JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING
M.Tech (QUALITY ENGINEERING AND MANAGEMENT)

I- SEMESTER:

Subject Code	SUBJECT	L	P	C
16D36101	Project Management	4	-	4
16D35102	Precision Engineering	4	-	4
16D36102	Statistical Quality Control	4	-	4
15D31110	Total Quality Management	4	-	4
	ELECTIVE-I	4	-	4
15D34210	Quality Concepts in Product Development			
16D36103	Probability and Statistical Methods			
16D36104	Dimensional Metrology & Inspection			
	ELECTIVE-II	4	-	4
16D36105	Technology Management			
16D36106	Data Analysis Techniques			
16D36107	Supply Chain Management			
16D36108	Quality Engineering Lab	0	4	2
TOTAL		**24**	**4**	**26**

II-

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I- SEMESTER	L	P	C
	4	-	4

PROJECT MANAGEMENT (16D36101)

UNIT I

STRATEGIC MANAGEMENT AND PROJECT SELECTION

Project selection models, Project portfolio process, Analysis under uncertainty, Project organization, Matrix organization

UNIT II

PROJECT PLANNING

Work Breakdown Structure, Systems integration, Interface coordination, Project life cycle, Conflict and negotiation.

UNIT III

PROJECT IMPLEMENTATION

Estimating Project Budgets, Process of cost estimation, Scheduling: Network Techniques PERT and CPM, Risk analysis using simulation, CPM- crashing a project, Resource loading, leveling, and allocation.

UNIT IV

MONITORING AND INFORMATION SYSTEMS

Information needs and the reporting process, computerized PMIS, Earned value analysis, Planning-Monitoring-Controlling cycle**,** Project control**:** types of control processes, design of control systems, control of change and scope.

UNIT V

PROJECT AUDITING

Construction and use of audit report, Project audit life cycle, Essentials of audit and evaluation, Varieties of project termination, the termination process, The Final Report – A project history.

TEXT BOOKS:

1. R.Panneer selvam,P. Senthil Kumar, Project Management, PHI, 2010.
2. Arun Kanada, Project Management A life cycle approach, PHI, 2011.

REFERENCES:

1. Jack R. Meredith, and Samuel J. Mantel Jr., Project Management – A Managerial Approach, John Wiley and Sons, 2006.
2. Harold Kerzner, Project Management – A Systems Approach to Planning, Scheduling and Controlling, John Wiley and Sons, 2006.

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I- SEMESTER	L	P	C
	4	-	4

PRECISION ENGINEERING (16D35102)

(Common to Advanced Manufacturing Systems & Quality Engineering & Management)

UNIT I:

CONCEPTS OF ACCURACY: Introduction – Concept of Accuracy of Machine Tools – Spindle and Displacement Accuracies – Accuracy of numerical Control Systems – Errors due to Numerical Interpolation Displacement Measurement System and Velocity lags.

GEOMETIC DEIMENSIONING AND TOLERANCING: Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datum's – Datum Feature of Representation – Form controls, Orientation Controls – Logical Approach to Tolerancing.

UNIT II:

DATUM SYSTEMS: Design of freedom, Grouped Datum Systems – different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair and tongue – slot pair – Computation of Transnational and rotational accuracy, Geometric analysis and application.

UNIT III:

TOLERANCE ANALYSIS: Process Capability, Mean, Variance, Skewness, Kurtosis, Process Capability Metrics, Cp, Cpk, Cost aspects, Feature Tolerances, Geometric Tolerances. Surface finish, Review of relationship between attainable tolerance grades and different machining process, Cumulative effect of tolerances sure fit law, normal law and truncated normal law.

UNIT IV:

TOLERANCE CHARTING TECHNIQUES: Operation Sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and centrally analysis, Examples, Design features to facilitate machining; Datum Features – functional and manufacturing Components design – Machining Considerations, Redesign for manufactured, Examples.

UNIT V:

FOUNDAMENTALS OF NANOTECHNOLGY: Systems of nanometer accuracies – Mechanism of metal Processing – Nano physical processing of atomic bit units. Nanotechnology and Electrochemical atomic bit processing.

MEASURING SYSTEMS PROCESSING: In processing or in-situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems.

REFERENCES:

1. Precision Engineering in Manufacturing/Murthy R.L./New Age International (P) limited, 1996.
2. Geometric Dimensioning and Tolerancing / James D. Meadows / Marcel Dekker inc. 1995.
3. Nano Technology / Norio Taniguchi / Oxford University Press, 1996.
4. Engineering Design – A systematic Approach / Matousek / Blackie & Son Ltd., London
5. Precision Engineering/VC Venkatesh& S Izman/TMH

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I- SEMESTER	L	P	C
	4	-	4

STATISTICAL QUALITY CONTROL (16D36102)

UNIT I

INTRODUCTION

Quality Dimensions – Quality definitions – Inspection - Quality control – Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function

UNIT II

CONTROL CHARTS

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u-Construction and application.

UNIT III

SPECIAL CONTROL PROCEDURES

Warning and modified control limits, control chart for individual measurements, multi-vari chart, X - chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV

STATISTICAL PROCESS CONTROL

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V

ACCEPTANCE SAMPLING

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

REFERENCES:

1. Douglas C Montgomery, Introduction to Statistical Quality Control, John Wiley, Seventh Edition, 2012.
2. Grant E.L. and Leavensworth, Statistical Quality Control, TMH, 2000.
3. IS 2500 Standard sampling plans

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I- SEMESTER	L	P	C
	4	-	4

TOTAL QUALITY MANAGEMENT (15D31110)

(Common to Advanced Manufacturing Systems & Quality Engineering & Management)

UNIT – I:

INTRODUCTION: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT – II:

CUSTOMER FOCUS AND SATISFACTION: The importance of customer satisfaction and loyalty-Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

UNIT – III:

ORGANIZING FOR TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

UNIT – IV:

THE COST OF QUALITY: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

UNIT – V:

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

REFERENCES:

1. Total Quality Management / Joel E.Ross/Taylor and Franscis Limited
2. Total Quality Management/P.N.Mukherjee/PHI
3. Beyond TQM / Robert L.Flood
4. Statistical Quality Control / E.L. Grant / McGraw Hill.
5. Total Quality Management- A Practical Approach/H. Lal
6. Quality Management/KanishkaBedi/Oxford University Press/2011
7. Total Engineering Quality Management/Sunil Sharma/Macmillan

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I- SEMESTER	L	P	C
	4	-	4

QUALITY CONCEPTS IN PRODUCT DEVELOPMENT (15D34210)

(ELECTIVE-I)

(Common to Product Design & Quality Engineering & Management)

UNIT I DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION Morphology of Design – The Design Process – Computer Aided Engineering – Concurrent Engineering – Competition Bench Marking – Creativity – Theory of Problem solving (TRIZ) – Value Analysis - Design for Manufacture, Design for Assembly – Design for casting, Forging, Metal Forming, Machining and Welding

UNIT II DESIGN FOR QUALITY

Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design –testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT III FAILURE MODE EFFECT ANALYSIS AND DESIGN FOR SIX SIGMA

Basic methods: Refining geometry and layout, general process of product embodiment - Embodiment checklist-Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling - Basis of SIX SIGMA –Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production –Lean SIX SIGMA and services

UNIT IV DESIGN OF EXPERIMENTS

Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments - Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments - Two and three factor full Factorial experiments, 2^{κ} factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi‟s approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios

UNIT V STATISTICAL CONSIDERATION AND RELIABILITY

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams –Multivariable charts – Matrix plots and 3-D plots.-Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distribution

REFERENCES

1. Dieter, George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2000.

2. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE), 2001.

3. Product Design And Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA McGRAW-HILL-3rd Edition, 2003.

4. The Management and control of Quality-6th edition-James R. Evens, William M Lindsay Pub:son south-western(www.swlearning.com)

5. Fundamentals of Quality control and improvement 2nd edition, AMITAVA MITRA, Pearson Education Asia, 2002.

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I- SEMESTER	L	P	C
	4	-	4

PROBABILITY AND STATISTICAL METHODS (16D36103)

(ELECTIVE-I)

OBJECTIVE:

To introduce the basic concepts of one dimensional and two dimensional Random Variables. To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.

To enable the students to use the concepts of multivariate normal distribution and principle components analysis.

OUTCOMES:

The course aims at providing the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering problems.

UNIT I

ONE DIMENSIONAL RANDOM VARIABLES

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II

TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY:

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV TESTING OF HYPOTHESES:

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V MULTIVARIATE ANALYSIS:

Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components: Population principal components – Principal components from standardized variables.

BOOKS:

1. Jay L. Devore, "Probability and statistics for Engineering and the Sciences", Thomson and Duxbury, Singapore, 2002.

2. Richard Johnson. "Miller & Freund's Probability and Statistics for Engineer", Prentice – Hall of India, Private Ltd., New Delhi, Seventh Edition, 2007.
3. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", Pearson Education, Asia, Fifth Edition, 2002.

REFERENCES:

1. Gupta S.C. and Kapoor V.K."Fundamentals of Mathematical Statistics", Sultan and Sons,New Delhi, 2001.

2. Dallas E Johnson et al., "Applied multivariate methods for data analysis", Thomson and Duxbury press, Singapore, 1998.

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I- SEMESTER	L	P	C
	4	-	4

DIMENSIONAL METROLOGY & INSPECTION (16D36104)

(ELECTIVE-I)

UNIT I

LINEAR MEASUREMENT AND ANGULAR MEASUREMENT

Accuracy, Precision, Readability, Sensitivity, Linear measuring instruments - vernier – micrometer-Gauge blocks- dial indicator-comparators – Angle standards – vernier bevel protractor-sine bar – autocollimator.

UNIT II

STANDARDS FOR LINEAR AND ANGULAR MEASUREMENTS

Shop floor standards and their calibration, light interference, Method of coincidence, Slip gauge calibration, Measurement errors, Limits, fits, Tolerance, Gauges, Gauge design.

UNIT III

MEASUREMENT APPLICATION

Measurement of screw threads and gears – Radius measurement – surface finish measurement - Measurement of straightness-flatness-parallelism – squareness-roundness – circularity

UNIT IV

MODERN CONCEPTS

Image processing and its application in Metrology, Co-ordinate measuring machine, Types of CMM, Probes used, Application, Non-contact CMM using Electro-optical sensors for dimensional metrology.

UNIT V

MEASUREMENT SYSTEMS

System configuration, basic characteristics of measuring devices, Displacement, force and torque measurement, standards, Calibration, Sensors, Basic principles and concepts of temperature, Pressure and flow measurement, Destructive testing – Nondestructive testing.

TEXT BOOK:

1. R.K.Jain ,Engineering metrology ,khanna publisher,2009.
2. M. Mahajan,Text book of Metrology, Dhanpat Rai & Co P Ltd ,2012

REFERENCES:

1. Galyer J.F. and Shotbolt C.R."Metrology for Engineers" ELBS, 1992.
2. Hune, K.J.Engineering Metrology, Kalyani Publishers, India, 1980.
3. Robinson, S.L. and Miller R.K. Automated Inspection and Quality Assurance, Marcel Dekker Inc.1989.

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I- SEMESTER	**L**	**P**	**C**
	4	**-**	**4**

TECHNOLOGY MANAGEMENT (16D36105)

(ELECTIVE-II)

UNIT I INTRODUCTION

Technology management - Scope, components, and overview. Technology and environment, Technology and society, Technology Impact analysis, environmental, social, legal, political aspects, techniques for analysis - steps involved. Technology policy strategy: Science and technology Policy of India, implications to industry, The dynamics of technology change

UNIT II TECHNOLOGY FORECASTING

Need, methodology and methods - trend Analysis, Analogy, Delphi, Soft System Methodology, Mathematical Models, Simulation, and System Dynamics.

