycle and process approach	5
3.	Various clauses for ISO 9001:2015, Difference from earlier version (ISO 9001:2008), important terms: Context of the organization, Risk Based thinking, External service provider, documented information, change control, Failure Non-Conformance Analysis and Corrective Action	5
4.	Implementation, Certification and Audits; Steps for implementing ISO 9000:2015: Check list, Steps involved in certification, Quality Audit: Internal Audit, Second party audit, Third party audit, Surveillance audit Types of audits: System Audits, Process Audits, Product Audits	3
5.	7Epsilonfor in-process quality improvement, risk based thinking and organizational knowledge management	3
6.	Integrated Management System (IMS), ISO 9001/ISO 14001 (Environment Management System) / OHSAS18001 (ISO 45000), Introduction to other sector specific standards: Quality Management System Standards for Automobile Sector: IATF 16949:2016, AS9100 (Aerospace), ISO: 22000 and HACCP (Hazard & Critical Control Point) for Food industry	4
7.	Guidelines for Control and Measurement Processes - ISO 10012-3 Quality Management - Guidelines for Training - ISO 10015, Standards & accreditations for laboratory: ISO/IEC 17025:2005, ISO/IEC 17011:2004,	3

8	Good Manufacturing Practices (GMP), Good Laboratory Practices (GLP) in Pharmaceutical Industries, Standards & accreditations for laboratory: ISO/IEC 17025:2005, ISO/IEC 17011:2004	2
9.	Case Studies:- <ul style="list-style-type: none"> • Gap assessment in ISO 9001:2008 and ISO 9001:2015 • Risk assessment and Context of organization • System Audits • Process Audits • Gap assessment in TS 16949 and IATF 16949 	14

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Draft a roadmap for implementing to ISO 9001:2015
2.	Plan for migration from ISO 9001:2008 to ISO 9001:2015
3.	Plan internal audits for QMS

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	The Memory Jogger ISO 9001:2015: What Is It? How Do I Do It? Tools and Techniques to Achieve by Jeremy Hazel, José Domínguez, Jim Collins	2016
2.	Copy of standards for:- <ul style="list-style-type: none"> • ISO 9000:2015, ISO:9001:2015, ISO 9004, ISO 19011 • ISO 14001 • OHSAS 18001 • IATF 16949:2016 	2015 2016
3.	Lorri Hunt, The ISO 9001: 2015 Handbook: A Practical Guide to Implementation	2016

MOOCs on this course are available at:

1. Quality Management System Auditor Course (3.5 hours)
<https://www.udemy.com/iso-90012015-quality-management-system-auditor-course/>
2. ISO 9001 transition course (10 hours)
<https://www.udemy.com/iso-9001-2015/>
3. ISO 14001:2015 Environmental management system (2 hours)
<https://www.udemy.com/iso-140012015-environmental-management-system/>
4. OHSAS 18001 (2.5 hours)
<https://www.udemy.com/complete-health-and-safety-auditor-course-ohsas-18001/>

PROGRAM ELECTIVE

Course Name	Problem Solving Tools & Techniques
Course Code	TQM5101
Credits	1.5
L-T-P	2 1 0
Segment	1-3

Total No. of Lectures -14
No. of Tutorials - 07

Course Objectives:

The main objectives of this course are:	
1.	To equip students with the problem solving process
2.	To introduce students various problem solving methodologies
3.	To enhance competence in application of QC tools

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Problem solving: Problem Classification, Problem Solving Process, Elements of effective problem solving; Analytical & Creative thinking, Brainstorming, Scientific thinking mechanism	4
2.	Defining a Problem, 5W1H, Steps for problem solving: PDCA/PDSA cycle, Toyota's step methodology, QC story, A3 Problem Solving, Root Cause Problem Solving	3
3.	Application of QC tools in Problem Solving: Flow Chart, Cause and Effect Diagram, Why-Why Analysis, Data Collection (Tally Sheets, Check sheet, Check List), Stratification	4
4.	Pareto Analysis, Histogram, Scatter Diagram, Run chart	3

Tutorials		No. of Hours
1.	Case Studies:-	
	<ul style="list-style-type: none"> • Application of QC Story/PDCA cycle • Application of QC tools <ul style="list-style-type: none"> ○ Cause & Effect Diagram ○ Why-2 Analysis ○ Stratification ○ Pareto Chart ○ Histogram ○ Scatter diagram 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Apply steps of problem solving using analytical and creative thinking
2.	Use structured problem solving steps in solving problem of the industry.
3.	Apply the QC tools aptly

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
2.	Creativity Innovation and Quality by Plsek, E. Paul; Prentice-Hall of India Pvt. Ltd., New Delhi.	1997
3.	Kaizen and the Art of Creative Thinking, by Shiego Shingo	2007
4.	The Quality Toolbox by Tague, Nancy R; Second Edition; Pearson Education (Published by arrangement with American Society for Quality)	1995
5.	Juran's Quality Handbook (5th Edition);Juran, J.M.; Godfrey, Blanton A; McGraw-Hill	2010

MOOCs on this course are available at:

1. Problem Solving & Decision Making: Tools & Techniques (3 hours)
<https://www.udemy.com/problem-solving-tools-techniques-methods/>
2. Mastering seven QC tools (2hours 20 min)
<https://www.udemy.com/intro-to-quality-engineering-the-seven-quality-tools/>

Course Name	Project Management
Course Code	TQM5102
Credits	1.5
L-T-P	2 1 0
Segment	1-3

