Pandit Deendayal Petroleum University
School of Technology
Course Structure for B. Tech. Industrial Engineering

SEMESTER VII			B. TECH. INDUSTRIAL ENGINEERING										
Sr. No.	Course Code	Course Name	Teaching Scheme					Exam Scheme					Total Marks
								Theory			Practical		
			L	T	P	C	Hrs./Wk.	MS	ES	IA	LW	LE/Viva	
		Industrial Training				6							
1	IE 401T	Quality Management & SQC (Theory)	3	-	-	6	3	30	60	10	-	-	100
2	IE 401P	Quality Management & SQC (Practical)	-	-	2	1	2	-	-	-	25	25	50
3	IE 402T (ME 425T)	CAD/CAM (Theory)	3	-	-	6	3	30	60	10	-	-	100
4	IE 402P (ME 425P)	CAD/CAM (Practical)	-	-	4	2	4	-	-	-	25	25	50
5	IE 403 (ME 453)	Facility and Material Handling Sys. Planning	3	-	-	6	3	30	60	10	-	-	100
6	IE 4XX	Department Elective - 2	3	-	-	6	3	30	60	10	-	-	100
7	IE 404	Lean Systems	3	-	-	6	3	30	60	10	-	-	100
8	IE 405	Industrial Engineering Seminar	-	-	6	3	6	30	60	10	-	-	100
		Total	**15**	**-**	**12**	**42**	**27**						**700**

MS = Mid Semester ES = End Semester IA = Internal Assessment (like quiz, assignments, etc.)
LW = Laboratory Work LE = Laboratory Exam

IE 401T QUALITY MANAGEMENT AND STATISTICAL QUALITY CONTROL										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	6	3	30	60	10	--	--	100

UNIT I **10**

Meaning of quality, history of quality improvement, cost of quality, QFD and the House of Quality. Review of statistical concepts: measures of central tendency and dispersion, probability distributions, point and interval estimates, hypothesis testing, correlation and regression.

UNIT II **10**

Concept of control, statistical basis of control charts. Control charts for variables, $\bar{x}$ and R charts, s chart, MR chart. Concept of ARL, economic design of control charts, charts with varying sample sizes, analysis of control chart patterns, sensitizing rules. Control charts for attributes: p, np and c charts. Process capability analysis.

UNIT III **10**

CUSUM and EWMA charts, control charts for short production runs, SPC with autocorrelated process data. Other procedures of control. Introduction to multivariate process monitoring and control. Acceptance sampling, the OC curve, single sampling plans, double, multiple and sequential sampling. Sampling standards: ANSI/ASQC Z1.4 (MIL 105E), Dodge-Romig Plans, other sampling techniques.

UNIT IV **8**

Gage repeatability and reproducibility studies. Total quality management, concept of six sigma, PDCA/DMAIC cycle, contribution of Deming, Juran, Crosby, Ishikawa, Taguchi, etc. to the field of quality. Quality systems: ISO 9000 series of standards, the Deming prize, the Malcolm Baldridge award, etc. Quality management in various industries: automotive, pharmaceutical, software, services, etc.

APPROXIMATE TOTAL **38**

Texts and References

1. Montgomery, Douglas C., Introduction to Statistical Quality Control, 6th edition, Wiley.
2. Juran, J. M. and Gryna, F. M., Juran's Quality Handbook, 6th edition, Tata McGraw-Hill
3. Juran, J. M. and Gryna, F. M., Juran's Quality Planning and Analysis, Tata McGraw-Hill
4. Bedi, Kanishka, Quality Management, Oxford University Press

IE 401P QUALITY MANAGEMENT AND STATISTICAL QUALITY CONTROL										
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**--**	**--**	**--**	**25**	**25**	**100**

LIST OF EXPERIMENTS **8**

1. Process Capability Analysis
2. $\bar{x}$ and R chart
3. p and np charts
4. c chart
5. $CUSUM$ chart
6. $EWMA$ chart
7. Deming's funnel experiment
8. Ishikawa diagrams
9. Gage Repeatability and Reproducibility

IE 403 PLANNING OF FACILITIES AND MATERIAL HANDLING SYSTEMS										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	6	3	30	60	10	--	--	100

UNIT I **9**

Introduction to facility planning, significance and objectives, the planning process, interaction of product, process and schedule design with facilities design. Flow systems, activity relationships, departmental planning and space requirements. Personnel requirements, the employee-facility interface, planning for food services, health services, etc.

UNIT II **10**

Basic layout types, algorithmic approaches. Department shapes and aisles, multi-floor facility layout. Software for facility layout – CRAFT, ALDEP, etc. Layouts for various functions: receiving and shipping storage and warehousing, manufacturing, office planning, services, non-manufacturing applications. Quantitative approaches – deterministic and probabilistic models. Evaluating and implementing the facilities plan.

UNIT III **10**

Material handling principles, design of material handling systems, unit load design, material handling equipment, estimating material handling costs, safety considerations in material handling. Automation in material handling. Material handling requirements in various industries. Fixed path material handling models, queuing and simulation models.