UNIT III TECHNOLOGY CHOICE AND EVALUATION

Issues in the development new high tech products, Methods of analyzing alternate technologies, Techno-economic feasibility studies, Need for multi-criteria considerations such as, social, environmental, and political, Analytic hierarchy method, Fuzzy multi-criteria decision making, and other methods.

UNIT IV TECHNOLOGY TRANSFER AND ACQUISITION

Import regulations, Implications of agreements like Uruguay Round and WTO, Bargaining process, Transfer option, MOU- Technology Adoption and Productivity - Adopting technology-human interactions, Organizational redesign and re-engineering, Technology productivity.

UNIT V TECHNOLOGY ABSORPTION AND INNOVATION

Present status in India, Need for new outlook, Absorption strategies for acquired technology, creating new/improved technologies, Innovations, Technology Measurement- Technology Audit, Risk and exposure, R&D portfolio management

REFERENCES:

1. Joseph M. Putti, Management – A Functional Approach, McGraw Hill, 1997
2. Kenneth C. Lauden , MIS: Organisation and Technology, Prentice Hall, 1995
3. James A.Senn, Information technology in Business, Prentice Hall, 1995
4. Ronald J. Jordan, Security analysis and Portfolio Management, Prentice Hall, 1995
5. Irvin M. Rubin, Organisational behavior an experimental approach, Prentice Hall, 1995
6.Gerard H. Gaynor, Handbook of Technology Management, McGraw-Hill Professional, 1996
7. Richard C. Dorf, Technology Management Handbook, CRC, 1999

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I- SEMESTER	L	P	C
	4	-	4

DATA ANALYSIS TECHNIQUES (16D36106)

(ELECTIVE-II)

UNIT I STATISTICAL DATA ANALYSIS

Data and Statistics- Review of Basic Statistical Measures-Probability Distributions-Testing of

Hypotheses-Non Parametric Tests.

UNIT II DATA ANALYSIS I

Introduction – Basic concepts – Uni-variate, Bi-variate and Multi-variate techniques – Types of multivariate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation – Approaches to multivariate model building.

UNIT III DATA ANALYSIS II

Simple and Multiple Linear Regression Analysis – Introduction – Basic concepts – Multiple linear regression model – Least square estimation – Inferences from the estimated regression function – Validation of the model. Factor Analysis: Definition – Objectives – Approaches to factor analysis – Methods of estimation – Factor rotation – Factor scores - Sum of variance explained – Interpretation of results .Canonical Correlation Analysis - Objectives – Canonical variates and canonical correlation – Interpretation of variates and correlations.

UNIT IV DATA ANALYSIS III

Multiple Discriminant Analysis - Basic concepts – Separation and classification of two populations - Evaluating classification functions – Validation of the model. Cluster Analysis – Definitions – Objectives – Similarity of measures – Hierarchical and Non – Hierarchical clustering methods – Interpretation and validation of the model.

UNIT V DATA ANALYSIS IV

Conjoint Analysis – Definitions – Basic concepts – Attributes – Preferences – Ranking of Preferences – Output of Conjoint measurements – Utility - Interpretation. Multi Dimensional Scaling – Definitions – Objectives – Basic concepts – Scaling techniques – Attribute and Non-Attributes based MDS Techniques – Interpretation and Validation of models. Advanced Techniques – Structural Equation modeling

REFERENCES

1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2010.
2. Richard A Johnson and Dean W.Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2012.
3. David R Anderson, Dennis J Sweeney and Thomas A Williams, Statistics for Business and Economics, Thompson, Singapore, 2011.

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I- SEMESTER	L	P	C
	4	-	4

SUPPLY CHAIN MANAGEMENT (16D36107)

(ELECTIVE-II)

UNIT I INTRODUCTION TO SUPPLY CHAIN MANAGEMENT

Supply chain stages and decision phases process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers - Obstacles to achieving fit.Case discussions.

UNIT II DESIGNING THE SUPPLY CHAIN NETWORK

Distribution Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions. Models for facility location and capacity allocation. Impact of uncertainty on SCN – discounted cash flow analysis, evaluating network design decisions using decision using decision trees.

UNIT III SOURCING, TRANSPORTATION AND PRICING

Role of sourcing, supplier – scoring and assessment, selection and contracts. Design collaboration. Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network. Trade-off in transportation design. Tailored transportation, Routing and scheduling in transportation. International transportation. Analytical problems. Role Revenue Management in the supply chain, Revenue management for: Multiple customer segments, perishable assets, seasonal demand, bulk and spot contracts.

UNIT IV COORDINATION AND TECHNOLOGY

Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. The role of IT supply Chain, The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in practice. Case discussion.

UNIT V EMERGING CONCEPTS

3PL- 4PL- Global Logistics -Reverse Logistics; Reasons, Activities, Role. Ware house Management-RFID Systems; Components, applications, implementation. Lean supply Chains-Sustainable supply Chains

REFERENCES

1. Sunil Chopra, Peter Meindl and Kalra, Supply Chain Management, Strategy, Planning, and operation,Pearson Education, 2013.
2. Robert B Handfield, Ernest L Nichols, Jr.,Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems , Pearson Education , 2002.
3. Jeremy F.Shapiro, Modeling the supply chain, Thomson Duxbury, 2006.
4. David Simchi Levi,Philip Kaminsky and Edith Simchi Levi, Designing and Managing the Supply Chain, Mc Graw Hill, 2009.

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I- SEMESTER	L	P	C
	-	4	2

QUALITY ENGINEERING LAB (16D36108)

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II - SEMESTER:

Subject Code	SUBJECT	L	P	C
16D36201	Quality Management Systems	4	-	4
16D36202	Reliability Engineering	4	-	4
16D36203	Lean Manufacturing and Six Sigma	4	-	4
16D36204	Quality by Design	4	-	4
	ELECTIVE-III	4	-	4
16D36205	Software Quality Management			
16D35203	Production and Operations Management			
16D36206	Industrial Safety and Hygiene			
	ELECTIVE-IV	4	-	4
15D32210	Reverse Engineering			
16D36207	Decision Support Systems			
16D36208	Optimization Techniques			
15D54201	Research Methodology (Audit Course)			
16D36209	Quality Assurance Lab	0	4	2
TOTAL		**24**	**4**	**26**

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II- SEMESTER	L	P	C
	4	-	4

QUALITY MANAGEMENT SYSTEMS (16D36201)

Objective: To impart knowledge on the concept of quality, tools for analyzing quality ,Statistical tools in quality acceptance sampling and life testing

UNIT-I

Introduction to the concept of quality - quality control - quality assurance - quality management - quality and total quality - small q and big Q - concept of total quality management - TQM axioms - major contributions of deeming, juran and cross by to quality management - enablers for total quality - strategic quality management

UNIT-II

Quality costs - analysis of quality costs - loss function - Taguchi methods - total quality tools - pare to chart - fishbone diagram – check sheet - histograms - scatter diagrams - run charts - flow diagram – Bench Marking-Overview of ISO 9000:2000 certification-Quality circles.

UNIT-III

Experimental design-Guidelines Overview of fact oral experiments, replication, General Idea on Process optimization- Process Robustness Studies, Quality function deployment, failure mode, effect and criticality analysis, continuous process improvement- The PDSA cycle- Kaizen.

UNIT-IV

Statistical tools in quality - making predictions using the normal, Poisson and binomial probability distributions - statistical process control - control charts for variables – X and R charts - process capability indices - control charts for attributes - P, np, c and u charts

UNIT-V

Module IV (12 hours) Acceptance sampling - lot by lot acceptance using single sampling by attributes - OC curve - average outgoing quality and the AOQL - double sampling - multiple and sequential sampling - ATI and AFI - introduction to life testing and reliability, MTBF, MTTR, system reliability-components in series and parallel

Refernces:

1. 1.Bester Field, Dale H,Carol Boeterfreld-Muchna,Glen H,Boeterfreld Mery Boeterfeld-Scare, 2003,
2. Total Quality Management, 3rd edition, Pearson Education, New Delhi.
3. Juran J.M., Gryna I.M., "Quality Planning and Analysis", Tata McGraw Hill Publishing Company. 3. Montgomery, douglas C2001,Introduction to statical quality control, fourth edition,John Wiley&sons Inc, New Delhi
4. Gerals M Smith-2004, Statistical Process Control and Quality Improvement-5th edition ,Pearson Education, New Delhi
5. Grant, Statistical Quality Control, McGraw Hill

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II- SEMESTER

L	P	C
4	-	4

RELIABILITY ENGINEERING (16D36201)

UNIT I RELIABILITY CONCEPTS

Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazard rate – Measures of Reliability – Design life –A priori and posteriori probabilities – Mortality of a component –Mortality curve – Useful life.

UNIT II LIFE DATA ANALYSIS

Data collection –Non Parametric methods: Ungrouped/Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull – Probability plotting – Goodness of fit tests.

UNIT III RELIABILITY ASSESSMENT

Different configurations – Redundancy – k out of n system – Complex systems: RBD – Baye's approach – Cut and tie sets – Fault Trees – Standby systems.

UNIT IV RELIABILITY MONITORING

Life testing methods: Failure terminated – Time terminated – Sequential Testing –Reliability growth monitoring – Reliability allocation – Software reliability-Human reliability.

UNIT V RELIABILITY IMPROVEMENT

Analysis of downtime – Repair time distribution – System repair time – Maintainability prediction – Measures of maintainability – Inspection decisions –System Availability.

REFERENCES:

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000.
2. Roy Billing ton and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.

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II- SEMESTER	L	P	C
	4	-	4

LEAN MANUFACTURING AND SIX SIGMA (16D36203)

UNIT I: INTRODUCTION TO LEAN MANUFACTURING AND SIX SIGMA

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, Critical success factors for six sigma.

UNIT II LEAN SIX SIGMA APPROACH

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 six sigma, The laws of lean six sigma, Benefits of lean six sigma, Introduction to DMAIC tools.

UNIT III INITIATION FOR LEAN SIX SIGMA

Top management commitment – Infrastructure and deployment planning, Process focus, organizational structures, Measures – Rewards and recognition, Infrastructure tools, structure of transforming event, Launch preparation.

UNIT IV PROJECT SELECTION FOR LEAN SIX SIGMA

Resource and project selection, Selection of Black belts, Selecting projects – Benefit/Effort graph, Process mapping, value stream mapping, Balanced score card for project identification, project suitable for lean six sigma.

UNIT V THE DMAIC PROCESS AND INSTITUTIONALIZING THE LSS

Predicting and improving team performance, Nine team roles, Team leadership, DMAIC process, Institutionalizing lean six sigma, Design for lean six sigma, Case study presentations.

REFERENCES:

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

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II- SEMESTER	**L**	**P**	**C**
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QUALITY BY DESIGN (16D36204)

UNIT I INTRODUCTION

Perception of quality, Taguchi's definition of quality – quality loss function, Planning of experiments, design principles, terminology, normal probability plot, Analysis of variance, Linear regression models.

UNIT II

FACTORIAL EXPERIMENTS

Design and analysis of single factor and multi-factor experiments, tests on means, EMS rules.

UNIT III SPECIAL DESIGNS

2^K Factorial designs, Fractional factorial designs, Nested designs, Blocking and Confounding.

UNIT IV ORTHOGONAL EXPERIMENTS

Selection of orthogonal arrays (OA's), OA designs, conduct of OA experiments, data collection and analysis of simple experiments, Modification of orthogonal arrays.

UNIT V ROBUST DESIGN

Variability due to noise factors, Product and process design, Principles of robust design, objective functions in robust design - S/N ratios , Inner and outer OA experiments, optimization using S/N ratios, fraction defective analysis, case studies.

