

DEPARTMENT OF PRODUCTION ENGINEERING
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



COURSE INFORMATION SHEET

COURSE CODE:	PE 1202 (Laboratory)								
COURSE TITLE:	WORKSHOP PRACTICE								
PRE-REQUISITE(S):	<ul style="list-style-type: none"> • Knowledge in dimensions and units, • Usage of geometrical instruments • Analytical ability 								
CREDITS:	<table style="width: 100%; border: none;"> <tr> <td style="text-align: center;">L</td> <td style="text-align: center;">T</td> <td style="text-align: center;">P</td> <td style="text-align: center;">C</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">3</td> <td style="text-align: center;">2</td> </tr> </table>	L	T	P	C	0	0	3	2
L	T	P	C						
0	0	3	2						
CLASS SCHEDULE PER WEEK:	<ul style="list-style-type: none"> • Laboratory (of Three class/ week/group) 								

COURSE OBJECTIVES : It expected to teach following concepts to the students

- A.** To impart knowledge and skill to use tools, machines, equipment, and measuring instruments.
- B.** ability to select manufacturing process and machine tool for the part drawing given.
- C.** To develop a skill in dignity of labour
- D.** team working and development of right attitude.
- E.** Educate students of safety and Safe handling of machines and tools

COURSE OUTCOMES: After completion of the course, the learners will be able to:

- CO 1:** Understand the Basics of Workshop practices.
- CO 2:** Students will be able to understand the practical difficulties encountered in manufacturing and assembly work in industries.
- CO 3:** Ability to manufacture product as per drawing given.
- CO 4:** Use gauging equipment to verify that a manufactured part fulfills the requirements specified on a manufacturing drawing
- CO 5:** Adopt safety practices while working on various machines.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES

Course Objectives	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
A	H		H	M	M
B		H	H	M	
C	H	H			L
D		M	M	M	
E	M				H



PE1202 WORKSHOP PRACTICE (2 Credits)

1. MACHINE SHOP:

EXPERIMENT-I CENTER LATHE

Objective: To study lathe machine and machine a given job as per given drawing.

EXPERIMENT-II SHAPER MACHINE

Objective: To study lathe machine and machine a given job as per given drawing.

2. CARPENTRY SHOP:

EXPERIMENT-I CARPENTRY TOOLS AND INSTRUMENTS

Objective: To study the various tools, instruments and equipment used in carpentry practice.

Experiment-II carpentry practice

Objective: To learn the carpentry work by making a wooden job using different tools.

3. FITTING SHOP:

EXPERIMENT-I FITTING TOOLS AND MEASURING INSTRUMENTS

Objective: To study the various tools uses and operation performed in fitting (like marking, chipping, hack-sawing, filing, drilling etc.)

EXPERIMENT-II FITTING ASSEMBLY PRACTICE

Objective: To make a job clamping plate as per given drawing by fitting and check for its assembly with a given component.

4. FORGINGSHOP:

EXPERIMENT-I FORGING TOOLS AND FORGING PRACTICE

Objective: To study different tools and equipments used in hand forging practice.

EXPERIMENT-II To learn about hand forging practice by making a job (make a square bar from round blank and bend it at a sharp corner of 90 degree as per drawing).

Objective: To study lathe machine and machine a given job as per given drawing.

5. FOUNDRY SHOP:

EXPERIMENT-I GREEN SAND MOULDING

Objective: To get acquainted with various tools and equipment used in making green sand mould (to practice green sand mould making with single piece pattern).

EXPERIMENT-II ALUMINIUM CASTING

Objective: To get acquainted with melting and pouring of metal in a mould (given two piece patterns of handle and make aluminium casting).

6. WELDING SHOP:

EXPERIMENT-I MANUAL METAL ARC WELDING

Objective: To learn about arc welding practice different arc welding machine (AC & DC), electrode and equipments.

EXPERIMENT-II GAS WELDING

Objective: To study gas welding processes different type of flames produced filler metal and flux etc.

To joint two pieces of given metal by gas welding process.

Text Books

1. Workshop Technology I,II,III, by S K Hajra, and A K Chaudhary. Media Promoters and Publishers Pvt. Ltd., Bombay
2. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi.
3. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.

DEPARTMENT OF PRODUCTION ENGINEERING

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



LECTURE PLAN: (PE1202 WORKSHOP PRACTICE)

Department offering the course: Production Engineering

target audience: First Year Bachelor of Engineering Students

Contact Hours: Laboratory - 1 period of 150 min per week

EXPERIMENT NO	THEORY TOPIC(S) TO BE COVERED	TOTAL NO. OF CONTACT HRS.
MACHINE SHOP:		
1.	EXPERIMENT-I CENTER LATHE Objective: To study lathe machine and machine a given job as per given drawing.	150 min
2.	EXPERIMENT-II SHAPER MACHINE Objective: To study lathe machine and machine a given job as per given drawing.	150min
CARPENTRY SHOP:		
3.	EXPERIMENT-I CARPENTRY TOOLS AND INSTRUMENTS Objective: To study the various tools, instruments and equipment used in carpentry practice.	150 min
4.	Experiment-II CARPENTRY PRACTICE Objective: To learn the carpentry work by making a wooden job using different tools	150min
FITTING SHOP:		
5.	EXPERIMENT-I FITTING TOOLS AND MEASURING INSTRUMENTS Objective: To study the various tools uses and operation performed in fitting (like marking, chipping, hack-sawing, filing, drilling etc.)	150 min
6.	EXPERIMENT-II FITTING ASSEMBLY PRACTICE Objective: To make a job clamping plate as per given drawing by fitting and check for its assembly with a given component.	150min
FORGINGSHOP:		
7.	EXPERIMENT-I FORGING TOOLS AND FORGING PRACTICE Objective: To study different tools and equipment's used in hand forging practice.	150 min
8.	EXPERIMENT-II To learn about hand forging practice by making a job (make a square bar from round blank and bend it at a sharp corner of 90 degree as per drawing). Objective: To study lathe machine and machine a given job as per given drawing.	150min
FOUNDRY SHOP:		
9.	EXPERIMENT-I GREEN SAND MOULDING Objective: To get acquainted with various tools and equipment used in making green sand mould (to practice green sand mould making with single piece pattern).	150 min
10.	EXPERIMENT-II ALUMINIUM CASTING Objective: To get acquainted with melting and pouring of metal in a mould (given two piece patterns of handle and make aluminium casting.	150min

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EXPERIMENT NO	THEORY TOPIC(S) TO BE COVERED	TOTAL NO. OF CONTACT HRS.
WELDING SHOP:		
11.	EXPERIMENT-I MANUAL METAL ARC WELDING (To joint two pieces of given metal by gas welding process. Objective: To learn about arc welding practice different arc welding machine (AC & DC), electrode and equipment's.	150 min
12.	EXPERIMENT-II GAS WELDING (To joint two pieces of given metal by gas welding process.) Objective: To study gas welding processes different type of flames produced filler metal and flux etc.	150min

COURSE DELIVERY METHODS

- *Hand on training on different machine tools and processes*

Mapping of lab experiment with Course Outcomes

experiment	Program Outcomes				
	1	2	3	4	5
1			L		
2	H	H	H	H	
3	H	H	H	H	
4	H	H	H	M	
5	H				
6					
7					
8					
9					
10					
11					
12					

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	H		L							
2	H	H	H	H		H			M	
3	H	H	H	H		H	L		M	
4	H	H	H	M		H	L			
5	H					M				

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION

PROCEDURE

ASSESSMENT

The University's policy on Assessment for Coursework Programs is based on the following five principles:

1. Assessment must encourage and reinforce learning.

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2. Assessment must measure achievement of the stated learning objectives.
3. Assessment must enable robust and fair judgements about student performance.
4. Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.
5. Assessment must maintain academic standards.