Total No. of Lectures -14
No. of Tutorials - 07

Course Objectives

The main objectives of this course are:	
1.	To enhance competence as a Project Manager
2.	To equip students with the process of feasibility analysis and risk analysis
3.	To provide skill in project time management

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Introduction to project management: What is a project: Project Characteristics; Relationship between Project Management, Operations Management, Role of the Project Manager, Skill requirements and functional competencies of the project manager, Project Team	2
2.	Six Variables of Project Management: Timescales, Costs, Quality, Scope, Benefits and Risk, Project Life Cycle, Process Model and Project Timeline, Principles, Critical aspects (Themes) of Project Management – Business Case, Organization, Quality, Plan, Risk, Change, Progress	3
3.	Stakeholder categories, level of organization, Roles and responsibilities, change authority, communication strategies, Project Quality- Quality Planning, Quality Assurance, Quality Control Project performance control: Reporting system – Process evaluation – Auditing	2
4.	Project risk management: Understanding risk and uncertainty, identifying risks: planning for risk responses, strategies for positive and negative risks, techniques for controlling risks	2
5.	Project evaluation/appraiser: Market feasibility, Technical feasibility, Financial feasibility: Net present value (NPV), Future Value, Internal rate of return (IRR), Payback period, Cash flow, Cost Vs. Benefit analysis	2
6.	Project Time Management, defining activities, sequencing, estimating time and resources for activities, tools and techniques for preparing a project timeline, Critical Path Method (CPM), Gantt chart, Using three point estimation, Program Evaluation and Review Techniques (PERT) to determine schedule durations under uncertainty. Introduction to Software packages for Project Management	3

Tutorials	No. of Hours
Case Studies:- Case studies demonstrating the applications of; <ul style="list-style-type: none"> • Project risk evaluation • Financial Evaluation • Project Time Management 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Define the Critical success factors of a project
2.	Do Financial feasibility of a project and help a start up in making project report
3.	Use project management software for project time management and resource allocation.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Project Management Heerkens, Gary R.; Tata McGraw Hill, New Delhi	2003
2.	Projects, Planning, Analysis, Selection, Financing, Implementation, and Review Chandra, Prasanna;; 8 th Edition; Tata McGraw Hill, New Delhi	2017
3.	Managing Projects Large and Small; The Fundamental Skills for Delivering on Budget and on Time; Harvard Business School Press, Boston	2011

Course Name	Quality Tools & Techniques
Course Code	TQM5201
Credits	1.5
L-T-P	2 1 0
Segment	4-6

Total No. of Lectures -14
No. of Tutorials - 07

Course Objectives:

The main objectives of this course are:	
1.	To enhance competence in application of Advanced (New) Quality Tools
2.	To develop competencies in planning and prevention tools
3.	To equip students with armoury of tools for collective decision making

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Advanced (New) Quality Tools: Affinity Diagram, Relationship Diagram, Tree Diagram, Matrix Diagram, Matrix Data Analysis Diagram, Process Decision Program Chart, Arrow Diagram	6
2.	Planning and Preventative Tools: Quality Function Deployment (QFD); FMEA (Design), FMEA (Process); Fault Tree Analysis, Process Validation, Process Control Plan	5
3.	Team decision making and other tools: Nominal group technique, Force field analysis, stake holder analysis, Cause & effect matrix	3

Tutorials		No. of Hours
1.	Case Studies:-	
	Case studies having the application planning and prevention tools <ul style="list-style-type: none"> • Advanced (New) Quality Tools • FMEA • Control Plan 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Capture verbal data by applying new QC tools
2.	Make QFD and FMEA (Design) for better product design
3.	FMEA (Process) and Control plan for better process design

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
2.	Total Quality Management by Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre, Pearson Educaiton	2003
3.	AIAG's Failure Mode Effects Analysis (FMEA) 4th Edition	

Course Name	:	Software Quality Management
Course Code	:	TQM5202
Credits	:	1.5
L T P	:	3 0 0
Segment	:	4-6

Total No. Lectures: 21

Course Objectives:

The main Objectives of this course are:	
1	To make the students understand the quality management process in the development of software.
2	To make the students understand the importance of standards in the quality assurance process and their impact on the final product.

Course Contents:

Sr. No.	Course contents	No. of Lectures
1.	Software Process assessment overview - Assessment phases - Assessment principles - Assessment conduct - Implementation consideration - Quality management - Quality assurance plan - Considerations – Verification and Validation.	6
2.	Need for configuration Management - Software product nomenclature - configuration management functions - Baselines - Responsibilities - Need for automated tools - plan – SCM support functions - The requirement phase Design control - The implementation phase - Test phase - SCM Tools - Configuration accounting and audit.	5
3.	Definitions - Reason for software standards - Benefits - Establishing standards - Guidelines	5
4.	Types of reviews - Inspection of objectives - Basic inspection principles - The conduct of inspection - Inspection training.	5

Course Outcomes:

At the end of the course, students will be able to:	
1.	Distinguish between the various activities of quality assurance, quality planning and quality control

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	John W. Horch, Practical Guide to Software Quality Management, Artech House	2003
2.	Roger S Pressman, Bruce R. Maxim, Software Engineering - A Practitioner's approach, 8 th edition, McGraw Hill	2014
3.	Gerard O'Regan, A Practical Approach to Software Quality, Springer Science & Business Media	2012
4.	Norman Fenton, James Bieman, Software Metrics: A Rigorous and Practical Approach, Third Edition, CRC Press	2014

ENGINEERING MATHEMATICS

Course Name	:	Statistical Techniques
Course Code	:	EMM5018
Credits	:	01
L T P	:	2-0-2
Segment	:	1-2

Total No. of Lectures– 10

Total No. of Lab hrs -10

Course Objectives:

The main Objectives of this course are:	
1	To make the students understand the concepts of random variable and probability distributions.
2	To make the students able to solve problems on Binomial, Poisson and Normal distributions, sampling distributions and hypothesis testing.