REFERENCES:

1. Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI learning private Ltd., 2012.
2. D.C.Montgomery, "Design and analysis of experiments", John Wiley, Eighth Edition, 2012.
3. Nicolo Belavendram, "Quality by design" Taguchi techniques for Industrial experimentation, Prentice Hall, 1999.

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SOFTWARE QUALITY MANAGEMENT (16D36205)

(ELECTIVE-III)

UNIT I SOFTWARE QUALITY

Definition of Software Quality, Quality Planning, Quality system – Quality Control Vs Quality Assurance – Product life cycle – Project life cycle models.

UNIT II SOFTWARE ENGINEERING ACTIVITIES

Estimation, Software requirements gathering, Analysis, Architecture, Design, development Testing and Maintenance.

UNIT III SUPPORTING ACTIVITIES

Metrics, Reviews –SCM – Software quality assurance and risk management.

UNIT IV SOFTWARE QUALITY MANAGEMENT TOOLS

Seven basic Quality tools – Checklist – Pareto diagram – Cause and effect diagram – Run chart – Histogram – Control chart – Scatter diagram – Poka Yoke – Statistical process control – Failure Mode and Effect Analysis – Quality Function deployment – Continuous improvement tools – Case study.

UNIT V

QUALITY ASSURANCE MODELS

Software Quality Standards, ISO 9000 series – CMM, CMMI – P-CMM – Case study.

TEXT BOOK

1. Software Engineering: A Practitioners Approach, 5th Edition Roger S. Pressman McGraw – Hill International Edition, 6th Edition, 2006.
2. Ramesh Gopalswamy, Managing global Projects ; Tata McGraw Hill, 2002.

REFERENCES

1. Norman E – Fenton and Share Lawrence P flieger, Software metrics , International Thomson Computer press , 1997.
2. Gordan Schulmeyer. G. and James .L. Mc Hanus , Total Quality management for software, International Thomson Computer press , USA , 1990.
3. Dunn Robert M., Software Quality: Concepts and Plans, Englewood clifts, Prentice Hall Inc., 1990.
4. Metrics and Models in Software Quality Engineering, Stephen, Stephen H. Kan, Pearson education, 2006, Low price edition.

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PRODUCTION AND OPERATIONS MANAGEMENT (16D35203)

(ELECTIVE-III)

(Common to Advanced Manufacturing Systems & Quality Engineering & Management)

UNIT -I

OPERATION MANAGEMENT: Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management.

Product design – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.

UNIT – II

VALUE ENGINEERING: objective – types of values – function & cost – product life cycle- steps in value engineering – methodology in value engineers – FAST Diagram – Matrix Method.

Location – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Types of layout– line balancing.

UNIT - III

AGGREGATE PLANNING: definition – Different Strategies – Various models of Aggregate Planning –Transportation and graphical models.

Advance inventory control systems push systems – Material Requirement – Terminology – types of demands – inputs to MRP- techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP – Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.

UNIT - IV

SCHEDULING: Policies – Types of scheduling – Forward and Backward Scheduling – Gantt Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of Balance.

UNIT – V

PROJECT MANAGEMENT: Programming Evaluation Review Techniques (PERT) – three times estimation– critical path – probability of completion of project – critical path method – crashing of simple nature.

REFERENCES:

1. Operations Management/ E.S. Buffs/ John Wiley & Sons / 2007
2. Operations Management Theory and Problems/ Joseph G. Monks / Macmillan / McGraw Hill / 3rd Edition.
3. Production Systems Management/ James I. Riggs / John Wiley & Sons.
4. Production and Operations Management/ Chary/ McGraw Hill/2004
5. Operations Management/ Richard Chase/ McGraw Hill/2006
6. Production and Operation Management / PannerSelvam / PHI.
7. Production and Operation Analysis/ Nahima/ McGraw Hill/2004

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INDUSTRIAL SAFETY AND HYGIENE (16D36206)

(ELECTIVE-III)

UNIT I OPERATIONAL SAFETY

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipes- metal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – planning security and risk assessments, on – site and off site. Control of major industrial hazards.

UNIT II SAFETY APPRAISA LAND ANALYSIS

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation. Measurement of safety performance, accident reporting and investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT III OCCUPATIONAL HEALTH

Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV SAFETY AND HEALTH REGULATIONS

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT V SAFETY MANAGEMENT

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity.

TEXT BOOKS:

1. John. V. Grimaldi and Rollin. H Simonds, “Safety Managenent”, All India traveler Book seller, New Delhi – 1989.
2. Krishnan N.V, “Safety in Industry”, Jaico Publisher House, 1996.

REFERENCES:

1. Occupational Safety Manual BHEL.
2. Industrial Safety and the law by P.M.C Nair Publishers, Trivandrum.
3. Managing emergencies in industries, loss prevention of India Ltd., proceedings, 1999.
4. Safety security and Risk management by U.K singh & J.M Dewam,. A.P.H. publishing company, New Delhi, 1996.
5. Singh, U.K and Dewan, J.M., “Sagety, Security and Risk Management”, APH publishing company, New Delhi, 1996.
6. John V Grimaldi, Safety Management. AITB publishers, 2003.
7. Safety Manual. EDEL engineering Consultancy, 2000.

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REVERSE ENGINEERING (15D32210)
(ELECTIVE-IV)
(Common to Product Design & Quality Engineering & Management)

UNIT I
INTRODUCTION
Scope and tasks of RE - Domain analysis- process of duplicating

UNIT II
TOOLS FOR RE
Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material- characteristics evaluation -software and application- prototyping - verification

UNIT III
CONCEPTS
History of Reverse Engineering – Preserving and preparation for the four stage process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation

UNIT IV
DATA MANAGEMENT
Data reverse engineering – Three data Reverse engineering strategies – Definition – organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces – Reverse Engineering of assembly programs: A model based approach and its logical basics

UNIT V
INTEGRATION
Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering -–coordinate measurement – feature capturing – surface and solid members

REFERENCES

1. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
5. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
6. Co-ordinate Measurment and reverse engineering, Donald R. Honsa, ISBN 1555897, American Gear Manufacturers Association

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DECISION SUPPORT SYSTEMS (16D36207)

(ELECTIVE-IV)

UNIT I DECISION MAKING

Managerial decision making, system modeling and support-preview of the modeling process-phases of decision making process.

UNIT II MODELING AND ANALYSIS

DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development.

UNIT III KNOWLEDGE MANAGEMENT

Group support systems- enterprise DSS- supply chain and DSS-knowledge management methods, technologies and tools.

UNIT IV INTELLIGENT SYSTEMS

Artificial intelligence and expert systems-concepts, structure, types-knowledge acquisition and validation, knowledge representation

UNIT V IMPLEMENTATION

Implementation, integration and impact of management support systems.

REFERENCES:

1. Efraim Turban and Jay E Aronson, Decision Support and Intelligent Systems, Pearson education Asia, Seventh edition, 2005.
2. Elain Rich and Kevin Knight, Artificial intelligence, TMH, 2006.

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OPTIMIZATION TECHNIQUES (16D36208)

(ELECTIVE – IV)

(Common to Advanced Manufacturing Sysytems & Quality Engineering & Management)

Course Objectives:

1. To introduce the advanced optimization techniques such as classical optimization techniques, numerical optimization techniques and genetic algorithms.

2. Learn the knowledge to formulate optimization problems

UNIT - I

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

UNIT - II

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT - III

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems

UNIT – IV

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT V

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam and general optimization model of a machining process.

TEXT BOOKS:

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers

REFERENCES:

1.Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

Course Out comes:

1. Students at the end of the course learn advanced optimization techniques to show real-life problems
2. Students can able to formulate and solve various practical optimization problems in manufacturing and service organizations

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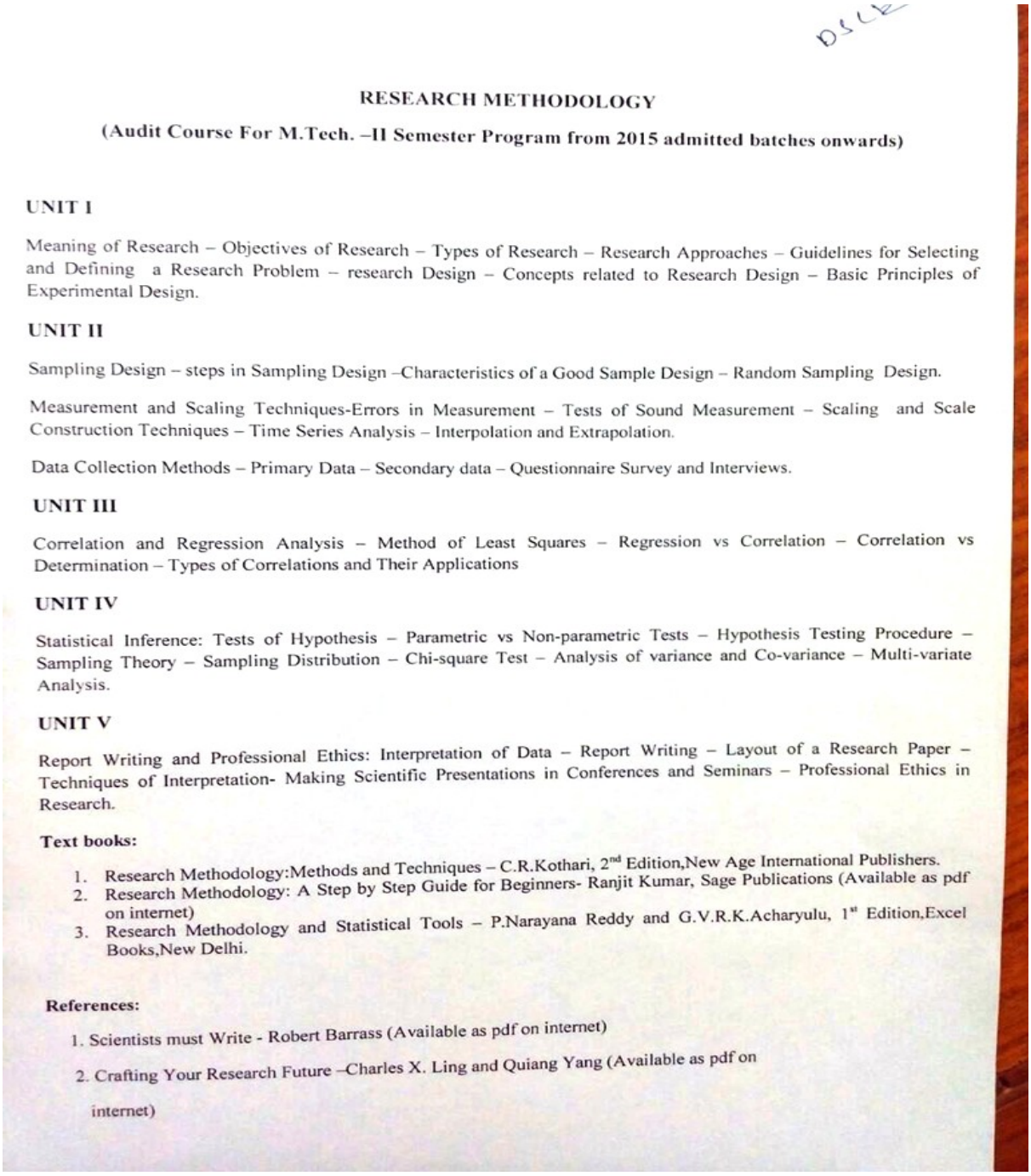
RESEARCH METHODOLOGY (AUDIT COURSE)(15D54201)



RESEARCH METHODOLOGY

(Audit Course For M.Tech. –II Semester Program from 2015 admitted batches onwards)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text books:

1. Research Methodology:Methods and Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.
2. Research Methodology: A Step by Step Guide for Beginners- Ranjit Kumar, Sage Publications (Available as pdf on internet)
3. Research Methodology and Statistical Tools – P.Narayana Reddy and G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.