ASSESSMENT SUMMARY

1. Direct Assessment

Task Type	Assessment	Weighting	Learning Outcomes
Formative Assessment	Quiz 1	15%	<ul style="list-style-type: none">• To know and be able to recall the main terminology, concepts, and techniques that applies some of the key issues of the design of Machine Tools.
Summative	Lab Record	20%	<ul style="list-style-type: none">• ability to disseminate knowledge in writing
Formative Assessment	Quiz 2	15%	Apply a critical-thinking and problem-solving approach towards the principles of machine tool design
Formative Assessment	Attendance	10%	Punctuality, Dedication
Summative	Final exam (Viva)	15%	Apply a critical-thinking on aspect of manufacturing process
Summative	Final exam (fabrication)	25%	Knowledge of manufacturing a product as per given drawing

Grades for your performance in this course will be awarded in accordance with the University policies as notified time to time and displayed in University website.

2. INDIRECT ASSESSMENT OF COURSE:

The course will also be indirectly assessed by the faculty using following methodologies:

- i. Faculty Feed back
- ii. Grades
- iii. Course evaluations (during the semester and end-of-semester)
- iv. Rubrics



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

Program Educational Objectives (PEO)

PEO 1: Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems

PEO 2: To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices

PEO 3: Enabling graduates to have command over various manufacturing processes and machine tools

PEO 4: To develop an attitude for continuous learning and aspiration to excel in all endeavors.

PEO 5: Improving inter-personal skill, team spirit and employability while believing on the ethical values.

Program Outcomes (PO)

A graduate in Production Engineering shall

PO 1: Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems

PO 2: Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice

PO 3: Demonstrate command in manufacturing processes and related machine tools

PO 4: Understand the morphology of a production system and its management

PO 5: Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production

PO 6: Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience

PO 7: Development of various managerial skills like interpersonal, communication and documentation

PO 8:-Development of innovative technical solutions for various challenges in society

PO 9: Be aware of financial, environmental and sustainability implications for each professional action

PO 10: Develop the right attitude for continuous learning and knowledge of latest developments

COURSE INFORMATION SHEET

Course code: PE 3001

Course title: Metallurgy

Credits: **L T P C**
 3 0 0 3

Class schedule per week: 3 lectures

Course Objectives :

1.	To acquaint with the various types of engineering materials.
2.	To understand the principles of iron and steel making.
3.	To learn Various types of equilibrium diagrams
4.	To acquaint with the principle of various types of heat treatment processes.
5.	To provide conceptual framework of destruction of metals by corrosion and erosion.
6.	To study the concept of different zones formed during welding process and fractures in metallic parts
7.	To give an idea about the properties and applications of non-ferrous alloys

Course Outcomes : After completion of the course, the learners will be able to:

1.	Select appropriate engineering materials for various engineering and industrial applications.
2.	Analyze various processes used for making steel through different routes.
3.	Construct and analyze iron - carbon equilibrium diagram
4.	Select and apply of heat treatment processes for hardenable and non hardenable treatment.
5.	Explain different methods of protection against corrosion.
6.	Suggest treatments to increase the serviceability of the weldments and differentiate between ductile and brittle fractures
7.	Analyze the properties and applications of Al and Cu alloys

Syllabus:

Module 1

Review of Engineering and industrial materials – their classification and application, recent development in metallic materials

Module 2

A brief description of iron and steel making – Raw materials Principles and processes

Module 3

Isomorphous, eutectic and peritectic systems, Iron – Carbon equilibrium diagram, classification of steels, effect of alloying elements on steels. Tool steels

Module 4

Isothermal decomposition of austenite (TTT Curve), transformation of austenite upon continuous cooling, annealing, normalising, hardening, tempering, hardenability of steel, Jominey hardening test, end quench test, surface hardening, case hardening, recovery, recrystallisation and grain growth

Module 5

Grey iron, S.G. Iron, white iron, malleable iron. Principles of corrosion, forms of corrosion, factors affecting the rate of corrosion, corrosive agents, protection against corrosion;

Module 6

Weld metal zone, HAZ, parent metal zone, Joint efficiency, weldability, concepts of ductile and brittle fractures

Module 7

Properties and applications of Non ferrous Metals and Alloys-Al & Cu

Text Books:

- | | |
|--|--------------|
| 1. Elements of Metallurgy | D. Swaroop |
| 2. Material Science and Engineering | V. Raghvan |
| 3. Physical Metallurgy | Y. Lakhtin |
| 4. Metallurgy for Engineers | E.C.Rollason |

LECTURE PLAN

Department: Production Engineering

Course: Metallurgy

Academic Year: 2016 – 17

Class: BE

Semester: III

Course Co-ordinator: Prof. A.K. Thakur

Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
1	1	Introduction to metallurgy – scope and different wings	T2	6
	2	Different wings of metallurgy continued	T1	
	3	Introduction and classification of engineering materials	T1	
	4	Metals and Ceramics	T2	
	5	Polymers and Composites	T2	
	6	Advanced/smart materials	T2	
2	1	Introduction to iron and steel production, integrated steel plants	T1	8
	2	Different routes of iron and steel production	T1	
	3	Raw materials in iron making and their functions mand	T1	
	4	principles of iron making, Blast furnace iron making	T1	
	5	Blast furnace iron making contd.	T1	
	6	Methods of steel production	T1	
	7	Methods of steel production contd.	T1	
	8	Refining of steel	T1	
3	1	Equilibrium diagrams,	T1, T3	10