Course contents:

Sr.No.	Course Contents	No. of Lectures
1	Random Variable, Discrete and continuous probability distributions, mean, variance, joint probability distribution, covariance, Binomial, Poisson and Normal distributions	06
2	Sample, Sampling distributions, Central Limit Theorem, Hypothesis Testing	04

Lab Work:

Sr.No.	Lab. Contents	No. of Hours
1.	Use of statistical functions in statistical software	10

Course Outcomes:

At the end of this course the students will be able to	
1	Understand random variable and probability distributions.
2	Solve problems based on probability distributions, sampling distributions and hypothesis testing
3	Use software to create tables and charts

Bibliography:

Sr. No.	Name of Book / Authors / Publishers	Year of Publication/ Edition
1	“Statistics for Management”, Levin, Rubin, Siddiqui and Rastogi, Pearson , eighth edition	2017
2	“Probability and statistics for Engineers and Scientists”, Walpole, Myers, Myers and Ye, Pearson Education, 7 th edition.	2002
3	“Introduction to Mathematical Statistics”, Hogg and Craig, Pearson Education, 5 th edition.	2002
4	“Miller and Freund’s: Probability and Statistics for Engineers”, Richard A. Johnson, 6 th edition.	2002
5	“John E. Freund’s: Mathematical statistics with Application”, Miller and Miller, Pearson Education, 7 th edition.	2003

Course Name	:	Numerical Methods
Course Code	:	EMM5013
Credits	:	01
L T P	:	2-0-2
Segment	:	3-4

Total No. of Lectures– 10
Total No. of Lab hrs -10

Course Objectives:

The main Objectives of this course are:	
1	To make the students understand the basics of numerical methods.
2	To make the students able to solve problems on system of linear equations and Interpolation by numerical methods.

Course contents:

Sr.No.	Course Contents	No. of Lectures
1	Error Analysis: Definition and sources of errors, Propagation of errors, Floating-point arithmetic and rounding errors.	02
2	Interpolation: Interpolation using Finite differences, Numerical Differentiation and Numerical integration, Trapezoidal and Simpson's rules.	04
3	Numerical Solution of Differential Equations: Picard's method, Taylor series method, Euler and modified Euler methods, Runge-Kutta methods, Predictor-Corrector method.	04

Lab Work:

Sr.No.	Lab. Contents	No. of Hours
1.	Solving Interpolation, Numerical Differentiation and Numerical integration problems using Mathematica.	04
2.	Solving Differential equations numerically using Mathematica.	06

Course Outcomes:

By the end of the course, the students will be able to :	
1.	Problems on Interpolation
2.	Problems on Differentiation, Integration
3.	Solve differential equations.

Bibliography:

Sr. No.	Name of Book / Authors / Publishers	Year of Publication/ Edition
1	“Introduction to Numerical Analysis”, Atkinson K. E., John Wiley.	1989
2	“Applied Numerical Analysis”, Gerald C. F. and Wheatley P. O., Pearson	2004
3	“Numerical Methods for Scientific and Engineering Computation”, Jain M. K., Iyengar S.R.K. and Jain R. K., New Age International Publisher.	2004
4	“Elements of Numerical Analysis”, Gupta R.S., Macmillan India Ltd .	2008

Course Name	:	Optimization Techniques and Evolutionary Algorithms
Course Code	:	EMM5012
Credits	:	01
L T P	:	2-0-2
Segments	:	5-6

**Total No. of Lectures – 10,
Total No. of Lab hrs -10**

Course Objectives:

The main objectives of this course are:	
1	To make the students understand the need of Optimization Techniques and develop the ability to form mathematical model of optimization problems.
2	To make the students able to identify and solve various optimization problems using Evolutionary Algorithms.

Course contents:

Sr.No	Course Contents	No. of Lectures
1	Introduction to optimization problem, local and global optimum, conversion of a constrained problem to unconstrained problem.	02
2	Basic steps of an Evolutionary Algorithm, Genetic Algorithm, (GA), Coding and decoding of variables, starting population, fitness evaluation, reproduction, crossover, mutation and evaluation in Genetic Algorithm; Evolutionary Strategies and Particle swarm optimization.	08

Lab Work:

Sr.No	Lab. Contents	No. of Hours
1.	Using Evolutionary Algorithms in various optimization Problems	10

Course Outcomes:

1	The students are able to form mathematical model of optimization problems .
2	The students are able to apply evolutionary algorithms to problems.
3	The students are able to solve simple problems using Mathematica/MATLAB

Bibliography:

Sr.No.	Name of Book / Authors / Publishers	Year of Publication/ Edition
1	Optimization for engineering Design, Algorithms and Examples, Kalyanmoy Deb, PHI	2005
2	“Practical Genetic Algorithms”, Haupt, R. L. and Haupt, S.E., John Wiley & Sons	1998
3	“Genetic Algorithm in Search, Optimization and Machine Learning” , Goldberg, D.E., Addison Wesley.	1989
4	“Engineering Optimization”, Ranjan, Ganguli, University Press.	2011

SEMESTER – II

**DESIGN OF
EXPERIMENTS
&
RESEARCH
METHODOLOGY**

Course Name	Design of Experiments and Research Methodology
Course Code	DRM5011
Credits	3
L-T-P	2 02
Segment	1-6

Total No. Lectures – 28
Total No. of Lab hrs – 28

Course Objectives

	The main objectives of this course are:
1.	To introduce objective of research for various types of research
2.	To enhance competence analysing experimental results
3.	To enhance competence in understanding mathematical relation between process variables and results
4.	To introduce contribution of Taguchi in designing, analysing and interpreting experiments.