UNIT IV **9**

Factors influencing facility location, distance functions in facility location, single and multi-facility location models, minisum, minimax and maxmin criteria, the quadratic assignment problem, covering problem, median location problem. Obnoxious facility location.

APPROXIMATE TOTAL **38**

Texts and References

1. Tompkins J. A., White J. A., Bozer Y. A. and Tanchoco J. M. A., Facilities Planning, 4th edition, Wiley.
2. Farahani, Reza and Hekmatfar, Masoud, Facility Location: Concepts, Models, Algorithms and Case Studies, Physica-Verlag (Springer)
3. Sule, Dileep, Manufacturing Facilities: Location, Planning and Design, PWS Boston

IE 402T/ME 425T COMPUTER AIDED DESIGN /COMPUTER AIDED MANUFACTURING										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	-	8	3	30	60	10	--	--	100

UNIT I **09**

CAD FUNDAMENTALS: Introduction, Reasons for implementing a CAD system, Computer aided process application, benefits, CAD software's, Elements of programming, CAD programming ,Need and scope of computer aided design

COMPUETR GRAPHICS: Scan conversion; Bresenham's Algorithm for line, circle and Ellipse. Standards for graphics programming, features of GKS, other graphics standards, PHIGS, IGES, PDES. Standards in CAD, 2D and 3D transformations.

UNIT II **10**

PLANE & SPACE CURVES: Types of mathematical representation of curves, parametric representation of line, circle, ellipse, parabola, hyperbola. Wire frame models, wire frame entities parametric representation of synthetic curves Hermit cubic splines, Bezier curves, B-splines, constructive solid geometry

Computer Programming: Use of computer programming in design of machine elements, thermal systems and fluid systems, development of computer program using C/Matlab, etc. parametric analysis using computer programming, use of computer programming in product data management.

UNIT III **06**

Introduction: Introduction to CAM, Concepts & scope of CAM, Nature & type of manufacturing system, Evolution, Benefits of CAM,

Constructional details, of CNC machines:

Basis and need of CNC machines: NC, CNC and DNC systems. Machine structures, slide ways, motion transmission elements, swarf (Chip) removal and safety considerations, Automatic tool changers and multiple pallet systems, Sensors and feedback devices in CNC machines, Constructional" details of CNC turning center, Classification of CNC control systems, Applications of CNC machines in manufacturing, advantages of CNC machine.

UNIT IV **14**

CNC part programming: Axis identification and coordinate systems, structure of CNC part program, Programming formats, NC programming codes.

Programming for 2 axis control systems: Manual part programming for a turning center, programming using tool nose radius compensation, do loop, sub routines and fixed cycles. Programming for CNC wire-cut machines.

Programming for 3 axis control system: Manual part programming for CNC machining center programming using tool radius compensation tool offsets, do loop, subroutines and fixed cycles.

COMPUTER AIDED CNC PART PROGRAMMING: Using APT language CAD/CAM Aided CNC part programming.

Tooling for CNC machines: Tooling requirements of CNC machine, preset and qualified tools, work and tool holding devices in CNC machines

Computer Aided Production management:

Introduction, PPC fundamentals, Problems with traditional PPC, use of computer in PPC such as CAPP, MRPI, MRPII, CAGC etc.

Approximate Total : 39 Hrs

Texts and References

1. Computer Aided Manufacturing by Tien Chien Chang, Pearson Education
2. Automation, Production Systems and Computer Integrated Manufacturing by by Groover, Pearson Education
3. CNC Programming - Principles and Applications, Mike Mattson, Cengage Publication.
4. CNC programming – Dr. S.K.Sinha – Golgotia publications.
5. P.Radhakrishnan, " Computer Numerical Control ", New Central Book Agency.
6. Computer integrated manufacturing -S. Kant Vajpayee – Prentice Hall of India.
7. Computer Aided Manufacturing- Rao, Tewari, Kundra, McGraw Hill.
8. CAD/CAM, Principles and Applications –P N Rao, McGraw Hill.
9. CAD/CAM, Introduction, -Ibrahim Zeid, Tata McGraw Hill.
10. CAD/CAM, Groovers and Zimmers, Pearson
11. Computer Aided Engineering & Design by Jim Browne, New Age International Publications,
12. Computer Graphics & design by P. Radhakrishnan, C.P. Kothanadaraman, New age publication
13. CAD / CAM - Chris McMohan, Jimmie Brown Addison – Wesley

IE 402P/ME 425P COMPUTER AIDED DESIGN/ COMPUTER AIDED MANUFACTURING

Teaching Scheme					Examination Scheme					
					Theory			Practical		Total Marks
L	T	P	C	Hrs/Week	MS	ES	IA	LW	LE/Viva	
--	--	4	2	4	--	--	--	50	50	100

LIST OF PRACTICALS:

1. Computer program for scan conversion of a straight line, circle and ellipse.
2. Computer program for scan conversion of a straight circle.
3. Computer program for scan conversion of a straight ellipse.
4. Computer program for transformation of 2-D entities.
5. Computer program for transformation of 3-D entities.
6. Demonstration of CNC Milling machine with user interface and calculating the Co - ordinates of given geometry in absolute end increment mode for cutter path.
7. Validate the CNC programming for a given geometry using Mirror and Subroutine.
8. Validate the CNC programming for a given geometry using Polar Co -ordinate for drilling cycles.
9. Validate the CNC programming for a given geometry using Tool Radius Compensation and Repeat loop for Peck drilling cycles.
10. Perform the Various turning and machining operation on CNC.
11. Tool path generation with CAM software like Master CAM, Siemens nx

IE 404 Lean Systems										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT-I **12**

Introduction, background and lean thinking, World class Manufacturing, Order winners and qualifiers, Agile Manufacturing, JIT, 5S Principal, Standard work, continuous improvement, TPM, SMED, Total cost of quality, push and pull system of production, Kanban, single and dual card system, CONWIP, Employee involvement, lean production preparation: System assessment, Process and value-stream mapping – Sources of waste. Waste elimination – Muda -7 types etc.

UNIT-II **8**

Toyota Production System: Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production Systems, poke yoke, heijunka, etc.

UNIT III **8**

Lean production processes, approaches and techniques Workplace organization Stability, One piece flow, Cellular systems. Total productive maintenance. Quality improvement. Standards. Leveling. Visual management.

UNIT IV **12**

Factory physics and laws, Bottle neck scheduling, lot stream, project scheduling, and Assembly line balance, Employee involvement:–Teams Training Supporting and encouraging involvement, Involving people in the change process communication Importance of culture. Startup of lean processes and examples of applications. Sustaining improvement and change, auditing, follow-up actions.

Approximate Total **40**

Text books and References

1. *The Toyota Way Fieldbook,* Jeffrey Liker and David Meier, McGraw-Hill, 2006.
2. *Lean Production Simplified*, Pascal Dennis, Productivity Press, 2007.
3. *Lean Thinking,* James Womack and Daniel Jones, Free Press, Revised Edition, 2003.
4. *The Machine That Changed The World,* James Womack, Daniel Jones, and Daniel Roos, Rawson Associates, 1990.
5. *Factory Physics by Hopp and spearman*
6. *Value Stream Management,* Don Topping, Tom Luyster, and Tom Shuker, Productivity Press, 2002.
7. Study of 'Toyota' Production System from Industrial Engineering Viewpoint, by Shigeo Shingo,Osaka, Japan, Shinsei Printing Co. Ltd. 1981
8. World Class Manufacturing —Richard schonberger, The Next Decade: Building Power, Strength, and Value *(1996).*
9. Japanese Manufacturing Techniques: Richard schonberger, Nine Hidden Lessons in Simplicity *(1982).*
10. Design and Analysis of Lean Production systems. Askin, R.G. and J. B. Goldberg(2002).

IE 411 Design of Experiments										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT-I **12**

Strategy of experimentations: Applications of experimental Design, basic principles, design guidelines, statistical design and problems. Experimental design; statistical analysis of data.

Comparative Experiments: Statistical concepts**,** sampling and sampling Distributions, Inferences about the differences in means, randomized design, and inference about differences in means paired comparison design, inferences about the variances of normal distributions, problems. Experiment with single factor: the analysis of variance (ANOVA), analysis of fixed effects models, model adequacy checking, practical interpretation of results, sample computer output, determining the sample size, discovering the dispersion effect, the regression approach to the ANOVA, and non-parametric method in the ANOVA.

UNIT-II **8**

Randomized blocks, Latin squares and related designs: Randomized complete block design, Latin square design, the Graeco-Latin square design, balance incomplete block design, problems. Introduction to factorial design: Basic definition and principals, advantage of factorials, two factor factorial design, the general factorial design, fitting response curve and surfaces, blocking in a factorial design, problems. The 2^k factorial design: 2^2, 2^3 and general 2^k factorial design, single replicate of 2^k design, addition of center points to the 2^k design, problems.

UNIT III **10**

Two-level fractional factorial design: one half fraction of the 2^k design, the on quarter fraction of the 2^k design, resolution III, IV and V design. Fitting regression models: Linear regression models, estimation of the parameters in linear regression models hypothesis testing in multiple regression, confidence intervals in multiple regression, prediction of new response observation, regression model diagnostics, testing for lack of it, problems.

UNIT IV **10**

Response surface methods and other approaches to process optimization: Method of steepest ascent, analysis of a second order response surface, experimental designs for fitting response surfaces, mixture of experiments, EVOP, Robust design and Taguchi method, problems.

Nested and split plot designs and its applications, use of computer software for analysis of designed experiments.

Approximate Total **40**

Texts and References

11. D.C. Montgomery, Design and Analysis of Experiments, 8th edition, John Wiley.
12. H. Toutenburg and Shalabh, Statistical analysis of designed experiments, Springer, 2009
13. G.E.P. Box, W.G. Hunter and J.S. Hunter, Statistics for experimenters: An Introduction to Design, data analysis and model building, John Wiley and sons, 1978.