		Phase rule		
	2	Solidification of metals and alloys, Solid solution	T1,T3	
	3	Isomorphous diagram, Lever rule	T1,T3	
	4	Eutectic, Peritectic reactions/diagrams	T1,T3	
	5	Solidification of iron	T1,T3	
	6	Iron-Carbon equilibrium diagram	T1,T3	
	7	Phase Analysis	T1,T3	
	8	Numerical problems	T1,T3	
	9	Classification of steel	T1,T2	
	10	Effects of alloying elements in steel	T1,T2	
4	1	Phase transformation, super heating/super cooling	T3	12
	2	Phase transformation in iron carbon system, TTT diagram	T3	
	3	TTT diagram contd.	T3	
	4	Continuous cooling curve	T3	
	5	CCT curve contd.	T3	
	6	Heat treatment processes	T3	
	7	Heat treatment contd.	T3	
	8	Heat treatment contd.		
	9	Hardenability	T3	
	10	Surface and case hardening	T3	
	11	Recovery, recrystallization, grain growth	T3	
	12	Tool steel	T3	
5	1	Cast iron	T1,T2	5
	2	Corrosion mechanism	T3	
	3	Corrosion contd.	T3	
	4	Protection against corrosion	T3	
	5	Protection against corrosion contd.	T3	
6	1	Metallurgy of welding, Weldability	T3	2
	2	Fracture – ductile and brittle	T3	
7	1	Non-ferrous metals, Al and its alloys	T2	2
	2	Cu and its alloys	T2	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Seml Examination Marks	60
Assignment/Quiz	15

Assessment Components	CO1	CO2	CO3	CO4	CO5	CO6	CO7
Mid Sem Examination Marks	√	√	√				
End Sem Examination Marks	√	√	√	√	√	√	√
Assignment			√	√			

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome



COURSE INFORMATION SHEET

COURSE CODE:	<i>PE 3002 (Laboratory)</i>			
COURSE TITLE:	<i>METALLURGY LABORATORY</i>			
CREDITS:	<i>L</i>	<i>T</i>	<i>P</i>	<i>C</i>
	<i>0</i>	<i>0</i>	<i>3</i>	<i>2</i>
CLASS SCHEDULE PER WEEK:	• <i>Laboratory (of Three class/ week/group)</i>			
<p><u>COURSE OBJECTIVES</u> : <i>It expected to teach following concepts to the students</i></p> <p>A. <i>Basics of process metallurgy</i></p> <p>B. <i>To impart knowledge and skill to use tools, equipment, and measuring instruments related to metallographic study.</i></p> <p>C. <i>To analyse microstructure of metals/alloys like iron and steels.</i></p> <p>D. <i>To analyse heat treatment processes</i></p>				
<p>COURSE OUTCOMES: <i>After completion of the course, the learners will be able to:</i></p> <p>CO1: <i>Learn how to prepare samples for metallographic study, measure properties of materials</i></p> <p>CO2: <i>Use tools, equipment, and measuring instruments related to metallographic study</i></p> <p>CO3: <i>To analyse microstructure of metals/alloys like iron and steels.</i></p> <p>CO4: <i>To analyse heat treatment processes</i></p>				
MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES				
Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4
A	<i>H</i>	<i>M</i>	<i>M</i>	<i>M</i>
B		<i>H</i>	<i>M</i>	
C	<i>M</i>		<i>H</i>	
D	<i>M</i>		<i>M</i>	<i>H</i>



PE 3002 METALLURGY LABORATORY (2 Credits)

<i>Experiment No.</i>	<i>Objective</i>
1	To study the working principal of metallurgical microscope
2	To reveal the microstructure of mild steel specimen containing 0.1% carbon (a) Specimen preparation (b) Observation of the microstructure through metallurgical microscope
3	To study the effect of quenching media on the hardness of steel specimens containing 0.2, 0.4, 0.6, 0.8 and 1.0% carbon (a) Heat treatment study when quenching media is furnace cooling, air cooling, water cooling and oil cooling (b) Observation of the microstructure through metallurgical microscope
4	To study the effect of period of time of heat treatment on the hardness of steel specimens containing 0.2, 0.4, 0.6, 0.8 and 1.0% carbon (a) Calculation of optimum period of time of heat treatment for maximum hardness (b) Observation of the microstructure through metallurgical microscope
5	To study the effect of temperature on the hardness of steel specimens containing 0.2, 0.4, 0.6, 0.8 and 1.0% carbon (a) Calculation of optimum temperature for heating the steel specimens for maximum hardness (b) Observation of the microstructure through microscope
6	To study the effect of tempering temperature on the properties of water quenched steel
7	To study the effect of tempering time on the properties of water quenched steel
8	To compare the comparison rate of low carbon steel, medium carbon steel, high carbon steel and cast iron in different dilution of acids (HCL/HNO ₃ /H ₂ SO ₄)

Course Delivery methods

- *Hand on training on sample preparation, equipment uses and heat treatment*
-



Mapping of lab experiment with Course Outcomes

experiment	Course Outcomes			
	1	2	3	4
1		H		
2	H	H		
3			H	H
4			H	H
5			H	H
6			H	H
7			H	H
8	H			

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1		M								L
2		M	H							L
3	H									L
4	H									L

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

ASSESSMENT

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ASSESSMENT SUMMARY

1. Direct Assessment

Task Type	Assessment	Weighting	Learning Outcomes
Formative Assessment	Quiz 1	15%	• To know and be able to recall the main terminology, concepts, and techniques of process metallurgy
Summative	Lab Record	20%	• ability to disseminate knowledge in writing
Formative Assessment	Quiz 2	15%	Apply a critical-thinking and problem-solving approach towards the principles of heat treatment
Formative Assessment	Attendance	10%	Punctuality, Dedication
Summative	Final exam (Viva)	15%	Apply a critical-thinking on aspect of metallurgical study
Summative	Final exam	25%	Knowledge of heat treatment and microstructure of metals/alloys

Grades for your performance in this course will be awarded in accordance with the University policies as notified time to time and displayed in University website.

2. INDIRECT ASSESSMENT OF COURSE:

The course will also be indirectly assessed by the faculty using following methodologies:

- i. Faculty Feed back
- ii. Grades
- iii. Course evaluations (during the semester and end-of-semester)
- iv. Rubrics



Department of Production Engineering

Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

Program Educational Objectives (PEO)

1. Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems
2. To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices
3. Enabling graduates to have command over various manufacturing processes and machine tools.
4. To develop an attitude for continuous learning and aspiration to excel in all endeavours.
5. Improving inter-personal skill, team spirit and employability while believing on the ethical values.

Program Outcomes (PO)

A graduate in Production Engineering shall

- a) Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems
- b) Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice
- c) Demonstrate command in manufacturing processes and related machine tools
- d) Understand the morphology of a production system and its management
- e) Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production
- f) Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience
- g) Development of various managerial skills like interpersonal, communication and documentation
- h) Development of innovative technical solutions for various challenges in society
- i) Be aware of financial, environmental and sustainability implications for each professional action
- j) Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE 3003

Course title: Operations Research

Pre-requisite(s): Nil

Credits:	L	T	P	C
	3	1	0	4

Class schedule per week: 3L+1T

Course Objectives : This course enables the students:

1.	Formulate a real-world problem as a mathematical programming model
2.	Know the theoretical workings of the simplex method for linear programming and perform iterations of it
3.	Analyze the relationship between a linear program and its dual, including strong duality and complementary slackness
4.	Solve specialized linear programming problems like the transportation, assignment, sequencing, games theory, and queuing model problems
5.	The use of Operations Research approaches in solving real problems in industry; mathematical models for analysis of real problems in Operations Research.