Course Contents:-

Module I

Sr. No.	Course Contents	No. of lectures
1.	Introduction: Types of Research and Their Purposes, Locating, Analyzing, stating and evaluating research problem, need for literature review, steps in conducting literature review, SWOT analysis, research questions and hypothesis, types of hypothesis, evaluation of hypothesis.	4
2.	Statistical Methods of Analysis: Descriptive statistics, Inferential statistics, Various Tests of significance based on type of input and output data, Steps involved in testing for significance, concept of p value, testing for means, Testing for variance, chi-square test- Goodness of fit, test of independence, Analysis of variance (ANOVA) - one-way, Correlation, Regression analysis	8
3	Procedure for writing a research report and manuscript: steps of writing a report, layout of report, layout of research paper, ethical issues related to publishing, Plagiarism and Self-Plagiarism.	2

Module-II (For Circuital Branch)

4	Research Design and Sampling Design: Concept of research design, features of a good research design, concept of population and sample, characteristics of sample design, types of sampling techniques	6
5	Methods of data collection and measurement: Primary data and Secondary data, data collection techniques: observation, interview, questionnaires, schedules, case-study, levels of measurement, problems in measurement in research – validity, reliability.	8

Module-III (For non-Circuital Branch)

4.	Engineering Research: Planning & management of experiments; Conventional method for experiment: One factor at a time (OFAT) experiment, Concept of design of experiments: Common terms, Designed experiment, Procedure for two-way ANOVA Full factorial experiments: Orthogonality of experiments, $Y = F(x)$ for DoE, main effect analysis, interaction analysis and results	4
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5.	Fractional factorial experiments, Resolution of design, screening DoE, practicing with statistical software, Optimizing using Response Surface Methodology (RSM)	4
6.	Taguchi Methods: Difference between conventional DoE and Taguchi methods, Orthogonal arrays, Taguchi's Robust parameter design, Noise factors, S/N ratio, Selection of right orthogonal array	5

Lab Work: (For Circuital Branch)

Sr. No.	Lab contents	No. of Hours
1.	Select a problem from your area of interest, identifying the type of research problem it is and perform the SWOT analysis of the existing literature.	4
2.	Generate research questions and hypotheses for a problem from your area of interest.	4
3.	Identify the population and sample for the study (highlighting the technique used for sample selection) for a problem from your area of interest.	4
4.	Design a questionnaire for the problem of interest.	4
5.	Utilizing software such as SPSS, Mini Tab, etc. for the statistical analysis of the results obtained for the desired questionnaire.	6
6.	Preparing a research paper for the problem of interest	6

Lab Work:- (For non-Circuital Branch)

Performing following analysis using statistical software		
1.	Hypothesis tests (Z-test, t-test, 2t test, paired t-test, Chi s square and test of equal variance etc)	5
2.	Correlation analysis between independent events, Regression analysis for dependent variables (having cause & effect) and developing $Y = F(x)$	5
3.	One-way ANOVA, Two-way ANOVA, General Linear Model	5
4.	Creating and analysing 2^k Experiments (Full & Fractional Factorial) and General Full Factorial Design	5
5.	Development of model using Response Surface Methodology	4
6.	Creating and analysing Taguchi design	4

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Plan a research activity including sample design, scaling, data collection and analysis
2.	Perform a required statistical analysis for the a research/ experiment
3.	Understand the relationship between process variables and output as $Y = f(x) + \square$
4.	Select the appropriate orthogonal array for a Taguchi design

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Design and Analysis of Experiment, Douglas C Montgomery, John Wiley & Sons	2016
2.	Taguchi Techniques for Quality Engineering Phillip, J. Ross; The Tata McGraw-Hill	2017
3.	Research Methodology - Methods and Techniques, C. K. Kothari, New Age International, 2nd Edition	2004

PROGRAM CORE

Course Name	Statistical Process Control
Course Code	TQM5031
Credits	1.5
L-T-P	2 0 2
Segment	1-3

Total No. of Lectures-14
Total No. of Lab hrs – 14

Course Objectives

The main objectives of this course are:	
1.	To understand the concept of variation and its impact on competitiveness
2.	To develop competence in computing process capability
3.	To develop competence in constructing control charts

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Introduction: Quality control, application of statistics in quality control: Statistical Process Control, Acceptance sampling Concept of variation, cause of variation: Common Cause & Special Cause of variation, Natural control limits of process, stable v/s capable process, Impact of variability in competitive environment, Loss function: traditional loss function, Taguchi's loss function	5
2.	Process Capability Analysis, Process capability indices: Cp, Cpk Process performance analysis from short pre- production; Pp, Ppk Taguchi's Index for process capability : Cpm, Setting Tolerances for Assembly and Components Process capability for attribute data; DPU (defects per unit), DPMO (defects per million opportunity, RTY (Rolled throughput yield)	4
3.	Control Charts for Variables – X Bar-R Charts, X Bar-s Charts, Individual Moving Range (IMR) Charts, Exponentially Weighted Moving Average (EWMA) Control charts and Control Charts for Attributes – p-Charts, np-Charts, c-Charts, u-Charts Analysis of Patterns in Control Charts	5

Sr. No.	Lab Contents	No. of Hours
Application of following tools in real life scenario by selecting a process/machine from the institute or in industry		
1.	Process capability from pre-production run	2
2.	X-bar –R control chart	4
3.	Process capability Analysis from control chart	2
4.	P-chart/NP-chart	2
5.	C-chart/U-chart	2

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Evaluate process capability from pre-production run as well as from a stable process
2.	Compute DPMO and RTY for processes generating discrete quality data.
3.	Draw and interpret control charts for variable as well as attribute data for different types of manufacturing processes and service activities.