References:

1. Scientists must Write - Robert Barrass (Available as pdf on internet)
2. Crafting Your Research Future –Charles X. Ling and Quiang Yang (Available as pdf on internet)

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QUALITY ASSURANCE LAB (16D36209)

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Course Structure of R21 Academic Regulations for M.Tech (Regular) Programs with effect from AY 2021-2022

DEPARTMENT OF MECHANICAL ENGINEERING

QUALITY ENGINEERING AND MANAGEMENT

I SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	21D36101	Statistical Quality Control	PC	3	0	0	3
2	21D35103	Precision Engineering	PC	3	0	0	3
3	**Professional Elective – I**						
	21D36102	Quality Engineering in Manufacturing	PE	3	0	0	3
	21D36103	Probability and Statistical Methods					
	21D36104	Dimensional Metrology & Inspection					
4	**Professional Elective – II**						
	21D36105	Supply Chain Management	PE	3	0	0	3
	21D36106	Technology Management					
	21D36107	Data Analysis Techniques					
5	21D11109	Research Methodology and IPR	MC	2	0	0	2
6	21D11110	English for Research Paper Writing	AC	2	0	0	0
	21D11111	Value Education					
	21D11112	Pedagogy Studies					
7	21D36108	Quality Engineering – I Lab	PC	0	0	4	2
8	21D36109	Simulation – I Lab	PC	0	0	4	2
Total				**16**	**00**	**08**	**18**

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DEPARTMENT OF MECHANICAL ENGINEERING

QUALITY ENGINEERING AND MANAGEMENT

II SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	21D36201	Reliability Engineering	PC	3	0	0	3
2	21D36202	Lean Manufacturing and Six Sigma	PC	3	0	0	3
3	**Professional Elective – III**						
	21D36203	Production and Operations Management	PE	3	0	0	3
	21D36204	Software Quality Management					
	21D36205	Industrial Safety and Hygiene					
4	**Professional Elective – IV**						
	21D35208	Optimization Techniques	PE	3	0	0	3
	21D34208	Reverse Engineering					
	21D36206	Decision Support Systems					
5	21D11209	Technical Seminar	PR	0	0	4	2
6	21D11210	Disaster Management	AC	2	0	0	0
	21D11211	Constitution of India					
	21D11212	Stress Management by Yoga					
7	21D36207	Quality Engineering-II Laboratory	PC	0	0	4	2
8	21D36208	Simulation-II Laboratory	PC	0	0	4	2
Total				**14**	**00**	**12**	**18**

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III SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	**Professional Elective – V**						
	21D36301	Total Quality Management	PE	3	0	0	3
	21D36302	Quality Management Systems					
	21D36303	Quality Concepts in Product Development					
2	**Open Elective**						
	21D30301	Mechatronics	OE	3	0	0	3
3	21D36304	Dissertation Phase – I	PR	0	0	20	10
4	21D00301	Co-curricular Activities	PR				2
Total				**06**	**00**	**20**	**18**

IV SEMESTER

S.No.	Course Code	Subject Name	Cate Gory	Hours Per Week			Credits
				L	T	P	
1	21D36401	Dissertation Phase – II	PR	0	0	32	16
Total				**00**	**00**	**32**	**16**

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36101	STATISTICAL QUALITY CONTROL (21D36101)	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To help students understand the concepts underlying statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries.
- Major topics include history and overview of the state of the art of quality control methodologies, tools for descriptive and predictive statistical analysis, design and use of various control charts for quality control, process characterization and capability analysis, R&R gauge capability studies, design of experiments, acceptance sampling and continuous improvement.
- The emphasis will be on ensuring that the students gain both a broad perspective of quality control as well as the technical skills necessary to implement quality control in any industrial setting.

Course Outcomes (CO): Student will be able to

- Understand the philosophy and basic concepts of quality improvement.
- Describe the DMAIC process (define, measure, analyze, improve, and control).
- Demonstrate the ability to use the methods of statistical process control.
- Demonstrate the ability to design, use, and interpret control charts for variables.
- Demonstrate the ability to design, use, and interpret control charts for attributes.
- Perform analysis of process capability and measurement system capability.
- Design, use, and interpret exponentially weighted moving average and moving average control charts.

UNIT – I	**INTRODUCTION**	Lecture Hrs:9

Quality Dimensions – Quality definitions – Inspection - Quality control – Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function

UNIT – II	**CONTROL CHARTS**	Lecture Hrs:9

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u-Construction and application.

UNIT – III	**SPECIAL CONTROL PROCEDURES**	Lecture Hrs:9

Warning and modified control limits, control chart for individual measurements, multi-vari chart, X - chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT – IV	**STATISTICAL PROCESS CONTROL**	Lecture Hrs:9

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT – V	**ACCEPTANCE SAMPLING**	Lecture Hrs:9

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

Textbooks:
1. Grant E.L. and Leavensworth, Statistical Quality Control, TMH, 2000. 2. IS 2500 Standard sampling plans
Reference Books:
1. Douglas C Montgomery, Introduction to Statistical Quality Control, John Wiley, Seventh Edition, 2012.
Online Learning Resources:
1. https://onlinecourses.nptel.ac.in/noc20_mg18/preview 2. https://nptel.ac.in/courses/110/105/110105088/ 3. https://nptel.ac.in/courses/116/102/116102019/ 4. https://nptel.ac.in/courses/116/102/116102019/

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D35103	PRECISION ENGINEERING	L	T	P	C
Semester	I	(21D35103)	3	0	0	3

Course Objectives:

To impart knowledge about basics of precision machining and different Manufacturing technique in precision engineering.

- Accuracy and alignment tests.
- Influences of static stiffness and thermal effects.
- Precision machining.
- Nano measuring systems.
- Various lithography techniques

Course Outcomes (CO): Student will be able to

- Apply fits and tolerances for parts and assemblies according to ISO standards
- Apply selective assembly concept for quality and economic production
- Assign tolerances using principles of dimensional chains for individual features of a part or assembly.
- Evaluate the part and machine tool accuracies.

UNIT – I	**CONCEPTS OF ACCURACY**	Lecture Hrs:9

Introduction – Concept of Accuracy of Machine Tools – Spindle and Displacement Accuracies – Accuracy of numerical Control Systems – Errors due to Numerical Interpolation Displacement Measurement System and Velocity lags.

GEOMETIC DEIMENSIONING AND TOLERANCING: Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datum's – Datum Feature of Representation – Form controls, Orientation Controls – Logical Approach to Tolerancing.

UNIT – II	**DATUM SYSTEMS**	Lecture Hrs:9

Design of freedom, Grouped Datum Systems – different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair and tongue – slot pair – Computation of Transnational and rotational accuracy, Geometric analysis and application.

UNIT – III	**TOLERANCE ANALYSIS**	Lecture Hrs:9

Process Capability, Mean, Variance, Skewness, Kurtosis, Process Capability Metrics, Cp, Cpk, Cost aspects, Feature Tolerances, Geometric Tolerances. Surface finish, Review of relationship between attainable tolerance grades and different machining process, Cumulative effect of tolerances sure fit law, normal law and truncated normal law.

UNIT – IV	**TOLERANCE CHARTING TECHNIQUES**	Lecture Hrs:9

Operation Sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and centrally analysis, Examples, Design features to facilitate machining; Datum Features – functional and manufacturing Components design – Machining Considerations, Redesign for manufactured, Examples.

UNIT – V	**FOUNDAMENTALS OF NANOTECHNOLGY**	Lecture Hrs:9

Systems of nanometer accuracies – Mechanism of metal Processing – Nano physical processing of atomic bit units. Nanotechnology and Electrochemical atomic bit processing.

MEASURING SYSTEMS PROCESSING: In processing or in-situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems.
Textbooks:
1. Engineering Design – A systematic Approach / Matousek / Blackie & Son Ltd., London 2. Precision Engineering/VC Venkatesh& S Izman/TMH
Reference Books:
1. Precision Engineering in Manufacturing/Murthy R.L./New Age International (P) limited, 1996. 2. Geometric Dimensioning and Tolerancing / James D. Meadows / Marcel Dekker inc. 1995. 3. Nano Technology / Norio Taniguchi / Oxford University Press, 1996
Online Learning Resources:
1. https://www.itsligo.ie/courses/beng-precision-engineering-design-online/ 2. https://www.bachelorsportal.com/studies/249110/precision-engineering-and-design.html 3. https://engineering.purdue.edu/online/courses/precision-manufacturing-systems

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36102	QUALITY ENGINEERING INMANUFACTURING (21D36102) PE – I	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- Explore knowledge of basic sciences engineering and manufacturing process.
- Manage projects in various sectors of economy which facing on conceptual , technological and human aspects.
- Identify the bottle ends and production process.
- Similarity of the manufacturing process to analyze the overall performance

Course Outcomes (CO): Student will be able to

- Applications of the user friendly software packages to simulate the manufacturing entities.
- Analyze the data by using different performance analysis techniques.
- Modelling various operators in manufacturing systems

UNIT - I	QUALITY VALUE AND ENGINEERING	Lecture Hrs:09

An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances.(N-type,S-type and L-type)

UNIT - II	TOLERANCE DESIGN AND TOLERANCING	Lecture Hrs:09

Functional limits, tolerance design for N-type. L-type and S-type characteristics, tolerance allocation fbr multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

UNIT - III	ANALYSIS OF VARIANCE (ANOVA)	Lecture Hrs:09

Introduction to ANOVA, Need for ANOVA, NO-way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT - IV	ORTHOGONAL ARRAYS	Lecture Hrs:09

Typical test strategies, better test strategies, efficient test strategies, steps indesigning, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

UNIT - V	SIX SIGMA AND THE TECHNICAL SYSTEM	Lecture Hrs:09

Six sigma DMAIC methodology, tools for process improvement, six sigma in services and small organizations, statistical foundations, statistical methodology.

Textbooks:

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill/ Intl. II Edition, 1995.
2. Quality Engineering in Production systems *I* G. Taguchi, A. Elsayed et al /Mc.Graw Hill Intl. Edition, 1989**.**

Reference Books:

1. Taguchi Methods explained: Practical steps to Robust Design /Papan P. Bagchi*I*Prentice Hall Pvt. Ltd., New Delhi.

R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Online Learning Resources:
1. https://nptel.ac.in/courses/112/107/112107259/ 2. https://onlinecourses.nptel.ac.in/noc20_me27/preview 3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-me27/ 4. https://nptel.ac.in/courses/110/101/110101010/ 5. https://onlinecourses.nptel.ac.in/noc20_mg18/preview

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36103	PROBABILITY AND STATISTICAL METHODS (21D36103)	L	T	P	C
Semester	I	PE – I	3	0	0	3

Course Objectives:

- To introduce the basic concepts of one dimensional and two dimensional Random Variables.
- To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principle components analysis.

Course Outcomes (CO): Student will be able to

- The course aims at providing the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering problems

UNIT – I	ONE DIMENSIONAL RANDOM VARIABLES	Lecture Hrs:

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT – II	TWO DIMENSIONAL RANDOM VARIABLES	Lecture Hrs:

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT – III	ESTIMATION THEORY	Lecture Hrs:

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT – IV	TESTING OF HYPOTHESES	Lecture Hrs:

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT – V	MULTIVARIATE ANALYSIS	Lecture Hrs:

Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components: Population principal components – Principal components from standardized variables.