Course Outcomes : After completion of the course, the learners will be able to:

1.	recognize the importance and value of Operations Research and mathematical modelling;
2.	formulate a managerial decision problem into a mathematical model;
3.	understand Operations Research models and apply them to real-life problems;
4.	use various approaches to solve a mathematical model for various practical problems in industry.

Syllabus

MODULE – I

Introduction: Scope and limitations of O.R., **Linear Programming:** Mathematical formulation of the problem. Graphic solution.

MODULE – II

Linear Programming: The simplex method.

MODULE – III

Linear Programming: Big-M Method, Concept of duality, Dual simplex method.

MODULE – IV

Transportation Model: Basic feasible solution by different methods, Finding optimal solutions, Degeneracy in transportation problems, Unbalanced transportation problems.

MODULE – V

Assignment Model: Balanced and unbalanced assignments, Assignment to given schedules.

Sequencing: Processing of 2 jobs through machines –graphical method, Processing of n jobs through two machines, Processing n jobs through three machines.

MODULE – VI

Games Theory: Two-persons zero sum games, Pure and mixed strategies, Rules of dominance, Solution methods without saddle point.

MODULE – VII

Queuing Model: Queuing systems and their characteristics, The M/M/1/FIFO/ ∞ Queuing system. Basic concept and applications of Non-linear programming.

Text Books:

- | | |
|------------------------|-------------------------|
| 1. Operations Research | Kanti Swaroop |
| 2. Operations Research | P.K. Gupta & D. S. Hira |

References Books:

- | | |
|---|------------|
| 1. Linear Programming | Hadely |
| 2. Quantitative Technique in management | N.D. Vohra |

LECTURE PLAN

Department : Production Engineering

Course: PE 3003: Operations Research

Academic Year: 2016 – 17

Class : BE

Semester : III

Course Coordinator : Dr. Vijay Pandey

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
1.	I	1	Scope and limitations of O.R		1
2.		2	Mathematical formulation		1
3.		3	Problems solving		1
4.		4	Graphical method		1
5.		5	Problems solving		1
6.		6	Special cases in graphical method		1
7.	II	7	Linear Programming: The simplex method for minimization objective		1
8.		8	Problems solving		2
9.		9	Problems solving		
10.		10	Special cases in simplex method		1
11.		11	Problems solving		2
12.		12	Problems solving		
13.	III	13	Linear Programming: The simplex method for maximization objective		1
14.		14	Problems solving		2
15.		15	Problems solving		
16.		16	Duality: Primal dual relationship		1
17.		17	Problems solving		2
18.		18	Problems solving		
19.	IV	19	Transportation Model: Basic feasible solution by NWCM, LCM, VAM		1
20.		20	Finding optimal solutions by stepping stone method & MODI method		1
21.		21	Problems solving		2
22.		22	Problems solving		
23.		23	Special cases in Transportation		1
24.		24	Problems solving		1
25.	V	25	Assignment Model		1
26.		26	Special cases in assignment model		1
27.		27	Problems solving		1
28.		28	Processing of n jobs through two machines, Processing n jobs through three machines.		1
29.		29	Processing of 2 jobs through machines		1

			-graphical method		
30.		30	Problems solving		1
31.	VI	31	Games Theory: Two-persons zero sum games, Pure and mixed strategies,		1
32.		32	Rules of dominance, Solution methods without saddle point.		1
33.		33	Sub-game method, graphical method		1
34.		34	Problems solving		2
35.		35	Problems solving		
36.	VII	36	Queuing Model: Queuing systems and their characteristics		1
37.		37	The /M/1/FIFO/ ∞ Queuing system.		2
38.		38	The /M/1/FIFO/ ∞ Queuing system.		
39.		39	Problems solving		2
40.		40	Problems solving		

Topics beyond syllabus/Advanced topics: Concept of nonlinear programming and AI tools

POs met through Topics beyond syllabus/Advanced topics: e, h, j

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Industrial/guest lectures
CD4	Self-learning such as use of NPTEL materials and internets

Mapping between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
CD1	√	√	√	√	√
CD2	√	√	√	√	√
CD3					√
CD4					√

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4
1	H	H	-	-
2	H	H	L	-
3	-	-	M	-
4	-	-	H	M
5	-	-	-	H



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

Program Educational Objectives (PEO)

1. PEO 1: Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems
2. PEO 2: To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices
3. PEO 3: Enabling graduates to have command over various manufacturing processes and machine tools
4. PEO 4: To develop an attitude for continuous learning and aspiration to excel in all endeavours.
5. PEO 5: Improving inter-personal skill, team spirit and employability while believing on the ethical values.

Program Outcomes (PO)

A graduate in Production Engineering shall

PO 1: Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems.

PO 2: Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice.

PO 3: Demonstrate command in manufacturing processes and related machine tools

PO 4: Understand the morphology of a production system and its management.

PO 5: Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production.

PO 6: Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience.

PO 7: Development of various managerial skills like interpersonal, communication and documentation

PO 8: Development of innovative technical solutions for various challenges in societyRecognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

PO 9: Be aware of financial, environmental and sustainability implications for each professional action.

PO 10: Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE4001

Course title: Manufacturing Process I

Pre-requisite(s): None

Credits: **L** **T** **P** **C**
 3 0 0 3

Class schedule per week: 3 lectures

Course Objectives : This course enables the students:

- A** To interpret the geometry of tooling used on various metal cutting machines;
- B** To understand the effect of various processes parameters on the machining process.
- C** Estimation of cutting forces acting on the tool and on the chip during machining
- D** To understand the effects of heat, lubrication and various cutting tool materials on the metal cutting process.
- E** To understand the constructional features, specification, operations and drives of various types conventional machine tools
- F** To understand the fundamental principles, application possibilities, process parameters, and operational characteristics of some non-conventional machining processes.

Course Outcomes : After completion of the course, the learners will be able to:

- CO1** Understand the constructional feature of machine tools and machining characteristics of metal cutting
- CO2** The ability to select appropriate tool material and tool geometry and machine tool for a particular machining process
- CO3** The ability to select appropriate machining parameters for a particular work material and machining processes
- CO4** The ability to identify, formulate, and solve engineering problems relating to machining, and able to estimate force and power requirements for various machining processes.
- CO5** To be able to select appropriate cutting fluid for particular combination of work material and machining process.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES					
Course Objectives	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
A	<i>L</i>	<i>H</i>	<i>H</i>	<i>L</i>	<i>L</i>
B	<i>H</i>	<i>H</i>	<i>H</i>	<i>M</i>	<i>L</i>
C	<i>M</i>	<i>M</i>	<i>H</i>	<i>H</i>	<i>L</i>
D	<i>H</i>	<i>H</i>	<i>M</i>	<i>L</i>	<i>H</i>
E	<i>H</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>
F	<i>H</i>	<i>M</i>	<i>H</i>	<i>H</i>	<i>L</i>

Syllabus:

COURSE TOPICS:

Module 1

Theory of Metal Cutting: Geometry of single point cutting tool, Orthogonal and oblique cutting, Tool forces in orthogonal cutting, types of chips,

Module 2

Machinability, tool failure, tool life, cutting fluids and cutting tool materials

Module 3

Machine Tools: Constructional features, specification, operations and drives of lathe, working principles of capstan and Turret lathes, Shaper, Planer, & Slotter.