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Statistical Quality Control by Eugene L. Grant, McGraw-Hill Series in Industrial Engineering and Management	2017
2.	Introduction to Statistical Quality Control by Douglas C. Montgomery, John Wiley & Sons	2016
3.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
4.	Automotive Industry Action Group (AIAG) manual of Statistical Process Control	2005

Course Name	Acceptance Sampling
Course Code	TQM5032
Credits	1.5
L-T-P	2 1 0
Segment	4-6

Total No. of Lectures -14
Total No. of Tutorials – 7

Course Objectives

The main objectives of this course are:	
1.	To understand the concept of sampling and its application in <i>acceptance sampling</i>
2.	To understand the various types of sampling plans.
3.	To develop competence in designing sampling plans and interpreting the standard plans

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Concept of population and sample, Sampling methods, Sampling risks and indices (Type I & Type II errors) Producer's risk (AQL), Consumer's risk (LQL), Operating Characteristic Curve (OCC), Effect of lot size, sample size and acceptance number, Average Outgoing Quality Limit (AOQL): AOQ graph, Calculation of AOQL	5
2.	Types of sampling plans: Attribute – Variable – Single sampling – Double sampling – Multiple sampling – Sequential sampling; Designing Acceptance Sampling Plans, Steps in referring Acceptance sampling plans for attributes and acceptance sampling plans for variables, Switching rules for Normal, tightened, reduced inspection Statistical tolerance limits for normal distribution	5
3.	Dodge-Romig sampling plans based on LQL, Plans based on AOQL Chain Sampling Plan (Ch SP), Sampling plans for continuous production: Continuous sampling inspection, skip lot sampling plan, Bulk sampling	4

Tutorials	No. of Hours
Case Studies:- <ul style="list-style-type: none"> • Economizing inspection cost through selection of appropriate sampling plan • Protecting consumer risk through C=0 plans • Economizing inspection cost through at a given consumer risk using skip lot plans 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Draw the operating characteristics curve for any plan and comment on its discriminatory power
2.	Design a sampling plan for a given Producer and consumer risk based
3.	Refer the standard sampling plans as per IS 2500 and ISO 2859

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Statistical Quality Control by Eugene L. Grant, McGraw-Hill Series in Industrial Engineering and Management	2017
2.	Introduction to Statistical Quality Control by Douglas C. Montgomery, John Wiley & Sons	2016
3.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
4.	IS 2500-1: 2000 Sampling Inspection Procedures, Part 1: Attribute Sampling Plans Indexed by Acceptable Quality Limit (AQL) for Lot-by-Lot Inspection	2000
5.	IS 2500-2: 1965 Sampling Inspection Procedures, Part 2: Inspection by Variables For Per cent Defective	1965
6.	IS 2500-3: 1995 Sampling Inspection Procedures, Part 3: Attribute Sampling Plans Indexed by Limiting Quality (LQ) for Isolated Lot Inspection	1995

Course Name	Six Sigma Quality Management
Course Code	TQM5041
Credits	3
L-T-P	2 0 2
Segment	1-6

Total No. of Lectures-28

Total No. of Lab hrs– 28

Course Objectives

	The main objectives of this course are:
1.	To provide knowledge about the six sigma organization
2.	To equip the students with step by step execution of six sigma project
3.	To develop competence in application of armoury of six sigma tools

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	History & Evolution of Six Sigma, Basic Concepts of Six Sigma, Cultural Imperatives for six sigma capabilities, Six Sigma Organization: Roles and responsibilities, Role of Leadership in building Six Sigma culture, Guidelines and Selection of belts for projects Project life Cycle, right team and managing team performance	4
2.	Understanding of Deployment Strategies- Business goals, including financial goals, Customer requirements, and current performance level, dash boards, selecting right projects, Overview of Six Sigma Project Execution based on DMAIC (Define – Measure – Analyze – Improve – Control) Project reviews	3
3.	Defining Phases for Six Sigma, Project Charter, Identify customer requirement: capturing Voice of Customer (VoC), analysing VoC: affinity diagram – Kano model – CTQ tree – Quality Function Deployment, Function Tree Diagram, High level mapping (SIPOC- Supplier-Input-Process-Output-Customer)	4
4.	Steps from measure, Process Mapping, Planning for data collection, validating measurement system, quantifying current performance, working through a sample six sigma project on Define and Measure Phase	4
5.	Steps for analyse, improve & Control, analysing root cause: application of quality and management tools, Control impact matrix, Cause & Effect matrix, validating root cause, Countermeasure matrix, application of lean tools in improvement, Project closures, working through a sample six sigma project on analyse, improve and control phase	4
6.	Shainin DoE Tools: Concept of Red X and Green X, Dominant cause of variation and progressive search, Clue generation, component search, variable search, paired comparison (BoB v/s WoW), B v/s C, concentration chart, multi-vari chart, Pre Control charts	5
7.	Design for six sigma: DFSS phases: Define – Measure – Analyze – Design – Verify	2
8.	Lean Six Sigma for logistics: Total supply chain acceleration, Integrating lean with six sigma	2