Textbooks:

1. Jay L. Devore, “Probability and statistics for Engineering and the Sciences”, Thomson and Duxbury, Singapore, 2002.
2. Richard Johnson. ”Miller & Freund’s Probability and Statistics for Engineer”, Prentice–Hall of India, Private Ltd., New Delhi, Seventh Edition, 2007.
3. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, Fifth Edition, 2002.

Reference Books:

1. Gupta S.C. and KapoorV.K.”Fundamentals of Mathematical Statistics”, Sultan and Sons,New Delhi, 2001.
2. Dallas E Johnson et al., “Applied multivariate methods for data analysis”, Thomson andDuxbury press, Singapore, 1998.

R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
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Online Learning Resources:
• https://onlinecourses.nptel.ac.in/noc21_ma74/preview • https://nptel.ac.in/courses/111/105/111105041/ • https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ma02/ • https://nptel.ac.in/courses/111/105/111105090/

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36104	DIMENSIONAL METROLOGY & INSPECTION (21D36104)	L	T	P	C
Semester	I	PE – I	3	0	0	3

Course Objectives: Students are expected to

- Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements.
- Calibrate measuring instruments and also design inspection gauges.
- Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.
- Select and apply appropriate Quality Control Technique for given application.
- Select and Apply appropriate Quality Management Tool and suggest appropriate Quality Management System (QMS).

Course Outcomes (CO): Student will be able to

- Understand the methods of measurement and selection of measuring instruments ,standards of measurement
- Identify and apply various measuring instruments
- Explain tolerance, limits of size, fits, geometric and position tolerances and gauge design
- Recommend the Quality Control Techniques and Statistical Tools appropriately
- Analyze the Data collected
- Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality improvement

UNIT - I	LINEAR MEASUREMENT AND ANGULAR MEASUREMENT	Lecture Hrs:

Accuracy, Precision, Readability, Sensitivity, Linear measuring instruments - vernier – micrometer-Gauge blocks- dial indicator-comparators – Angle standards – vernier bevel protractor-sine bar – autocollimator.

UNIT – II	STANDARDS FOR LINEAR AND ANGULAR MEASUREMENTS	Lecture Hrs:

Shop floor standards and their calibration, light interference, Method of coincidence, Slip gauge calibration, Measurement errors, Limits, fits, Tolerance, Gauges, Gauge design.

UNIT – III	MEASUREMENT APPLICATION	Lecture Hrs:

Measurement of screw threads and gears – Radius measurement – surface finish measurement - Measurement of straightness-flatness-parallelism – squareness-roundness – circularity

UNIT – IV	MODERN CONCEPTS	Lecture Hrs:

Image processing and its application in Metrology, Co-ordinate measuring machine, Types of CMM, Probes used, Application, Non-contact CMM using Electro-optical sensors for dimensional metrology.

UNIT – V	MEASUREMENT SYSTEMS	Lecture Hrs:

System configuration, basic characteristics of measuring devices, Displacement, force and torque measurement, standards, Calibration, Sensors, Basic principles and concepts of temperature, Pressure and flow measurement, Destructive testing – Non-destructive testing.

Textbooks:

1. R.K.Jain ,Engineering metrology ,khanna publisher,2009.

2. M. Mahajan,Text book of Metrology, DhanpatRai& Co P Ltd ,2012

Reference Books:

1. Galyer J.F. and ShotboltC.R."Metrology for Engineers" ELBS, 1992.
2. Hune, K.J.Engineering Metrology, Kalyani Publishers, India, 1980.
3. Robinson, S.L. and Miller R.K. Automated Inspection and Quality Assurance, Marcel Dekker Inc.1989.

Online Learning Resources:

1. https://nptel.ac.in/courses/112/104/112104250/
2. https://nptel.ac.in/courses/116/102/116102029/
3. https://nptel.ac.in/courses/112/107/112107259/

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36105	SUPPLY CHAIN MANAGEMENT (21D36105) PE – II	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- To develop an understanding of basic concepts and role of Logistics and supply chain management in business.
- To understand how supply chain drivers play an important role in redefining value chain excellence of Firms.
- To develop analytical and critical understanding & skills for planning, designing and operations of supply chain.
- To understand, appraise and integrate various supply chain strategies.

Course Outcomes (CO): Student will be able to

- Understand the fundamentals of elements and functions of supply chain, role of drivers and demand forecasting.
- To apply various techniques of inventory management and their practical situations.
- Analyze how supply chain decisions related to facility location can be applied to various industries and designing the supply chain.
- How various warehousing management system and transportation can be practiced in various industries?
- How logistics and supply chain strategies can create value generation and utilise IT applications How supply chain performance can be measured using various models?

UNIT – I	INTRODUCTION TO SUPPLY CHAIN MANAGEMENT	Lecture Hrs:

Supply chain stages and decision phases process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers - Obstacles to achieving fit.Case discussions.

UNIT – II	DESIGNING THE SUPPLY CHAIN NETWORK	Lecture Hrs:

Distribution Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions. Models for facility location and capacity allocation. Impact of uncertainty on SCN – discounted cash flow analysis, evaluating network design decisions using decision using decision trees.

UNIT – III	SOURCING, TRANSPORTATION AND PRICING	Lecture Hrs:

Role of sourcing, supplier – scoring and assessment, selection and contracts. Design collaboration. Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network. Trade-off in transportation design. Tailored transportation, Routing and scheduling in transportation. International transportation. Analytical problems. Role Revenue Management in the supply chain, Revenue management for: Multiple customer segments, perishable assets, seasonal demand, bulk and spot contracts.

UNIT – IV	COORDINATION AND TECHNOLOGY	Lecture Hrs:

Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. The role of IT supply Chain,

The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in practice. Case discussion.		
UNIT – V	**EMERGING CONCEPTS**	Lecture Hrs:
3PL- 4PL- Global Logistics -Reverse Logistics; Reasons, Activities, Role. Ware house Management-RFID Systems; Components, applications, implementation. Lean supply Chains-Sustainable supply Chains		
Textbooks:		
1. Jeremy F.Shapiro, Modeling the supply chain, Thomson Duxbury, 2006. 2. David SimchiLevi,PhilipKaminsky and Edith Simchi Levi, Designing and Managing the Supply Chain, McGraw Hill, 2009		
Reference Books:		
1. Sunil Chopra, Peter Meindl and Kalra, Supply Chain Management, Strategy, Planning, and operation,Pearson Education, 2013. 2. Robert B Handfield, Ernest L Nichols, Jr.,Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems , Pearson Education , 2002.		
Online Learning Resources:		
1. https://nptel.ac.in/courses/110/106/110106045/ 2. https://nptel.ac.in/courses/110/107/110107074/ 3. https://nptel.ac.in/courses/110/108/110108056/ 4. https://nptel.ac.in/courses/110/105/110105141/		

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36106	TECHNOLOGY MANAGEMENT (21D36106) PE – II	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- Understanding of the concepts and techniques of strategy technology management;
- An ability to critically analyse the behaviour or organizations and organisational members in developing, implementing, and managing technology from a strategic perspective; and
- The capacity to critically evaluate the strategic management of technology within diversified companies.

Course Outcomes (CO): Student will be able to

- The learner will demonstrate through a written class assignment the ability to read course materials and textbook, analytically comprehend the content, organize and summarize the major points to others in an effective and concise manner consist with a junior level university student.
- The learner will demonstrate through a written class assignment the ability to research course related literature, understand and compose comprehensive and concise definitions/descriptions of specific terminology, management principles, management theory and management practices directly related to the course of study.
- The learner will demonstrate the ability to conduct a comprehensive review of literature outside the course textbook and to develop written documents that effectively explain to others the key areas of understanding and practices that are required of contemporary managers of technology. The learner will demonstrate through class participation and required writings a working knowledge of and an advanced understanding of the discipline that constitutes technology management.
- The learner will demonstrate through discussion boards, written assignments, and classroom presentation the ability to effectively apply the principles and practices of technology management to a real-world environment/enterprise.

UNIT – I	INTRODUCTION	Lecture Hrs:

Technology management - Scope, components, and overview. Technology and environment, Technology and society, Technology Impact analysis, environmental, social, legal, political aspects, techniques for analysis - steps involved. Technology policy strategy: Science and technology Policy of India, implications to industry, The dynamics of technology change.

UNIT – II	TECHNOLOGY FORECASTING	Lecture Hrs:

Need, methodology and methods - trend Analysis, Analogy, Delphi, Soft System Methodology, Mathematical Models, Simulation, and System Dynamics.

UNIT – III	TECHNOLOGY CHOICE AND EVALUATION	Lecture Hrs:

Issues in the development new high tech products, Methods of analyzing alternate technologies, Techno-economic feasibility studies, Need for multi-criteria considerations such as, social, environmental, and political, Analytic hierarchy method, Fuzzy multi-criteria decision making, and other methods.

UNIT – IV	TECHNOLOGY TRANSFER AND ACQUISITION	Lecture Hrs:

Import regulations, Implications of agreements like Uruguay Round and WTO, Bargaining process, Transfer option, MOU- Technology Adoption and Productivity - Adopting

technology-human interactions, Organizational redesign and re-engineering, Technology productivity.		
UNIT – V	**TECHNOLOGY ABSORPTION AND INNOVATION**	Lecture Hrs:
Present status in India, Need for new outlook, Absorption strategies for acquired technology, creating new/improved technologies, Innovations, Technology Measurement- Technology Audit, Risk and exposure, R&D portfolio management		
Textbooks:		
1. Irvin M. Rubin, Organisational behavior an experimental approach, Prentice Hall, 1995 2. Gerard H. Gaynor, Handbook of Technology Management, McGraw-Hill Professional, 1996 3. Richard C. Dorf, Technology Management Handbook, CRC, 1999		
Reference Books:		
1. Joseph M. Putti, Management – A Functional Approach, McGraw Hill, 1997 2. Kenneth C. Lauden , MIS: Organisation and Technology, Prentice Hall, 1995 3. James A.Senn, Information technology in Business, Prentice Hall, 1995 4. Ronald J. Jordan, Security analysis and Portfolio Management, Prentice Hall, 1995		
Online Learning Resources:		
1. https://onlinecourses.nptel.ac.in/noc20_mg60/preview 2. https://nptel.ac.in/courses/110/105/110105148/		

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36107	DATA ANALYSIS TECHNIQUES (21D36107) PE – II	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- Gather sufficient relevant data, conduct data analytics using scientific methods, and make appropriate and powerful connections between quantitative analysis and real-world problems.
- Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using data analytics skills to provide constructive guidance in decision making.
- Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
- Show substantial understanding of the real problems; conduct deep data analytics using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.
- Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.

Course Outcomes (CO): Student will be able to

- To provide delegates with both an understanding and practical experience of a range of the more common analytical techniques and representation methods for numerical data
- To give delegates the ability to recognize which types of analysis are best suited to particular types of problems
- To give delegates sufficient background and theoretical knowledge to be able to judge when an applied technique will likely lead to incorrect conclusions
- To provide delegates with a working vocabulary of analytical terms to enable them to converse with people who are experts in the areas of data analysis, statistics and probability, and to be able to read and comprehend common textbooks and journal articles in this field
- To introduce some basic statistical methods and concepts

UNIT – I	STATISTICAL DATA ANALYSIS	Lecture Hrs:

Data and Statistics- Review of Basic Statistical Measures-Probability Distributions-Testing of Hypotheses-Non Parametric Tests.

UNIT – II	DATA ANALYSIS I	Lecture Hrs:

Introduction – Basic concepts – Uni-variate, Bi-variate and Multi-variate techniques – Types of multivariate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation – Approaches to multivariate model building.