Module 4

Constructional features, specification, operations and drives of milling & drilling machine, indexing in milling operations

Module 5

Grinding and finishing operations: Cylindrical, surface and centreless grinding; Broaching, lapping, honing and buffing

Module 6

Gear cutting by forming and generating methods.

Module 7

Introduction to Modern Manufacturing Processes

Fundamental principles, application possibilities, process parameters, and operational characteristics of Abrasive Jet Machining (AJM), Water Jet Machining (WJM), Ultrasonic Machining (USM), Chemical Machining (CHM).

TEXTBOOK:

- Serope Kalpakjian and Steven Schmidt , Manufacturing Processes for Engineering Materials, Prentice Hall, 4th Edition
- P.N. Rao, Manufacturing Technology – Metal Cutting and Machine Tools, TMH.
- Hajra Choudhury, Elements of Workshop Technology–Vol.-II, Media Promoters and Publishers.

LECTURE PLAN

Course: PE 4001 Manufacturing Process I

Academic Year: 2016 – 17

Class: BE (Mech/Prod)

Semester: IV

Course Coordinator: Dr. Joyjeet Ghose

Lecture No.	Topics to be covered
1.	Introduction to Manufacturing Processes, Classification of Manufacturing Processes, Manufacturing Processes, Manufacturing system and Production System, Application of Manufacturing Processes, Introduction to machine tools and machining parameters: Cutting speed, feed, and depth of cut and basis of their selection.
2.	Cutting tools & its characteristics, Different Cutting Tool Materials and their applications.
3.	Single Point Cutting Tool Geometry and importance and functions of different tool angles and other parameters associated with the geometry of a single point cutting tool. Tool signature (ASA)
4.	Introduction to Theory of Metal Cutting, Orthogonal and Oblique Cutting, Mechanics of orthogonal metal cutting, and Assumptions in orthogonal metal cutting.
5.	Chip thickness ratio, Velocity Relationship, Cutting forces, Forces in orthogonal cutting, and forces acting on the chip in orthogonal cutting.
6.	Merchant's Circle Diagram, The procedure to construct a Merchants circle diagram.
7.	Relationship of various forces acting on the chip with the horizontal and vertical cutting force from Merchant circle diagram. Power required in Metal cutting, Specific Energy, Approximate specific-energy requirements in cutting operations. Numerical problems.
8.	Theory of Merchant and its proof. Stress and Strain acting on the chip, Cutting Temperature, Temperature Distribution in the Cutting Zone.
9.	Chip Formation, Types of chip and factors are responsible for formation of these different types of chips, Chip breakers,
10.	Types of Tool wear, Tool Wear Mechanisms, Tool Failure Criterion, Tool life, Taylor's equation, Tool-Life Curves, Factors that influence 'tool life', Economics of machining, Example problems relating to tool life equation
11.	Machinability of metals, Machinability of different materials, Methods for improvement of machinability, Machinability Ratings,
12.	Cutting fluids, Functions of cutting fluids, Properties of cutting fluids, cutting fluids: Methods of application, Types of cutting fluid, Cutting fluids: Environmental issues.
13.	Introduction to lathe machine, Types of lathe machine, Engine lathe, Components of Engine lathe and their functions.
14.	Lathe specifications, Work holding methods, Types of tools used in lathe machine, and lathe accessories, cutting speed, feed, and depth of cut and their calculations
15.	Different operations that can be done on lathe machine: Turning, Straight and taper turning, taper turning methods, facing, chamfering, parting, Grooving, threading etc, Thread cutting calculations
16.	Example problems relating to taper turning, thread cutting calculations, and machining time (simple straight turning) and MRR.

Lecture No.	Topics to be covered
17.	Introduction to shaper machine, Types of shaper machine, Components of shaper and their functions, shaper specifications, Work holding methods, Types of tools used in shaper machine. Shaper mechanisms, Quick return drive mechanisms,
18.	Types of operation performed. Shaper cutting speed, feed, and depth of cut and their calculations. Machining time and MRR.
19.	Introduction to Slotter machine, Components of Slotter and their functions, slotter specifications, Work holding methods.
20.	Introduction to Planer machine, Types of Planer machine, Components of Planer and their functions, Planer specifications, Work holding methods, difference between Shaper, planer, and slotter.
21.	Introduction to Drilling and Drilling machine, Types of Drilling machine, Components of Drilling machine and their functions, Drilling machine specifications, Work holding methods, Types of drills,
22.	Twist drill nomenclature, Drilling Operations, cutting speed, feed, and depth of cut and their calculations. Machining time and MRR.
23.	Introduction to milling machine, Types of milling machine, Components of Column and Knee Type Milling Machines and their functions, milling machine specifications, Work holding methods, Types of tools used in milling machine.
24.	Milling machine accessories, milling cutters, milling operations like Gang milling, straddle milling, form milling, and end milling etc, Differences between up milling and down milling.
25.	Cutting speed, feed, and Depth of cut calculations of milling, Introduction to The Dividing Head or Indexing Head
26.	Plain dividing head, Universal dividing head, Indexing methods: Direct indexing, Plain or simple indexing, calculations.
27.	Indexing methods: Compound, differential and angular indexing, calculations.
28.	Introduction to Grinding, Types & shapes of Grinding Wheels, Grinding Wheels Variables
29.	Grinding Wheel Selection, Grinding Wheel Glazing and loading, Grinding Wheel Dressing and Truing. Grinding Processes and Machines
30.	Introduction to Broaching, Broaching Tools, Advantages & limitations of Broaching. Honing, Lapping, and Buffing.
31.	Gear Manufacturing, Gear forming: Form milling, Gear cutting by Broaching
32.	Gear Generation: milling with a hob (gear hobbing), gear shaping with a pinion-shaped cutter, or gear shaping with a rack-shaped cutter.
33.	Traditional vs. non-traditional processes, Need for Non-conventional Processes, classification.
34.	Fundamental principles, application possibilities, process parameters, and operational characteristics of Abrasive Jet Machining (AJM). Advantages and limitations.
35.	Fundamental principles, application possibilities, and operational characteristics of Water Jet Machining (WJM), nozzle materials, Advantages and limitations.
36.	Fundamental principles, application possibilities, process parameters, and operational characteristics of Ultrasonic Machining (USM).
37.	Fundamental principles, application possibilities, and operational characteristics of Chemical Machining (CHM). Chemical milling and blanking. Masking methods. Types of etchants and their applications. Advantages and limitations.