Sr. No.	Lab Contents	No. of Hours
Projects		
Students will do field visit for collecting necessary information. Visit may be to an Industry, a fast food outlet, a Hospital, a BPO or any business entity highly engaged with its customers. They will be using the pertinent tools from the following set of tools for understanding voice of customer (VoC), cascading VoC to CTQ, Process mapping and data collection;		
1.	Check list to capture VoC	6
2.	CTQ Tree	4
3.	Kano Model	2
4.	SIPOC	2
5.	Process Mapping	4
6.	Data Collection Plan	2
Two case studies shall be discussed in the classroom (one from manufacturing and one from service sector). Students will be draft project charter covering:		
1) Business case, 2) Problem Statement, 3) Goal Statement 4) Constraints 5) Scope, 6) Team 7) Timeline		8

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Deploy culture required for six sigma quality management
2.	Select a six sigma project
3.	Draft a project charter
4.	Apply DMAIC methodology in a structured way & select pertinent tools during each phase

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	The Certified 6 Sigma Green belt Handbook by Roderick A Munro, Mathew J Maio, Mohamed B. Nawaz, Govindrajan Ramu	2015
2.	The Six Sigma Way by Peter Pande, Robert Neuman, Roland Cavanagh, McGraw Hills	2006
3.	World Class Quality” Bhote, K.R. “American Management Association, New York.	2000
4.	Lean Six Sigma by Michael L George by McGraw Hills	2005

MOOCs on this course are available at:

1. Six Sigma – Define & Measure Phase
<https://www.edx.org/course/six-sigma-define-measure-tumx-qpls1x-0>
2. Six Sigma – Analyse-Improve-Control
<https://www.edx.org/course/six-sigma-analyse-improve-control-tumx-qpls2x-0>

PROGRAM ELECTIVE

Course Name	Reliability Engineering
Course Code	TQM5301
Credits	1.5
L-T-P	2 1 0
Segment	1-3

Total No. of Lectures -14
No. of Tutorials – 07

Course Objectives:

The main Objectives of this course are:	
1	To make the students understand the relationship between reliability, maintainability and availability of a system.
2	To provide knowledge of constant failure rate models and time dependent failure models
3	To enhance competency in assessment of system reliability and design for reliability
4	To give the appreciation level knowledge of various reliability testing methods

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Introduction to reliability engineering, Relationship between reliability, maintainability and availability, Availability – Operational, Inherent and Achieved; MTBF and MTTR Trade off, MTTR Prediction	3
2.	Failure distribution, Reliability function – Mean time to failure – Hazard rate function – Bathtub curve – Life Testing and Reliability, Failure Terminated Tests, Time Terminated Tests, Sequential Reliability Testing, Constant failure rate models (Exponential reliability function), Two-parameter exponential distribution model, Time dependent failure models: Weibull distribution – Normal distribution – Lognormal distribution	4
3.	System reliability: Basics of redundancy – Standby redundancy systems, Use of reliability block diagrams, System with components in series, System with components in parallel, mixed system, k-out-of-n redundancy, Fault tree construction and analysis, Design for reliability: Basic parameters, reliability allocation, Redundancy, Failure analysis	4
4.	Reliability life testing, Types of reliability tests, Accelerated life testing (ALT) highly accelerated life testing (HALT) Reliability enhancement testing (RET), Environmental stress screening (ESS), Burn-in testing, Life testing plans for reliability	3

Tutorials	No. of Hours
Case Studies:- <ul style="list-style-type: none"> • Application of MTBF & MTTR in maintenance of machines • Application of Fault tree in reliability assessment • Reliability enhancement techniques 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Compute MTBF and MTTR
2.	Do reliability testing and assessment for constant failure rate models and time dependent failure rate models
3.	Assess & predict system reliability
4.	Select pertinent reliability test

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	An Introduction to Reliability and Maintainability Engineering by Charles E.Ebeling, Tata McGraw-Hill	2000
2.	Life Cycle Reliability Engineering by Guangbin Yang Ford Motor Company, John Wiley & Sons	2007
3.	An introduction to reliability engineering by L. Shrinath	2005
4.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
5.	Probability and statistics for Engineers, by I. R. Miller, J. E. Freund & R. Johnson, Prentice Hall of India	2001
6.	Handbook of Reliability Engineering, HoangPham (Editor), Springer	2003

Course Name	Performance Management
Course Code	TQM5302
Credits	1.5
L-T-P	2 1 0
Segment	1-3

Total No. of Lectures -14

No. of Tutorials – 07

Course Objectives:

The main objectives of this course are:	
1.	To make the student understand the relevance of Key Performance indicators (KPIs) in meeting quality objectives, business goals and customer satisfaction.
2.	To make students aware about the various practices of performance evaluation

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Introduction: Performance Management(PM), Efficiency and effectiveness of processes, Organizations, Business Objectives, Human Resources, Metric, Key Performance indicators, Monitoring & Measurement; Step-by-step PM Process Checklist, Reporting, Dashboards The KPI Family Dimension	3
2.	Productivity and Efficiency Measurements, Quality Measurements, Profitability Effectiveness, Timeliness and Effective Resource Utilization, Innovation and Technology; the Human Factor	3
3.	Metrics for an Engaged Workforce, Employee Engagement and Productivity, Performance enhancement, Synergizing people, Role, Benefits Strategic Plan Key Result Areas Results, Measures or KPIs, Real-World Improvements Using KPIs, Distributing Knowledge Management Responsibilities, Getting Cooperation and Buy-In to KPI Objectives Human Competence:	4
4.	Engineering Worthy Performance, Performance Appraisals Catalytic Coaching: The modern thoughts in Performance Review Abolishing, 360 Degree Feedback Knowledge Management & Development Measurements: Strategic Performance Management Systems	4