UNIT – III	DATA ANALYSIS II	Lecture Hrs:

Simple and Multiple Linear Regression Analysis – Introduction – Basic concepts – Multiple linear regression model – Least square estimation – Inferences from the estimated regression function – Validation of the model. Factor Analysis: Definition – Objectives – Approaches to factor analysis – Methods of estimation – Factor rotation – Factor scores - Sum of variance explained – Interpretation of results .Canonical Correlation Analysis - Objectives – Canonical variates and canonical correlation – Interpretation of variates and correlations.

UNIT – IV	**DATA ANALYSIS III**	Lecture Hrs:
Multiple Discriminant Analysis - Basic concepts – Separation and classification of two populations - Evaluating classification functions – Validation of the model. Cluster Analysis – Definitions – Objectives – Similarity of measures – Hierarchical and Non – Hierarchical clustering methods – Interpretation and validation of the model.		
UNIT – V	**DATA ANALYSIS IV**	Lecture Hrs:
Conjoint Analysis – Definitions – Basic concepts – Attributes – Preferences – Ranking of Preferences – Output of Conjoint measurements – Utility - Interpretation. Multi-Dimensional Scaling – Definitions – Objectives – Basic concepts – Scaling techniques – Attribute and Non-Attributes based MDS Techniques – Interpretation and Validation of models. Advanced Techniques – Structural Equation modelling		
Textbooks:		
1. Richard A Johnson and Dean W.Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2012.		
Reference Books:		
1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham& William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2010. 2. David R Anderson, Dennis J Sweeney and Thomas A Williams, Statistics for Business and Economics, Thompson, Singapore, 2011.		
Online Learning Resources:		
1. https://nptel.ac.in/courses/110/104/110104094/ 2. https://nptel.ac.in/courses/110/104/110104094/ 3. https://onlinecourses.nptel.ac.in/noc21_mg02/preview		

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36108	QUALITY ENGINEERING-I LABORATORY (21D36108)	L	T	P	C
Semester	I		0	0	4	2

Course Objectives:

Course Outcomes (CO):

List of Experiments:

1. Testing the goodness of fit for the quality characteristic of component using normal distribution.
2. Testing the goodness of fit for the quality characteristic using Poisson distribution.
3. Testing the goodness of fit for the given quality characteristic using Binomial distribution.
4. Testing the goodness of fit for the given quality characteristic using uniform distribution.
5. Application of 7 QC tools as applied to manufacturing and service operations.
6. Assessment of process capability of the given manufacturing process using normal probability paper method.

References:

Online learning resources/Virtual labs:

R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36109	SIMULATION-I LABORATORY (21D36109)	L	T	P	C
Semester	II		0	0	4	2

Course Objectives:

- To understand the various Simulation Processes

Course Outcomes (CO):

LIST OF EXPERIMENTS:

CYCLE-I: DEMO EXPERIMENTS

1. MATLAB Commands and Examples
2. Built-in functions

RELIABILITY SOFTWARE MODULES

1. SPARE Software package
2. Failure Mode Software Package
3. FMEA-RPN Software package
4. SPC Software package

CYCLE-II: TESTING PROGRAMS

1. Characteristics of Binomial and Poisson distributions
2. Characteristics of Exponential and Weibull distributions
3. Characteristics of Normal and Log-Normal distributions
4. Determination of MTTF for series and parallel systems
5. Evaluation of Limiting State Probabilities (LSPs)

References:

Online learning resources/Virtual labs:

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36201	RELIABILITY ENGINEERING	L	T	P	C
Semester	II	(21D36201)	3	0	0	3

Course Objectives:

- This course is designed to introduce basic concepts of maintenance and reliability to the students, to introduce various methods of reliability analysis with real time problems with constraints and to make understanding the applications of Reliability and Maintenance analysis in different types of systems.

Course Outcomes (CO): Student will be able to

- Explain the basic concepts of Reliability Engineering and its Understand measures.
- Predict the Reliability at system level using various models.
- Design the test plan to meet the reliability Requirements.
- Predict and estimate the reliability from failure data.
- Develop and implement a successful Reliability programme.

UNIT - I	RELIABILITY CONCEPTS	Lecture Hrs:

Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazard rate – Measures of Reliability – Design life –A priori and posteriori probabilities – Mortality of a component –Mortality curve – Useful life.

UNIT – II	LIFE DATA ANALYSIS	Lecture Hrs:

Data collection –Non Parametric methods: Ungrouped/Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull – Probability plotting – Goodness of fit tests.

UNIT – III	RELIABILITY ASSESSMENT	Lecture Hrs:

Different configurations – Redundancy – k out of n system – Complex systems: RBD – Baye's approach – Cut and tie sets – Fault Trees – Standby systems.

UNIT – IV	RELIABILITY MONITORING	Lecture Hrs:

Life testing methods: Failure terminated – Time terminated – Sequential Testing –Reliability growth monitoring – Reliability allocation – Software reliability-Human reliability.

UNIT – V	RELIABILITY IMPROVEMENT	Lecture Hrs:

Analysis of downtime – Repair time distribution – System repair time – Maintainability prediction – Measures of maintainability – Inspection decisions –System Availability.

Textbooks:

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000.

Reference Books:

1. Roy Billing ton and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.

Online Learning Resources:

1. https://nptel.ac.in/courses/105/108/105108128/
2. https://www.youtube.com/watch?v=uw8-XO630dw
3. https://www.youtube.com/watch?v=uutg8jKrL9w

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36202	LEAN MANUFACTURING AND SIX SIGMA (21D36202)	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To impart knowledge for facilitating worker environment to identify hidden manufacturing wastes
- To impart knowledge on systematic approach for implementing

Course Outcomes (CO): Student will be able to

- Identify and Quantify the hidden manufacturing wastes in industries
- Analyze the effectiveness of lean manufacturing tools
- Develop a roadmap for successful implementation of lean principles
- Identify and organize the elements of just in time manufacturing

UNIT - I	INTRODUCTION TO LEAN MANUFACTURING AND SIX SIGMA	Lecture Hrs:

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, Critical success factors for six sigma.

UNIT – II	LEAN SIX SIGMA APPROACH	Lecture Hrs:

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 six sigma, The laws of lean six sigma, Benefits of lean six sigma, Introduction to DMAIC tools.

UNIT – III	INITIATION FOR LEAN SIX SIGMA	Lecture Hrs:

Top management commitment – Infrastructure and deployment planning, Process focus, organizational structures, Measures – Rewards and recognition, Infrastructure tools, structure of transforming event, Launch preparation.

UNIT – IV	PROJECT SELECTION FOR LEAN SIX SIGMA	Lecture Hrs:

Resource and project selection, Selection of Black belts, Selecting projects – Benefit/Effort graph, Process mapping, value stream mapping, Balanced score card for project identification, project suitable for lean six sigma.

UNIT – V	THE DMAIC PROCESS AND INSTITUTIONALIZING THE LSS	Lecture Hrs:

Predicting and improving team performance, Nine team roles, Team leadership, DMAIC process, Institutionalizing lean six sigma, Design for lean six sigma, Case study presentations.

Textbooks:

1. Michael L. George, Lean Six Sigma, McGraw-Hill, 2002.
2. James P. Womack, Daniel T. Jones, Lean Thinking, Free press business, 2003.

Reference Books:

1. Forrest W. Breyfogle III, Implementing Six Sigma: Smarter solutions Using Statistical Methods, 1999.
2. Ronald G.Askin and Jeffrey B.Goldberg, Design and Analysis of Lean Production Systems, John Wiley & Sons, 2003.

3. Rother M. and hook J., Learning to See: Value Stream Mapping to add value and Eliminate Muda, Lean Enterprise Institute, Brookline, MA.

Online Learning Resources:

1. https://nptel.ac.in/courses/110/105/110105039/
2. https://henryharvin.com/ppc/six-sigma-certification?gclid=Cj0KCQiA15yNBhDTARIsAGnwe0V9po4fZdt3tVqFISJo3TZxeicEUwBKk88NIPLRQ_77iN5a-nybW1oaAmYQEALw_wcB
3. http://www.nptelvideos.in/2012/12/six-sigma.html

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36203	PRODUCTION AND OPERATIONS MANAGEMENT (21D36203) PE – III	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- The objective is to introduce concepts and techniques related to the design, planning, control and improvement of businesses in both manufacturing and service sectors.
- This course aims at developing a focus and critical thinking important to solve problems in the operations of business. The students will be required to understand and apply the tools of management learned in the course to practical situations.
- To produce the desired product this has marketability at the most affordable price by properly planning the manpower, material and processes.
- To achieve the objective of delivering the right goods of right quantity as well as quality, at right place and at right time one needs to understand and apply the concepts of Production and operations management.
- Efficient Advanced Production and operations management, give benefits to various sections including consumers, investors, employees, suppliers and community in different ways.

Course Outcomes (CO): Student will be able to

- Understand the principles of production and operations Management
- Understand the operations process, be able to analyze and solve problems pertaining to operations.
- Understand some of the mathematical models of production management.
- Appraise how other functional areas of business are integrated with Operations Management.

UNIT – I **OPERATION MANAGEMENT** Lecture Hrs:

Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management.
Product design – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.

UNIT – II **VALUE ENGINEERING** Lecture Hrs:

Objective – types of values – function & cost – product life cycle- steps in value engineering – methodology in value engineers – FAST Diagram – Matrix Method.
Location – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Types of layout– line balancing.

UNIT – III **AGGREGATE PLANNING** Lecture Hrs:

Definition – Different Strategies – Various models of Aggregate Planning –Transportation and graphical models.
Advance inventory control systems push systems – Material Requirement – Terminology – types of demands – inputs to MRP- techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP – Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push

system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.		
UNIT – IV	**SCHEDULING**	Lecture Hrs:
Policies – Types of scheduling – Forward and Backward Scheduling – Gantt Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of Balance.		
UNIT – V	**PROJECT MANAGEMENT**	Lecture Hrs:
Programming Evaluation Review Techniques (PERT) – three times estimation– critical path – probability of completion of project – critical path method – crashing of simple nature.		
Textbooks:		
1. Production and Operations Management/ Chary/ McGraw Hill/2004 2. Operations Management/ Richard Chase/ McGraw Hill/2006 3. Production and Operation Management / PannerSelvam / PHI. 4. Production and Operation Analysis/ Nahima/ McGraw Hill/2004		
Reference Books:		
1. Operations Management/ E.S. Buffs/ John Wiley & Sons / 2007 2. Operations Management Theory and Problems/ Joseph G. Monks / Macmillan / McGraw Hill / 3rd Edition. 3. Production Systems Management/ James I. Riggs / John Wiley & Sons.		
Online Learning Resources:		
1. https://nptel.ac.in/courses/110/107/110107141/ 2. https://nptel.ac.in/courses/111/107/111107128/ 3. https://nptel.ac.in/courses/112/106/112106131/ 4. https://nptel.ac.in/courses/112/106/112106134/		

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36204	SOFTWARE QUALITY MANAGEMENT (21D36204)	L	T	P	C
Semester	II	PE – III	3	0	0	3

Course Objectives:

- This course is aimed at introducing the primary important concepts of project management related to managing software development projects.
- They will also get familiar with the different activities involved in Software Project Management.
- Further, they will also come to know how to successfully plan and implement a software project management activity, and to complete a specific project in time with the available budget.

Course Outcomes (CO): Student will be able to

- Identify the different project contexts and suggest an appropriate management strategy.
- Practice the role of professional ethics insuccessful software development.
- Identify and describe the key phases of project management.
- Determine an appropriate project management approach through an evaluation of the business context and scope of the project.

UNIT - I	SOFTWARE QUALITY	Lecture Hrs:

Definition of Software Quality, Quality Planning, Quality system – Quality Control Vs Quality Assurance – Product life cycle – Project life cycle models.

UNIT – II	SOFTWARE ENGINEERING ACTIVITIES	Lecture Hrs:

Estimation, Software requirements gathering, Analysis, Architecture, Design, development Testing and Maintenance.

