INDUSTRIAL ENGINEERING AND QUALITY CONTROL **Course Code : 316362**

Programme Name/s : Mechanical Engineering

Programme Code : ME

Semester : Sixth

Course Title : INDUSTRIAL ENGINEERING AND QUALITY CONTROL

Course Code : 316362

I. RATIONALE

In today's highly competitive industrial environment, efficiency and quality are critical for organizational success. Industrial Engineering focuses on process optimization, resource utilization, and system efficiency, while quality control ensures that products and services meet predefined standards. The integration of these two aspects enables industries to minimize waste, reduce costs, enhance product reliability, and improve customer satisfaction. This course plays a crucial role in developing Mechanical Diploma Engineering students with the knowledge and skills required to optimize industrial processes, enhance productivity, and ensure quality in manufacturing and service sectors by using conventional as well as modern computerized methods.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Apply knowledge & skills related to Industrial Engineering for enhancement of quality & productivity..

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Prepare the process sheet in given situation.
- CO2 - Apply work study techniques for optimizing manufacturing processes.
- CO3 - Apply quality control tools for monitoring product quality in industrial processes.
- CO4 - Determine process Capability using Statistical Quality Control techniques.
- CO5 - Choose relevant computer aided quality control / inspection method for manufacturing.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316362	INDUSTRIAL ENGINEERING AND QUALITY CONTROL	IEQ	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	-	-	25	10	150

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 List site selection factors. TLO 1.2 Draw types of plant layout. TLO 1.3 Compare types of production systems. TLO 1.4 Explain methods for improving productivity. TLO 1.5 Prepare operation sheet for given component TLO 1.6 Explain need and importance of line balancing	**Unit - I Plant and Process Engineering** 1.1 Plant location and layout: Importance of site selection, factors affecting site selection, types of plant layouts, design principles of plant layout, merits and demerits of different plant layouts. 1.2 Production systems: Types of production system job order production, batch production, mass production, continuous production. 1.3 Productivity: -Definition, measurement of productivity, methods of improving productivity. 1.4 Process Engineering: Definition and importance of process engineering, procedure of process planning, factors affecting process planning, operation sheet/route sheet. 1.5 Line balancing: Definition, importance of line balancing.	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Explain importance of industrial engineering. TLO 2.2 Define work study, method study, time study. TLO 2.3 State the objectives of work study, method study, time study. TLO 2.4 State meaning of therblig symbols. TLO 2.5 Prepare a relevant type of chart for given process using recording techniques. TLO 2.6 Calculate standard time for a given activity.	**Unit - II Work Study** 2.1 Industrial Engineering: Definition, need, objectives and scope. 2.2 Work study: Components of work study, method study (Motion study) and time study (Work measurement) 2.3 Method study: Definition, objectives, procedure, factors considered for selection of work for method study 2.4 Recording techniques of method study: Process charts — outline process chart, flow process chart, two handed process chart/SIMO chart, multiple activity chart, flow diagram, string diagram, therbligs, travel chart. 2.5 Work Measurement : Objectives, procedure, time study, time study equipment, time study allowances. 2.6 Calculation of standard time. (simple numerical on work study)	Lecture Using Chalk-Board Video Demonstrations Presentations Role Play
3	TLO 3.1 Explain different quality concepts. TLO 3.2 Define cost of quality and value of quality. TLO 3.3 Solve quality problems using quality control tools for a given problem. TLO 3.4 Differentiate between quality control and inspection. TLO 3.5 Differentiate between types of inspection.	**Unit - III Quality Control** 3.1 Meaning of quality of product and services, importance of quality control, quality characteristics, quality of design, quality of conformance, quality of performance, meaning and importance of quality assurance. 3.2 Quality economics: Cost of quality, value of quality, economics of quality confirmation, cost of quality appraisal, prevention, external and internal failure cost. 3.3 Quality control tools: Basic concept and areas of application. various Q-C tools, cause-and-effect diagram (fishbone or Ishikawa diagram), check sheet, histogram, pareto chart and scatter diagram 3.4 Inspection definition and meaning, difference between Inspection and quality control, classification of inspection —(i) Inprocess inspection (ii) Final inspection (iii) Raw material inspection. 3.5 Role of quality control inspector /supervisor.	Lecture Using Chalk-Board Presentations Video Demonstrations
4	TLO 4.1 Explain SQC and its importance. TLO 4.2 Differentiate variables and attribute data. TLO 4.3 Draw control charts for variables and attributes. TLO 4.4 Determine process capability of a given manufacturing process. TLO 4.5 Explain different types of sampling plan.	**Unit - IV Statistical Quality Control** 4.1 Definition, objectives and benefits of Statistical Quality Control (SQC). 4.2 Variable and attribute measurement. inherent and assignable sources of variation. 4.3 Control charts for variables — X bar and R charts, control charts for attributes p, np, c charts. 4.4 Process capability of machine (+/-3 sigma or +/- 6 sigma), Cp and Cpk calculations. 4.5 Acceptance sampling concept, comparison with 100% inspection operating characteristics curve. 4.6 Different types of sampling methods.	Lecture Using Chalk-Board Presentations Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 List different types of computer-aided process planning. TLO 5.2 Describe computer-aided quality control TLO 5.3 List quality control software. TLO 5.4 Describe computer-aided inspection TLO 5.5 Compare traditional quality control and computer aided quality control TLO 5.6 Explain CAQC, its objectives and relevant manufacturing example.	**Unit - V Computer-aided Process Planning and Quality Control** 5.1 Computer-Aided Process Planning (CAPP):- Introduction, objectives, types, applications, comparison between traditional process planning and CAPP 5.2 Computer-Aided Quality Control (CAQC) Introduction, objectives, types ,applications comparison between traditional quality control and CAQC 5.3 Computer-Aided Inspection (CAI):- Introduction, objectives, applications, comparison between traditional inspection and CAI.	Lecture Using Chalk-Board Presentations Flipped Classroom