Tutorials	No. of Hours
Case Studies:- <ul style="list-style-type: none"> • Cascading strategic objectives to KRAs and KPI • Performance Appraisal System and Analysis • New developments in strategic performance measurement system 	7

Course Outcomes:-

Upon successful completion of the course, students will be able to	
1.	Develop, Monitor and Measure Key Performance indicators
2.	Differentiate between Key result area (KRA) and Key Performance Indicator (KPI)
3.	Perform Performance evaluation

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Keeping Score: Using Right METRICS TO DRIVE World Class Performance: Brown PHI Learning	1996
2.	Performance Management: Strategies, Interventions, Drivers ISBN: Kandula, Srinivas, PHI Learning, Delhi	2000
3.	Productivity Engineering & Management, Sumanth DJ, TMH, New Delhi	1990

Course Name	Lean Manufacturing
Course Code	TQM5401
Credits	1.5
L-T-P	2 1 0
Segment	4-6

Total No. of Lectures -14
No. of Tutorials – 07

Course Objectives:

The main Objectives of this course are:	
1	To understand the concept of non-value added activities
2	To develop competency for identifying wastes in the processes.
3	To develop competency to use lean concepts and tools in reducing waste and managing flow of product
4	To introduce Total Productive Maintenance (TPM) for improving operational efficiencies

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Introduction to Lean Manufacturing: Basic concept of Lean, overview of Toyota Production System, Pillars of Lean House, Concept of value added and non-value added activities, Concept of 3Ms: Muri-Mura-Muda, Seven Wastes, Waste elimination: need and methods	2
2.	Concept of takt time, Value Stream Mapping, Identifying areas for improvement	2
3.	Implementation of Lean methodology – Cultural change, Pitfalls, Building base for Lean: 5S & Visual management	2
4.	Working on JIDOKA pillar (Poke yoke, Andon, Gemba Kaizen), Working on JIT Pillar (Tact time, Balanced operation, Push- Pull system, Minimum lot size, SMED/ OTS, Standardization), Heijunka Production control tools – Scheduling, Buffer stock, KANBAN	4
5.	Total Productive Maintenance- concept and advantages, Goals of TPM, Seven Pillars of TPM, Type of Losses, Type of Abnormalities, 0- 7JH steps, OPL, Why- Why analysis, Calculations of OEE	4

Tutorials	No. of Hours
Case Studies:- Case studies demonstrating the application of <ul style="list-style-type: none"> • 5S • SMED • Mistake Proofing • KANBAN 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Identify manufacturing wastes
2.	Make Value Stream Map
3.	Apply tools and practices under JIDOKA and JIT pillars of Lean house
4.	Draft Roadmap for implementing TPM

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	The Toyota Way Fieldbook Liker, Jeffrey K. and Meier, David P. ; Tata McGraw-Hill	2007
2.	The Toyota Way Liker, Jeffrey K.; Tata McGraw-Hill.	2004
3.	TPM Development Programme : Nikajima, Productivity Press Cambridge	1988
4.	James P.Womac, Daniel T Jones, Daniel Rose; The Machine That Changed the World	1996

MOOCs on this course are available at:

1. Lean Manufacturing made easy – Introduction to Lean
<https://www.udemy.com/introduction-to-lean-a/>
2. Lean Production
<https://www.edx.org/course/lean-production-tumx-qpls3x>

Course Name	Measurement System Analysis
Course Code	TQM5402
Credits	1.5
L-T-P	2 0 2
Segment	4-6

Total No. of Lectures-14
Total No. of Lab hrs-14

Course Objectives:

The main objectives of this course are:	
1.	To make the students understand the various issues of measurement and methods to quantify the measurement variations.
2.	To develop competency in conducting Gauge R&R and Attribute Agreement Analysis (AAA) studies

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Objectives of Measurement System Analysis, Effects of measurement system uncertainties, Basic terminology of measurement system such as Resolution, Accuracy or Bias, Linearity, Stability and precision, Measurement system repeatability and reproducibility; Measurement system variation: capability, performance and uncertainty; Error Model for measurement system – SWIPE	4
2.	Gauge Repeatability & Reproducibility (GRR) Studies, Range & ANOVA Methods for computing measurement system analysis metrics repeatability, reproducibility, total error, Precision/tolerance ratio, number of distinct categories (NDC)	4
3.	MSA for destructive testing using nested ANOVA	3
4.	Application of MSA in service industry (such as BPO), Attribute Agreement Analysis (AAA), Kappa analysis	3

Lab/ Project (Using statistical software and excel)

Sr. No.	Lab Contents	No. of Hours
1.	Making MSA templates in statistical software and excel a. Normal studies b. Destructive testing c. Attribute studies	2
2.	Performing a GRR Study and doing analysis	4
	Performing a GRR using nested ANOVA	4
3.	Performing AAA studies	4

Course Outcomes:-

After completion of the course, students will be able to perform	
1.	GRR Studies
2.	Nested ANOVA Studies
3.	Attribute Agreement Analysis (AAA) Studies