UNIT – III	SUPPORTING ACTIVITIES	Lecture Hrs:

Metrics, Reviews –SCM – Software quality assurance and risk management.

UNIT – IV	SOFTWARE QUALITY MANAGEMENT TOOLS	Lecture Hrs:

Seven basic Quality tools – Checklist – Pareto diagram – Cause and effect diagram – Run chart – Histogram – Control chart – Scatter diagram – Poka Yoke – Statistical process control – Failure Mode and Effect Analysis – Quality Function deployment – Continuous improvement tools – Case study.

UNIT – V	QUALITY ASSURANCE MODELS	Lecture Hrs:

Software Quality Standards, ISO 9000 series – CMM, CMMI – P-CMM – Case study.

Textbooks:

1. Software Engineering: A Practitioners Approach, 5th Edition Roger S. Pressman McGraw – Hill International Edition, 6th Edition, 2006.
2. Ramesh Gopalswamy, Managing global Projects ; Tata McGraw Hill, 2002.

Reference Books:

1. Norman E – Fenton and Share Lawrence P flieger, Software metrics, International Thomson Computer press , 1997.
2. GordanSchulmeyer. G. and James .L. McHanus, Total Quality management for software, International Thomson Computer press , USA , 1990.
3. Dunn Robert M., Software Quality: Concepts and Plans, Englewood clifts, Prentice Hall Inc., 1990.

4. Metrics and Models in Software Quality Engineering, Stephen, Stephen H. Kan, Pearson education, 2006, Low price edition.

Online Learning Resources:

1. https://nptel.ac.in/courses/106/105/106105218/
2. https://onlinecourses.nptel.ac.in/noc19_cs70/preview
3. https://nptel.ac.in/courses/106/101/106101061/

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36205	INDUSTRIAL SAFETY AND HYGIENE (21D36205)	L	T	P	C
Semester	II	PE – III	3	0	0	3

Course Objectives:

- Anticipate, recognize, evaluate and control hazardous conditions and practices affecting people, property and the environment;
- Communicate and interact effectively with technical and non-technical audiences;
- Integrate ethical, social, current, and global issues and responsibilities in their practice as a professional in the field;
- Work individually or on a team to critically analyze, interpret, and provide leadership to address and manage problems in occupational safety and health; and
- Recognize that the practice of occupational safety and health requires ongoing learning, and undertake appropriate activities to address this need.

Course Outcomes (CO): Student will be able to

- An ability to identify, formulate, and solve broadly defined technical or scientific problems by applying knowledge of mathematics and science and/or technical topics to areas relevant to occupational safety and health.
- An ability to formulate or design a system, process, procedure or program to meet desired needs.
- An ability to develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.
- An ability to communicate effectively with a range of audiences.
- An ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts.
- An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

UNIT - I	OPERATIONAL SAFETY	Lecture Hrs:

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipes- metal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – planning security and risk assessments, on – site and off site. Control of major industrial hazards.

UNIT – II	SAFETY APPRAISA LAND ANALYSIS	Lecture Hrs:

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation. Measurement of safety performance, accident reporting and investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT – III	**OCCUPATIONAL HEALTH**	Lecture Hrs:
Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.		
UNIT – IV	**SAFETY AND HEALTH REGULATIONS**	Lecture Hrs:
Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.		
UNIT – V	**SAFETY MANAGEMENT**	Lecture Hrs:
Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity.		

Textbooks:

1. John. V. Grimaldi and Rollin. H Simonds, “Safety Managenent”, All India traveler Book seller, New Delhi – 1989.
2. Krishnan N.V, “Safety in Industry”, Jaico Publisher House, 1996.

Reference Books:

1. Occupational Safety Manual BHEL.
2. Industrial Safety and the law by P.M.C Nair Publishers, Trivandrum.
3. Managing emergencies in industries, loss prevention of India Ltd., proceedings, 1999.
4. Safety security and Risk management by U.K singh& J.M Dewam,. A.P.H. publishing company, New Delhi, 1996.
5. Singh, U.K and Dewan, J.M., “Sagety, Security and Risk Management”, APH publishing company, New Delhi, 1996.
6. John V Grimaldi, Safety Management. AITB publishers, 2003.
7. Safety Manual. EDEL engineering Consultancy, 2000.

Online Learning Resources:

1. https://nptel.ac.in/courses/110/105/110105094/
2. https://onlinecourses.nptel.ac.in/noc20_mg43/preview
3. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-mg43/

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D35208	OPTIMIZATION TECHNIQUES (21D35208)	L	T	P	C
Semester	II	PE – IV	3	0	0	3

Course Objectives:

- To introduce the advanced optimization techniques such as classical optimization techniques, numerical optimization techniques and genetic algorithms.
- Learn the knowledge to formulate optimization problems

Course Outcomes (CO): Student will be able to

- Students at the end of the course learn advanced optimization techniques to show real-life problems
- Students can able to formulate and solve various practical optimization problems in manufacturing and service organizations

UNIT - I	Classical optimization techniques	Lecture Hrs:

Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

UNIT – II	Numerical methods for optimization	Lecture Hrs:

Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT – III	Genetic algorithm (GA) & Multi-Objective GA	Lecture Hrs:

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems

UNIT – IV	Genetic Programming (GP)	Lecture Hrs:

Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT – V	Applications of Optimization in Design and Manufacturing systems	Lecture Hrs:

Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam and general optimization model of a machining process.

Textbooks:

1. Optimal design – JasbirArora, McGraw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers

Reference Books:

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

Online Learning Resources:
1. https://www.youtube.com/watch?v=eo2tOPV3AoE
2. https://www.youtube.com/watch?v=4t3z8y4CAcs
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/lecture-videos/lecture-1-introduction-and-optimization-problems/
4. https://ocw.mit.edu/courses/sloan-school-of-management/15-093j-optimization-methods-fall-2009/lecture-notes/
5. https://web.eng.fiu.edu/arleon/courses/Optimization/Lectures/Classical_Optimization.pdf
6. https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L4_LN.pdf
7. https://www.iare.ac.in/sites/default/files/OT%20Complete%20Notes_1.pdf

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D34208	REVERSE ENGINEERING (21D34208)	L	T	P	C
Semester	II	PE – IV	3	0	0	3

Course Objectives:

- The purpose of reverse engineering is to facilitate the maintenance work by improving the understandability of a system and to produce the necessary documents for a legacy system.

Course Outcomes (CO): Student will be able to

CO1. Understand the problem in the existing process.
CO2. Collect the large number of data/ information for the product
CO3. Depth analyze of the products and extraction of real time data
CO4. Understand the principles behind the design of the product, ways to redesign and improve the performance of the system

UNIT - I		Lecture Hrs:

INTRODUCTION
Scope and tasks of RE - Domain analysis- process of duplicating

UNIT – II		Lecture Hrs:

TOOLS FOR RE
Functionality- dimensional- developing technical data - digitizing techniques - construction ofsurface model - solid-part material- characteristics evaluation -software and applicationprototyping- verification

UNIT – III		Lecture Hrs:

CONCEPTS
History of Reverse Engineering – Preserving and preparation for the four stage process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation

UNIT – IV		Lecture Hrs:

DATA MANAGEMENT
Data reverse engineering – Three data Reverse engineering strategies – Definition – organizationdata issues - Software application – Finding reusable software components – Recycling real-timeembedded software – Design experiments to evaluate a Reverse Engineering tool – Rule baseddetection for reverse Engineering user interfaces – Reverse Engineering of assembly programs: Amodel based approach and its logical basics

UNIT – V		Lecture Hrs:

INTEGRATION
Cognitive approach to program understated – Integrating formal and structured methods in reverseengineering – Integrating reverse engineering, reuse and specification tool environments to reverseengineering -–coordinate measurement – feature capturing – surface and solid members

Textbooks:

1. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994

3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996

Reference Books:

1. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
2. Co-ordinate Measurement and reverse engineering, Donald R. Honsa, ISBN 1555897, AmericanGear Manufacturers Association

Online Learning Resources:

1. http://www.digimat.in/nptel/courses/video/112102101/L52.html

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36206	DECISION SUPPORT SYSTEMS (21D36206)	L	T	P	C
Semester	II	PE – IV	3	0	0	3

Course Objectives:

- To review and clarify the fundamental terms, concepts and theories associated with Decision Support Systems, computerized decision aids, expert systems, group support systems and executive information systems.
- To examine examples and case studies documenting computer support for organizational decision making, and various planning, analysis and control tasks.
- To discuss and develop skills in the analysis, design and implementation of computerized Decision Support Systems.
- To examine user interface design issues and evaluate the user interfaces and capabilities of Decision Support Systems.
- To improve hands-on skills using HTML, Microsoft Access and Excel, and JavaScript for building state-of-the-art Decision Support Systems, especially Web-Based systems that use advanced computing and networking technologies.
- To understand that most Decision Support Systems are designed to support rather than replace decision makers and the consequences of this perspective for designing DSS.
- To discuss organizational and social implications of Decision Support Systems.

Course Outcomes (CO): Student will be able to

- Provide students with the main concepts of Decision Support System (DSS) and management sciences
- Study the components of DSS and the main players who participate in the decision process.
- Study different types of modeling and analysis.
- Explain key areas contributing to DSS such as knowledge acquisition, expert system and knowledge base systems
- Study group decision support and groupware technologies within organization

UNIT - I	**DECISION MAKING**	Lecture Hrs:9
Managerial decision making, system modeling and support-preview of the modeling process-phases of decision making process.		
UNIT – II	**MODELING AND ANALYSIS**	Lecture Hrs:9
DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development.		
UNIT – III	**KNOWLEDGE MANAGEMENT**	Lecture Hrs:9
Group support systems- enterprise DSS- supply chain and DSS-knowledge management methods, technologies and tools.		
UNIT – IV	**INTELLIGENT SYSTEMS**	Lecture Hrs:9
Artificial intelligence and expert systems-concepts, structure, types-knowledge acquisition and validation, knowledge representation		
UNIT – V	**IMPLEMENTATION**	Lecture Hrs:9
Implementation, integration and impact of management support systems.		

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Textbooks:

1. C.R. Bacon, Practical Risk-Adjusted Performance Measurement, John Wiley & Sons Ltd, Oxford, UK, 2012.
2. K. Soetaert, Solving Differential Equations in R, Springer, Berlin, Heidelberg, 2012.
3. J.C.H. Chen, H.A. Wu, Aesthetic Creativity: Bridging Arts, Culture, and Education, in: S. Leong, B.W. Leung (Eds.), Creative Arts in Education and Culture: Perspectives from Greater China, Springer Netherlands, Dordrecht, 2013: pp. 43–53.

Reference Books:

1. L. Randall, Extra dimensions and warped geometries, Science. 296 (2002) 1422–1427.
2. G. Smith, J. Yard, Quantum communication with zero-capacity channels, Science. 321 (2008) 1812–1815.
3. Y. Yang, Y. Dong, N.V. Chawla, Predicting node degree centrality with the node prominence profile, Sci. Rep. 4 (2014) 7236.
4. S.M. Grenon, M. Jeanne, J. Aguado-Zuniga, M.S. Conte, M. Hughes-Fulford, Effects of gravitational mechanical unloading in endothelial cells: association between caveolins, inflammation and adhesion molecules, Sci. Rep. 3 (2013) 1494.