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify nearby small scale industry. LLO 1.2 List product, process and volume. LLO 1.3 Prepare suitable plant layout.	1	Preparation of Plant Layout for Small Scale Industry.	2	CO1
LLO 2.1 Identify key dimensions, tolerances and surface finish requirement. LLO 2.2 Evaluate manufacturing feasibility based on part print analysis LLO 2.3 Enlist manufacturing operation LLO 2.4 Arrange the optimized sequence of operation	2	Part print analysis for manufacturing feasibility.	2	CO1
LLO 3.1 Analyze the given job and interpret its design and manufacturing requirements. LLO 3.2 Identify suitable manufacturing processes and sequences them appropriately LLO 3.3 Select appropriate machines, tools, cutting parameters, and inspection methods LLO 3.4 Prepare a comprehensive process plan including operation sheets and process routing.	3	*Preparation of a detail process plan for a given manufacturing job.	4	CO1 CO5
LLO 4.1 Select the activity for motion study from given examples. LLO 4.2 Select the equipment's for motion study LLO 4.3 Record motion involved in operation.	4	Record motions of given manufacturing operation using motion study.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Select the activity for time study from given examples LLO 5.2 Select the proper equipment's for time study LLO 5.3 Measure time component involved in operation LLO 5.4 Compile measured time for each activity	5	Measure time of given manufacturing operation using time study method.	2	CO2
LLO 6.1 Identify the essential and excess motions in given situation. LLO 6.2 Assess the excess motion and time in given situation LLO 6.3 Prepare new motion chart by eliminating excess motion time.	6	* Productivity improvement using motions and time study.	2	CO2
LLO 7.1 Select activity from given examples LLO 7.2 Choose appropriate THERBLIGS for motion study LLO 7.3 Draw two handed motion chart.	7	* Construction of two handed motion chart	2	CO2
LLO 8.1 Prepare multiple activity chart for given situation.	8	Prepration of multiple activity chart	2	CO2
LLO 9.1 Select work to be measured from given examples LLO 9.2 Record the time activity wise by observing each activity LLO 9.3 Calculate standard time by adding normal time and applicable allowances	9	*Determination of standard time for given manufacturing operation	2	CO2
LLO 10.1 Select problem for pareto chart analysis from given examples LLO 10.2 Choose any computer aided quality control software LLO 10.3 Generate a pareto chart	10	*Pareto chart using computer aided quality control software.	2	CO3 CO5
LLO 11.1 Identify a real-world mechanical issue (e.g., machine failure, defective parts, poor surface finish). LLO 11.2 Choose any computer aided quality control software LLO 11.3 Construct a fishbone diagram	11	Develop a fishbone diagram for a given mechanical problem.	2	CO3 CO5
LLO 12.1 Collect and arrange data LLO 12.2 Calculate X bar and R LLO 12.3 Calculate UCL and LCL LLO 12.4 Draw and interpret variable chart LLO 12.5 Validate using CAQC software.	12	*Preparation of variable control charts (X bar and R) for given data and validate using CAQC software.	2	CO4 CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 13.1 Collect and arrange data LLO 13.2 Calculate P bar and C bar LLO 13.3 Calculate UCL and LCL LLO 13.4 Draw and interpret attribute chart LLO 13.5 Validate using CAQC software.	13	Preparation attribute control charts (P-chart and C-chart) for given data and validate using CAQC software.	2	CO4 CO5
LLO 14.1 Collect and arrange data LLO 14.2 Determine process capability LLO 14.3 Validate using CAQC software.	14	*Determination of process capability and validate using CAQC software.	2	CO4 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Industrial Visit to an Automobile manufacturing plant
- Collect an information and make a report about Quality Circle forum of India. (QCFI)
- Collect an information and make a repot about different software's used in CAPP, CAQC and CAI
- Choose a task (Typing a document, packing items, assembling a small product etc.), record time for each step using a stopwatch, and analyze it. Suggest improvements if any.
- Analyze the ergonomic setup of a workstation (e.g., Computer desk, Assembly line, Kitchen work area of a Canteen, Machine shop arrangement, Inspection table). Identify posture issues, repetitive strain risks, and suggest ergonomic improvements.
- Visit to Small-Scale Industry, create a layout to reduce material handling time and improve workflow efficiency.
- Prepare Wall Chart of 3 Sigma and Six Sigma Curves.
- Prepare a wall chart using standard Therbligs, Giving meaning of Each Symbol.
- Compare Manual Process planning with a computer aided approach.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Standard samples like steel balls, bearings, turning operation jobs, Milling operation Jobs, Gears for sample measurement	2,4,14,12,13
2	Open source freeware / educational version CAQC,CAPP,CAI software	3,10,11,14,12,13
3	Stop watch timing capacity: 23 Hrs, 59 mins and 59.99 secs, Accuracy: +/- 3 seconds/day	5,6,7,8,9,10
4	Digital video camera for micro motion analysis with following specification (i) ISO 100-12800 (ii) Focal length f= 3.5-5.6 (iii) 24.2 MP(iv) lenses 18-55 mm	5,6,7,8,9,10