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Practical Attribute and Variable Measurement Systems Analysis (MSA): A Guide for Conducting Gage R&R Studies and Test Method Validations, Mark Allen Durivage	2016
2.	Measurement System Analysis, Rehman M. Khan, Wiley Online Library	2013
3.	Automotive Industry Action Group (AIAG) manual of Measurement System Analysis 4 th Edition	

OPEN ELECTIVE

Course Name	Total Quality Management
Course Code	TQO5001
Credits	1.5
L-T-P	2 1 0
Segment	1-3

Total No. of lectures -14
Total No. Tutorials - 07

Course Objectives:

The main objectives of this course are:	
1.	To introduce the importance of quality in improving competitiveness
2.	To develop competency in assessment of Cost of Poor Quality
3.	To sensitize students in role of leadership & employee engagements in building quality culture in organization

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Evolution of Global Quality movement, Post war scenario of quality: Japanese revolution – American response, Globalisation and quality, Competition & Customer expectations: Key drivers of Quality, Penetration of quality movement in Indian industry, Vision of Make In India – Zero Defect Zero Effect Basic Definitions of Quality, Definition and pillar of Total Quality Management (TQM), Basic philosophies and principles	4
2.	Various Quality Gurus & their contributions - Early Americans: Pioneering Efforts of Walter Shewhart & Edward Deming, Other Quality Gurus Joseph Juran, Philip Crosby, Armand Feigenbaum; Japanese Approach to TQM, Contribution of Japanese Gurus: Kaoru Ishikawa, Taiichiohno, Shigeo Shingo and Genichi Taguchi	4
3.	Economics of quality, Concept of right first time and its effect on income, Cost of Poor Quality: hidden losses and quality iceberg, Elements of Cost of Poor Quality, Objectives of calculating COPQ, Relating CoPQ to business measures	3
4.	Role of Leadership and Commitment in Quality Deployment, Quality Culture, Total Employee Involvement –Team Dynamic, Methods for employee engagements: Suggestion Schemes, Kaizen groups, cross functional teams, Quality Circles and other small group activities	3

Tutorials	No. of hours
Case Studies:- <ul style="list-style-type: none"> • TQM in manufacturing/Process Industries • TQM in service industry <ul style="list-style-type: none"> • Infrastructure, Health, Banking & Finance, IT & ITES (IT Enabled Services) • TQM in Government & Public Utilities 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Prioritize quality goals based on customer expectations & competition
2.	Identify improvement areas based on cost of poor quality
3.	Organize for quality and development of quality culture through small group activities

Bibliography:

Sr. No.	Book Detail	Year of Publication
1.	Fundamentals of Quality Control and Improvement; by Mitra, Amitava; Wiley	2013
2.	Total Quality Management by Dale H. Besterfield	2011
3.	Quality Planning and Analysis for Enterprise Quality by Juran, J.M. and Gryna, F.M.	2007
4.	Total Quality Management: Text with Cases, John S. Oakland, Butterworth-Heinemann	2003
5.	Juran's Quality Handbook (5th Edition); Juran, J.M.; Godfrey, Blanton A; McGraw-Hill	2010
6.	Principles of Quality Costs: Principles Implementation and Use by Campanella, Jack;; American Society for Quality (ASQ), Quality Costs Committee; Signet	1999

Course Name	Lean Manufacturing
Course Code	TQO5002
Credits	1.5
L-T-P	2 1 0
Segment	4-6

Total No. of Lectures -14

No. of Tutorials - 07

Course Objectives

The main objectives of this course are:	
1.	To understand the concept non added activities
2.	To develop competence for identifying waste
3.	To develop competence in applying lean concepts and tools to eliminate waste

Course Contents:-

Sr. No.	Course Contents	No. of lectures
1.	Introduction to Lean Manufacturing: Basic concept of Lean, overview of Toyota Production System, Pillars of Lean House, Concept of value added and non-value added activities, Concept of 3Ms: Muri-Mura-Muda, Seven Wastes, Waste elimination: need and methods	2
2.	Concept of takt time, Value Stream Mapping, Identifying areas for improvement	2
3.	Implementation of Lean methodology – Cultural change, Pitfalls, Building base for Lean: 5S & Visual management	2
4.	Working on JIDOKA pillar (Poke yoke, Andon, Gemba Kaizen), Working on JIT Pillar (Tact time, Balanced operation, Push- Pull system, Minimum lot size, SMED/ OTS, Standardization), Heijunka Production control tools – Scheduling, Buffer stock, KANBAN	4
5.	Total Productive Maintenance- concept and advantages, Goals of TPM, Seven Pillars of TPM, Type of Losses, Type of Abnormalities, 0- 7JH steps, OPL, Why- Why analysis, Calculations of OEE	4

Tutorials	No. of Hours
Case Studies:- Case studies demonstrating the application of <ul style="list-style-type: none"> • 5S • SMED • Mistake Proofing • KANBAN 	7

Course Outcomes:-

After successful completion of the course, students will be able to	
1.	Identify manufacturing wastes
2.	Make Value Stream Map
3.	Apply tools and practices under JIDOKA and JIT pillars of Lean house
4.	Draft Roadmap for implementing TPM

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3.	TPM Development Programme : Nikajima, Productivity Press Cambridge	1988
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MOOCs on this course are available at:

1. Lean Manufacturing made easy – Introduction to Lean
<https://www.udemy.com/introduction-to-lean-a/>
2. Lean Production
<https://www.edx.org/course/lean-production-tumx-qpls3x>