Online Learning Resources:

1. https://scholarworks.uni.edu/facbook/67/
2. https://nptel.ac.in/courses/110/105/110105147/
3. https://onlinecourses.nptel.ac.in/noc20_mg59/preview
4. https://alison.com/course/decision-support-systems-for-inventory

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36207	QUALITY ENGINEERING – II LABORATORY (21D36207)	L	T	P	C
Semester	II		0	0	4	2

Course Objectives:

Course Outcomes (CO):

LIST OF EXPERIMENTS:

1. Assessment of process capability of the given manufacturing process using process capability indices.
2. Assessment of process capability of the given manufacturing process using process Digital motorized multifunctional height gauge.
3. Construction of control chart for variable quality characteristic using Digital motorized multifunctional height gauge.
4. Construction of control chart for variable quality characteristic using SQC display unit.
5. Construction of control chart for variable quality characteristic using SQC software.
6. Construction of Repeatability and reproducibility studies for appraiser and instrument using R & R software.

References:

Online learning resources/Virtual labs:

R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36208	SIMULATION-II LABORATORY (21D36208)	L	T	P	C
Semester	II		0	0	4	2

Course Objectives:

- To understand the various Simulation Processes

Course Outcomes (CO):

- To learn various softwares to design.

LIST OF EXPERIMENTS:

CYCLE-I: DEMO EXPERIMENTS

1. MATLAB Commands and Examples
2. Built-in functions

RELIABILITY SOFTWARE MODULES

3. SPARE Software package
4. Failure Mode Software Package
5. FMEA-RPN Software package
6. SPC Software package

CYCLE-II: TESTING PROGRAMS

1. Evaluation of basic probability indices for series and parallel system
2. Parametric Boot-Strap estimation and finding best parameters
3. Chi-Square Goodness of Fit
4. Determination of Covariance, Correlation and Cross-Correlation coefficients
5. Neural Network design to Block box models
6. Testing of sampling methods
7. Characteristics of Histogram, Scatter diagram, Process Flow diagram and Pareto

References:

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Semester-III							
S.No.	**Course Code**	**Course Name**	**Category**	**Hours per**			**Credits**
				L	T	**P**	
1.		Program Elective Course – V a. Total Quality Management b. Quality Management Systems c. Quality Concepts in Product Development	PE	3	0	0	3
2.		Open Elective	OE	3	0	0	3
3.		Dissertation Phase – I	PR	0	0	20	10
4.		Co-curricular Activities					2
Total							**18**

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36301	TOTAL QUALITY MANAGEMENT (PE – V)	L	T	P	C
Semester	III		3	0	0	3

Course Objectives:

1. Implement the principles and concepts inherent in a Total Quality Management (TQM) approach to managing a manufacturing or service organization.
2. Explain the system of documentation, implementation and assessment of quality
3. Assess exactly where an organization stands on quality management with respect to the ISO 9000 quality management standard.
4. Develop a strategy for implementing TQM in an organization

Course Outcomes (CO): Student will be able to

1. Develop an understanding on quality management philosophies and framework
2. Develop in-depth knowledge on various tools and techniques of quality management.
3. Learn the applications of quality tools and techniques.
4. Develop analytical skills for investigating and analyzing quality management issues in the industry and suggest implement able solutions to those.

UNIT - I **Lecture Hrs:**

INTRODUCTION: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT – II **Lecture Hrs:**

CUSTOMER FOCUS AND SATISFACTION: The importance of customer satisfaction and loyalty- Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

UNIT – III **Lecture Hrs:**

ORGANIZING FOR TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

UNIT – IV **Lecture Hrs:**

THE COST OF QUALITY: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

UNIT – V **Lecture Hrs:**

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Textbooks:
1. Total Quality Management- A Practical Approach/H. Lal 2. Quality Management/KanishkaBedi/Oxford University Press/2011 3. Total Engineering Quality Management/Sunil Sharma/Macmillan
Reference Books:
1. Total Quality Management / Joel E.Ross/Taylor and Franscis Limited 2. Total Quality Management/P.N.Mukherjee/PHI 3. Beyond TQM / Robert L.Flood 4. Statistical Quality Control / E.L. Grant / McGraw Hill.
Online Learning Resources:
• https://nptel.ac.in/courses/110/104/110104080/ • https://onlinecourses.nptel.ac.in/noc21_mg03/preview • https://nptel.ac.in/courses/110/104/110104085/ • https://nptel.ac.in/content/syllabus_pdf/110104080.pdf

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R21 COURSE STRUCTURE &SYLLABUS FOR M.TECH COURSES
DEPARTMENT OF MECHANICAL ENGINEERING
(QUALITY ENGINEERING AND MANAGEMENT)

Course Code	21D36302	QUALITY MANAGEMENT SYSTEMS (PE – V)	L	T	P	C
Semester	III		3	0	0	3

Course Objectives:

- To impart knowledge on the concept of quality, tools for analyzing quality ,Statistical tools in quality acceptance sampling and life testing
- understanding of the laws, principles and phenomena in the field of quality management,
- adoption of theoretical and practical knowledge and skills in the field of quality management.

Course Outcomes (CO): Student will be able to

- Define the basic concepts, terminology and overcome legislative framework in the subject area of quality, quality control and quality management system,
- describe ways of applying quality management in the actual organization,
- demonstrate the capability of making quality process for the selected process,
- perceiving the organization to determine the existence or nonexistence of the implemented quality management system,
- demonstrate the capability of making quality process, given the well-known process, identify the standard that could be applied, the roles and responsibilities of reference legislative framework
- choose the optimal approach to the analysis of a given process by describing the activities

UNIT - I		Lecture Hrs:

Introduction to the concept of quality - quality control - quality assurance - quality management - quality and total quality - small q and big Q - concept of total quality management - TQM axioms - major contributions of deeming, juran and cross by to quality management - enablers for total quality - strategic quality management

UNIT – II		Lecture Hrs:

Quality costs - analysis of quality costs - loss function - Taguchi methods - total quality tools - pare to chart - fishbone diagram – check sheet - histograms - scatter diagrams - run charts - flow diagram – Bench Marking-Overview of ISO 9000:2000 certification-Quality circles.

UNIT – III		Lecture Hrs:

Experimental design-Guidelines Overview of fact oral experiments, replication, General Idea on Process optimization- Process Robustness Studies, Quality function deployment, failure mode, effect and criticality analysis, continuous process improvement- The PDSA cycle-Kaizen.

UNIT – IV		Lecture Hrs:

Statistical tools in quality - making predictions using the normal, Poisson and binomial probability distributions - statistical process control - control charts for variables – X and R

charts - process capability indices - control charts for attributes - P, np, c and u charts

UNIT – V		Lecture Hrs:

Module IV (12 hours) Acceptance sampling - lot by lot acceptance using single sampling by attributes - OC curve - average outgoing quality and the AOQL - double sampling - multiple and sequential sampling - ATI and AFI - introduction to life testing and reliability, MTBF, MTTR, system reliability-components in series and parallel

Textbooks:

1. Gerals M Smith-2004, Statistical Process Control and Quality Improvement-5th edition ,Pearson Education, New Delhi
2. Grant, Statistical Quality Control, McGraw Hill

Reference Books:

1. Bester Field, Dale H,CarolBoeterfreld-Muchna,GlenH,BoeterfreldMeryBoeterfeld-Scare, 2003,
3. Total Quality Management, 3rd edition, Pearson Education, New Delhi.
4. Juran J.M., Gryna I.M., “Quality Planning and Analysis”, Tata McGraw Hill Publishing Company.
5. Montgomery, douglas C2001,Introduction to statical quality control, fourth edition,JohnWiley&sonsInc, New Delhi

Online Learning Resources:

- https://nptel.ac.in/courses/110/101/110101010/
- https://nptel.ac.in/courses/110/105/110105039/

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DEPARTMENT OF MECHANICAL ENGINEERING
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Course Code		Program Elective Course – V	L	T	P	C
Semester	III	a. QUALITY CONCEPTS IN PRODUCT DEVELOPMENT	3	0	0	3

Course Objectives:

- Understand the concepts of tools and techniques in the Integrated Product Development area of the Engineering Services industry.
- Relate the engineering topics into real world engineering applications.

Course Outcomes (CO): Student will be able to

- Summarise the various trends affecting product decision
- Identify the requirements to create new product
- Compare different techniques involved in design creation and design testing
- Rephrase the methods of model creation and integration between software and hardware.
- Illustrate the need of end of life and patenting.

UNIT - I	**DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION**	Lecture Hrs:9

Design – The Design Process – Computer Aided Engineering – Concurrent Engineering – Competition Bench Marking – Creativity – Theory of Problem solving (TRIZ) – Value Analysis - Design for Manufacture, Design for Assembly – Design for casting, Forging, Metal Forming, Machining and Welding

UNIT – II	**DESIGN FOR QUALITY**	Lecture Hrs:9

Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design –testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT – III	**FAILURE MODE EFFECT ANALYSIS AND DESIGN FOR SIX SIGMA**	Lecture Hrs:9

Basic methods: Refining geometry and layout, general process of product embodiment - Embodiment checklist- Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling - Basis of SIX SIGMA – Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production –Lean SIX SIGMA and services

UNIT – IV	**DESIGN OF EXPERIMENTS**	Lecture Hrs:9

Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments - Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments - Two and three factor full Factorial experiments, 2K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi's approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios

UNIT – V	**STATISTICAL CONSIDERATION AND RELIABILITY**	Lecture Hrs:9

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams –Multivariable charts –Matrix plots and 3-D plots.-Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distribution

Textbooks:

1. The Management and control of Quality-6th edition-James R. Evens, William M Lindsay Pub:son south-western(www.swlearning.com)
2. Fundamentals of Quality control and improvement 2nd edition, AMITAVA MITRA, Pearson Education Asia, 2002.

Reference Books:

1. Dieter, George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2000.
2. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE), 2001.
3. Product Design And Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA McGRAW-HILL- 3rd Edition, 2003.

Online Learning Resources:

- https://nptel.ac.in/courses/112/107/112107217/
- https://onlinecourses.nptel.ac.in/noc21_me83/preview
- https://nptel.ac.in/courses/112/106/112106249/
- https://nptel.ac.in/courses/110/105/110105088/

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DEPARTMENT OF MECHANICAL ENGINEERING
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Course Code		Open Elective	L	T	P	C
Semester	III	Mechatronics	3	0	0	3

Course Objectives:

To impart knowledge on

To impart knowledge on about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

Course Outcomes (CO): Student will be able to

1.Students can able to understand the concepts,need and importance of mechatronics.
2. They can able to know the concepts of 8085 microprocessor, 8051 microcontroller
3. They can able to understand the Programmable peripheral Interface
4. Students can able to know the structure, programming and selection of PLC
5. They can able to know the working principle and design concepts of actuators, mechatronic system.

UNIT – I — Lecture Hrs:

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors.

UNIT – II — Lecture Hrs:

8085 MICROPROCESSOR AND 8051 MICROCONTROLLER
Introduction – Architecture of 8085– Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,.

UNIT – III — Lecture Hrs:

PROGRAMMABLE PERIPHERAL INTERFACE
Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT – IV — Lecture Hrs:

PROGRAMMABLE LOGIC CONTROLLER
Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT – V — Lecture Hrs:

ACTUATORS AND MECHATRONIC SYSTEM DESIGN
Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

Textbooks:

1.Bolton, “Mechatronics”, Printice Hall, 2008 2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice

Hall, 2008.

Reference Books:

1. Michael B.Histand and Davis G.Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International edition,2007.
2. Bradley D.A, Dawson D, Buru N.C and Loader A.J, "Mechatronics", Chapman and Hall, 1993.
3. Smaili.A and Mrad.F , "Mechatronics Integrated Technologies for Intelligent Machines", Oxford University Press,2007.
4. DevadasShetty and Richard A. Kolk, "Mechatronics Systems Design", PWS publishing company,2007.
5. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India,2007.
6. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print,2013

Online Learning Resources:

https://nptel.ac.in › courses › noc21 › SEM1 › noc21-me27