Topics beyond syllabus/Advanced topics/Design:

- Mechanics of oblique cutting
- Assessment of economic aspects of machining
- Analysis of MRR of various non-conventional machining

POs met through Topics beyond syllabus/Advanced topics/Design: i, j, k

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	H	L	L	H	L	L	M	M
CO2	H	H	H	L	L	H	L	M	M	M
CO3	H	H	H	L	L	M	L	M	M	M
CO4	H	H	H	L	L	H	L	M	M	M
CO5	H	H	H	L	L	H	L	M	M	M

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure**Direct Assessment**

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Seml Examination Marks	60
Assignment	15

Assessment Compoents	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks					
End Sem Examination Marks					
Assignment					

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome



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Program Outcomes (PO)

A graduate in Production Engineering shall

PO 1: Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems.

PO 2: Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice.

PO 3: Demonstrate command in manufacturing processes and related machine tools

PO 4: Understand the morphology of a production system and its management.

PO 5: Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production.

PO 6: Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience.

PO 7: Development of various managerial skills like interpersonal, communication and documentation

PO 8: Development of innovative technical solutions for various challenges in societyRecognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

PO 9: Be aware of financial, environmental and sustainability implications for each professional action.

PO 10: Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE4002

Course title: Manufacturing Process I LAB

Pre-requisite(s): None

Credits: L T P C
 0 0 1 3

Class schedule per week: 3 period

Course Objectives : This course enables the students:

A	To understand the constructional features, specification, operations and drives of various types conventional machine tools
B	To understand the effect of various processes parameters on the machining process.
C	To understand the process capabilities of various types conventional machine tools and welding processes.
D	To know about the different types of foundry patterns
E	To be able to find out the amount of clay and moisture content in moulding sand

Course Outcomes : After completion of the course, the learners will be able to:

- CO1 Understand the constructional feature and working of machine tools and machining characteristics of metal cutting
- CO2 Understand the constructional feature and working of various welding
- CO3 The ability to identify to select appropriate pattern for sand casting
- CO4 The ability to determine the amount of moisture and clay in moulding sand

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES

Course Objectives	CO1	CO2	CO3	CO4
A	<i>H</i>	-	-	-
B	<i>H</i>	-	-	-
C	<i>H</i>	<i>H</i>	-	-
D	-	-	<i>H</i>	-
E	-	-	-	<i>H</i>

LIST OF EXPERIMENTS

EXP NO.	NAME OF THE EXPERIMENT
I	SLAB MILLING IN MILLING MACHINE
II	SHAPER MACHINE
III	SLOTTER MACHINE
IV	CAPSTAN LATHE
V	GEAR CUTTING ON A HORIZONTAL MILLING MACHINE
VI	TOOLS & ATTACHMENT STUDY
VII	RETROFITTED LATHE
VIII	PATTERN STUDY
IX	SAND TESTING (MOISTURE CONTENT)
X	MIG WELDING
XI	ULTRASONIC WELDING
XII	TOOL & CUTTER GRINDING MACHINE

Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Evaluation Examination Marks	60 (viva -20, Lab record-40)
End Sem Examination Marks	40 (Performance -20, Viva -20)

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome



COURSE INFORMATION SHEET

COURSE CODE:	PE 4003 (Theory) PE 4004 (Laboratory)			
COURSE TITLE:	METROLOGY			
PRE-REQUISITE(S):	<ul style="list-style-type: none"> • Knowledge of Science of measurement • Knowledge of Optics • Knowledge of Linear and Angular measurement 			
CREDITS:	L	T	P	
	3		3	
CLASS SCHEDULE PER WEEK:	<ul style="list-style-type: none"> • Lectures- 3 • Totorial-0 • Laboratory- 1 (of Three class) 			
<p><u>COURSE OBJECTIVES:</u> It expected to teach following concepts to the students</p> <p>A. To educate students on different measurement systems, common types of Errors and various types of Linear Standards</p> <p>B. To introduce different types of Comparators optical metrology, Limit Fits, tolearnce and gauges used for measurement and gauge design</p> <p>C. To give knowledge about Surface measurement and screw thread measurement used for measurements.</p> <p>D. To familiarize students with online measurements on machine, Roundness Flatness and Squareness Measurement</p>				
<p><u>COURSE OUTCOMES:</u> After completion of the course, the students will be able to:</p> <p>CO1: Students will be able to maintain quality in engineering products.</p> <p>CO2: Students will be able to maintain quality in engineering products. Students will be able to work in Quality control and quality assurances divisions in industries</p> <p>CO3: Students will be able to design a Gauges used for measurement and analysis purpose.</p> <p>CO4: Students will be able to analyze the results of optical microscopes and various equipments for the measurement of surface roughness, screw thread</p>				
MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES				
Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4



A	<i>H</i>	<i>M</i>	<i>M</i>	<i>M</i>
B	<i>L</i>	<i>H</i>	<i>H</i>	<i>M</i>
C	<i>L</i>	<i>L</i>	<i>M</i>	<i>M</i>
D	<i>H</i>	<i>H</i>	<i>H</i>	<i>L</i>

PE 4003 METROLOGY (3 Credits)

Module 1: Introduction

Standards of Measurement: Line, End & wave standards

Module 2: Comparators

Principle and uses of mechanical, optical, Electrical, electronic and pneumatic Comparators.

Module 3: Limits, Fits & Limit Gauge Design

Interchangeable Manufacture , selective assembly, Concept of Limits ,Fits and Tolerances ,Indian Standard System ,Type of Plain Limit Gauges , Design of plain limit gauges , Taylor’s principle of gauging Module.

Module 4: Optics in Metrology

Concept of Projectors, Autocollimator and Interferometer.

Module 5: Screw thread And Gear Measurement

Measurement of minor, major, effective diameter, Pitch and thread angle of screw threads, Involute profile of gear

Module 6: Geometrical Form and surface Finish

Straightness, Flatness and Squareness and Circularity Tests , Numerical Evaluation Measurement of Surface Finish , Construction Detail and Working of Taylor – Hobson Instrument

Module 7: Miscellaneous Measurement

Angle measurement by sine bar, and angle gauge, concept of on-line inspection.