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Plant and Process Engineering	CO1	12	4	4	6	14
2	II	Work Study	CO2	12	4	4	6	14
3	III	Quality Control	CO3	12	2	8	4	14
4	IV	Statistical Quality Control	CO4	14	2	4	12	18
5	V	Computer-aided Process Planning and Quality Control	CO5	10	2	4	4	10
Grand Total				**60**	**14**	**24**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two Unit Tests of 30 Marks and average of two unit tests.
- For Laboratory learning Term Work -25 Marks ;
- For Self Learning-25 Marks

Summative Assessment (Assessment of Learning)

- End Semester Assessment of 70 Marks

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	-	-	2	1			
CO2	3	2	1	-	1	-	1			
CO3	3	3	2	1	1	-	1			
CO4	3	3	2	1	-	-	1			
CO5	3	3	2	3	-	-	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Khanna, O.P.	Industrial Engineering and management	Dhanapat Rai Publications(P) Ltd., New Delhi, (1980), ISBN-10: 818992835X
2	Mahajan M.	Statistical Quality Control	Dhanpat Rai and Sons, New Delhi, (2006) ISBN-10: 817700039X
3	Jain R.K	Engineering Metrology	Khanna Publishers; Special Edition (1 January 2022); Khanna Publishers ISBN-10 9788174091536 ISBN-13 978-8174091536
4	M. Groover	Computer-Aided Design and Manufacturing	Pearson Education; 1st edition (1 January 2003); Pearson Education ISBN-10, 8177584162. ISBN-13, 978-8174906700
5	P. N. Rao	Computer Aided Manufacturing	McGraw Hill Education (1 July 2017) ISBN-10 007463103 ,ISBN-13 ,978-0074631034
6	L C Jhamb	Production Planning and Control	Everest Publishing House; 12th Edition (1 January 2010) ISBN-10 8186314725 ,ISBN-13 978-8186314722
7	T R Banga , S C Sharma	Industrial Organization and Engineering Economics.	Khanna Publication 1 January 2006 ISBN - 10 8174090789 ISBN - 13 978-9174090782

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/6ZevuJlCFBM?si=X5vCK0GAHSlU21m7	Process capability Cp, Cpk, Pp, Ppk, analysis in MINITAB
2	https://www.youtube.com/watch?v=gJDYV2SmFeY	Introduction and concept of productivity
3	https://www.youtube.com/watch?v=KNFZXNWYVno	Work Study: Basic concept
4	https://www.youtube.com/watch?v=y6NKspIn2XE	Method Study: Recording techniques
5	http://digimat.in/nptel/courses/video/112107259/L01.html	Introduction: Fundamental concepts of quality, inspection and their role in manufacturing
6	https://www.youtube.com/watch?v=yYIVumq6sVM	Production planning and control
7	https://www.youtube.com/watch?v=qb3mvJ1gb9g	Statistical quality control (SQC)
8	https://hcmindonesia.wordpress.com/wp-content/uploads/2012/12/introduction-to-work-study.pdf	Introduction to work study: Edited by George Kanawaty Fourth (revised) edition
9	https://www.youtube.com/watch?v=oMEXLiANqMU	Computer aided quality control

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students