Text Books:

1. A Text book of Engineering Metrology –I. C. Gupta , 5th Edition, 1998 ,Dhanpat Rai , New Delhi
2. Engineering Metrology –K. J. Hume

Reference Books:

Engineering Metrology –R.K. Jain ,17th Edition ,2nd Reprint,2007,Khanna Pub.,

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New Delhi

2. Engineering Metrology –M. Mahajan ,3rd Edition , 2001, Dhanpat Rai & Co.

New Delhi

LECTURE PLAN: (PE 4003- METROLOGY)

Department offering the course: Production Engineering

Contact Hours: Theory class - 3 periods per week of 50min. each
 Laboratory - 1 period of 150 min per week

MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
I	1.	Introduction to the subject, its industrial and research relevance, overview of all the module, evaluation method to be followed	T2	50 min
I	2.	Introduction, Purpose of Measurement, Definition of Standards, Principle of Standards, Classification and requirements.	T2	50 min
I	3.	Basic functions of Linear Measurement Definition, History and importance of basic Standards and their use (Meter, Yard).	T2	100 min
I	4.			
I	5.	Basic functions of End Standards Measurement Definition and importance of basic Standards and their use .	T2	50
	6.	Basic functions of Wavelength Standards Measurement Definition, History and importance of basic Standards and their use	R1	50
I	7.	Related Problems solving.	T2	50
II	8.	Principle and uses of mechanical, Comparators.	T1&T2	
II	9.	Principle and uses of .optical Comparators, pneumatic	T1, T2, R1	50
II	10.	Principle and uses of Electrical & Electronics Comparators,	T1, T2, R1	50
II	11.	Principle and uses of Pneumatic Comparators	T1, T2, R1	50
II	12.	Introduction of Limits, Fits, Tolerance & Limit Gauge Design	T1, T2, R1	50



COURSE INFORMATION SHEET

COURSE CODE:	PE 4004 (Laboratory)			
COURSE TITLE:	METROLOGY LABORATORY			
CREDITS:	L	T	P	C
	0	0	3	2
CLASS SCHEDULE PER WEEK:	• Laboratory (of Three class/ week/group)			
<p>COURSE OBJECTIVES : It expected to teach following concepts to the students</p> <p>A. To provide to the students an understanding and appreciation of the science of Measurement.</p> <p>B. To expose the students to various mechanical and electrical engineering measuring devices, and understand the different degree of accuracy obtained from different types of instruments.</p> <p>C. To impart knowledge and skill to use measuring tools, equipment, and related to optical microscope study.</p> <p>D. To analyse the results of optical microscope microstructure of metals/ alloys like iron and steels.</p>				
<p>COURSE OUTCOMES: After completion of the course, the students will be able to:</p> <p>CO1: To be familiar with the different instruments that are available for linear, angular, roundness and roughness measurements.</p> <p>CO2: To be able to select and use the appropriate measuring instrument according to a specific requirement (in terms of accuracy, etc.)</p> <p>CO3: Learn how to measure and prepare samples for optical microscopes study, Use tools, equipment, and measuring instruments related to optical microscopes study</p> <p>CO4: To analyse the results of optical microscopes microstructure of metals/ alloys like iron and steels.</p>				
MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES				
Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4
A	H	M	M	M
B	H	H	M	M
C	M	H	H	H
D	M	M	M	H

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LAB PLAN: PE 4004 METROLOGY LABORATORY

Department offering the course: Production Engineering

Target audience: Second Year Bachelor of Engineering (Production Engg.) Students

Contact Hours: Laboratory - 1 period of 150 min per week

EXPERIMENT NO	THEORY TOPIC(S) TO BE COVERED	TOTAL NO. OF CONTACT HRS.
1.	To study the measurement of dimensions of a given work piece using vernier caliper. inside diameter, outside inside micrometer, vernier and height gauge.	150 min
2.	To study slip gauges and angle gauges to construct different given dimensions and angles.	150min
3.	To determine the included angle of a given angle plate using sine bar and slip gauges.	150 min
4.	To measure the different angles of a single point cutting tool ("V" tool) by profile projector.	150min
5.	To study the Rank Taylor Hobson surface finish measurement machine and determine surface finish parameters of a given test-piece.	150 min
6.	To measure the included angle of an internal dovetail using standard pins, slip gauges and inside micrometer.	150min
7.	To measure the included angle of a V - slide using standard pins, slip gauges and inside micrometer.	150 min
8.	To measure the internal angle of a V - block using standard pins and vernier height gauge.	150min
9.	To study the morphology and composition of a solid sample by Scanning Electron Microscope coupled with Energy Dispersive Spectroscopy.	150 min
10.	To study the working of optical flat and monochromatic light source.	150min
11.	To study the working of auto-collimator.	150 min
12.	To study the working of workshop microscope.	150min

COURSE DELIVERY METHODS

- *Short lectures and Hand on training on measuring equipment uses and optical microscopes in Metrology Laboratory.*

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	H	M	M	L	L	M	M	M		L	M	L
CO 2	M	M	H	M	H					L	M	L
CO 3	H	L	L	M						L		
CO 4	M	M	M	L						L		

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COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION
PROCEDURE

ASSESSMENT

The University's policy on Assessment for Coursework Programs is based on the following five principles:

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.
3. Assessment must enable robust and fair judgements about student performance.
4. Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.
5. Assessment must maintain academic standards.

ASSESSMENT SUMMARY

1. Direct Assessment

Task Type	Assessment	Weighting	Learning Outcomes
Formative Assessment	Quiz 1	15%	• To know and be able to recall the main terminology, concepts, and techniques that applies some of the key issues of the measuring instruments.
Summative	Lab Record	20%	• ability to disseminate knowledge in writing
Formative Assessment	Quiz 2	15%	Apply a critical-thinking and problem-solving approach towards the principles of measuring instruments.
Formative Assessment	Attendance	10%	Punctuality, Dedication
Summative	Final exam (Viva)	15%	Apply a critical-thinking on aspect of measuring instruments study
Summative	Final exam	25%	Knowledge of heat treatment and microstructure of metals/alloys

Grades for your performance in this course will be awarded in accordance with the University policies as notified time to time and displayed in University website.

2. INDIRECT ASSESSMENT OF COURSE:

The course will also be indirectly assessed by the faculty using following methodologies:

- i. Faculty Feed back
- ii. Grades
- iii. Course evaluations (during the semester and end-of-semester)
- iv. Rubrics



COURSE INFORMATION SHEET

COURSE CODE:	PE 5001 (Theory) PE 5004 (Laboratory)						
COURSE TITLE:	MANUFACTURING PROCESSES - II						
PRE-REQUISITE(S):	<ul style="list-style-type: none"> • Knowledge of Mechanics of Solid • Manufacturing Process • Machine Design 						
CREDITS:	<table style="display: inline-table; border: none;"> <tr> <td style="padding: 0 10px;">L</td> <td style="padding: 0 10px;">P</td> <td style="padding: 0 10px;">C</td> </tr> <tr> <td style="padding: 0 10px;">3</td> <td style="padding: 0 10px;">3</td> <td style="padding: 0 10px;">6</td> </tr> </table>	L	P	C	3	3	6
L	P	C					
3	3	6					
CLASS SCHEDULE PER WEEK:	<ul style="list-style-type: none"> • Lectures- 3 • Laboratory- 1 (of Three class) 						

COURSE OBJECTIVES : It expected to teach following concepts to the students

- A.** Sand casting process and various testing & inspection methods.
- B.** Melting practice.
- C.** Special casting processes and its applications.
- D.** Classification, advantages, limitations and applications of different welding processes.
- E.** Various types and applications of non - conventional machining processes.

COURSE OUTCOMES: After completion of the course, the learners will be able to:

- CO 1:** Understand the process of traditional sand casting and to plan for the actual production of the orders, in keeping with customer specifications.
- CO 2:** Choose a special casting processes like Die, Centrifugal, Investment casting etc. for making a particular product.
- CO 3:** Fabricate basic parts and assemblies using different welding processes and compare which process is better to fabricate a given part.
- CO 4:** Select a non – conventional machining process for manufacturing a product.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES

Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4
A	H	L	L	L
B	H	M	L	L
C	L	H	L	L
D	L	L	H	L
E	M	M	L	H



PE5001 MANUFACTURING PROCESSES – II (3 Credits)

Module 1

Introduction to foundry process and its importance, Patterns, pattern materials, types of patterns, pattern allowances, mould and core making, properties of molding and core sands. Sand testing, machine molding, gating, risers and solidification of casting, design of gating systems.

Module 2

Centrifugal casting, investment casting, die casting and shell molding

Module 3

Working principle and operation of cupola, cleaning of casting, inspection of casting, casting defects

Module 4

Principle, working and application of oxy- acetylene gas welding and gas cutting, electric arc welding, MMAW

Module 5

SAW, MIG, Electroslag, TIG and plasma arc welding, Thermit welding, and solid state welding.

Module 6

Resistance welding, spot, seam, projection and butt welding, soldering and brazing

Module 7

Fundamental principles, application possibilities, process parameters, and operational characteristics of Electrochemical machining (ECM), Electrochemical Grinding (ECG), Laser Beam and Electron Beam machining and welding, Electro Discharge Machining (EDM).

Text Books:

- | | |
|---------------------------------|------------------------------------|
| 1. Foundry, Forming and Welding | P.N. Rao, Tata Mc Graw- Hill |
| 2. Modern Machining Processes | P. C. Pandey, H. S. Shan, TMCH |
| 3. Principles of metal casting | Rosenthal. P. C, Tata Mc Graw Hill |

Reference Books:

- | | |
|------------------------------------|---------------------------------------|
| 1. A course in workshop Technology | B.S. Raghuvansi, Dhanpat Rai & Co. |
| 2. Non-conventional Machining | P. K. Mishra ,Narosa Publishing House |
| 3. Text book of welding technology | O.P. Khanna, Dhanpat Rai & co. |

DEPARTMENT OF PRODUCTION ENGINEERING
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



LECTURE PLAN: (PE 5001- MANUFACTURING PROCESSES - II)

Department offering the course: Production Engineering

Contact Hours: Theory class - 3 periods per week of 50min. each
 Laboratory - 1 period of 150 min per week

MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
I	1.	Introduction to the subject, its industrial and research relevance, overview of the entire modules, evaluation method to be followed.	T1,T2&T3	50 min
I	2.	Introduction to foundry process and its importance.	T1,T3&R1	50 min
I	3.	Patterns, pattern materials, types of patterns.	T1&T3	50 min
I	4.	Pattern allowances.	T1&T3	50 min
I	5.	Mould and core making	T1&T3	50 min
I	6.	Machine molding	T1& T3	50 min
I	7.	Properties of molding and core sands.	TI & R1	50 min
I	8.	Sand Conditioning and testing	T1&T3	50 min
I	9.	Gating, risers and solidification of casting	T1&T3	50 min
I	10.	Design of gating systems.	T1&T3	50 min
I	11.	Related Problems solving.	T1,T3&R1	50 min
II	12.	Fundamental principles, application possibilities, advantages, disadvantages and limitations of Centrifugal casting.	T1,T3&R1	50 min

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MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
II	13.	Fundamental principles, application possibilities, advantages, disadvantages and limitations of investment casting.	T1,T3&R1	50 min
II	14.	Fundamental principles, application possibilities, advantages, disadvantages and limitations of die casting.	T1,T3&R1	50 min
II	15.	Fundamental principles, application possibilities, advantages, disadvantages and limitations of shell molding.	T1,T3&R1	50 min
III	16.	Working principle and operation of cupola.	T1& T3	50 min
III	17.	Zones of Cupola	T1 & R1	50 min
III	18.	Cleaning of casting	T1 & R1	50 min
III	19.	Inspection of casting.	T1 & R1	50 min
III	20.	Casting defects.	T1 & R1	50 min
IV	21.	Oxy- acetylene welding equipment and welding technique.	T1 & R3	50 min
IV	22.	Working principle and application of oxy- acetylene gas welding.	T1 & R3	50 min
IV	23.	Working principle and application of oxy- acetylene gas cutting.	T1 & R3	50 min
IV	24.	Working principle and application of electric arc welding.	T1 & R3	50 min
IV	25.	Working principle and application of MMAW.	T1 & R3	50 min
V	26.	Working principle and application of Submerged arc welding.	T1, R1 & R3	50 min
V	27.	Working principle and application of MIG arc welding process.	T1 & R3	50 min

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MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
V	28.	Working principle and application of TIG (Tungsten Inert Gas) arc welding process.	T1 & R3	50 min
V	29.	Working principle and application of Electroslag arc welding process.	T1, R1 & R3	50 min
V	30.	Working principle and application of Plasma arc welding process.	T1 & R3	50 min
V	31.	Working principle and application of Thermit welding process.	T1, R1 & R3	50 min
V	32.	Overview of Solid state welding process.	T1 & R3	50 min
V	33.	Working principle and application of Solid state welding processes.	T1 & R3	50 min
VI	34.	Overview of Resistance welding process.	T1 & R3	50 min
VI	35.	Working principle and application of spot, seam, projection and butt resistance welding processes.	T1 & R3	50 min
VI	36.	Concept of soldering and brazing.	T1, R1 & R3	50 min
VII	37.	Fundamental principles, application possibilities of Electrochemical machining (ECM).	T2 & R2	50 min
VII	38.	Process parameters and operational characteristics of Electrochemical machining (ECM).	T2 & R2	50 min
VII	39.	Fundamental principles, application possibilities, process parameters, and operational characteristics of Electrochemical Grinding (ECG).	T2 & R2	50 min
VII	40.	Fundamental principles, application possibilities, process parameters, and operational characteristics of Laser Beam machining.	T2 & R2	50 min

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MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
VII	41.	Fundamental principles, application possibilities, process parameters, and operational characteristics of Laser Beam welding.	T2 & R2	50 min
VII	42.	Fundamental principles, application possibilities, process parameters, and operational characteristics of Electron Beam machining.	T2 & R2	50 min
VII	43.	Fundamental principles, application possibilities, process parameters, and operational characteristics of Electron Beam welding.	T2 & R2	50 min
VII	44.	Fundamental principles, application possibilities of Electro Discharge Machining (EDM).	T2 & R2	50 min
VII	45.	Process parameters and operational characteristics of Electro Discharge Machining (EDM).	T2 & R2	50 min
VII	46.	Related problem solving.	T2 & R2	50 min

POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE DELIVERY METHODS

- *Lecture by use of boards/LCD projectors*
- *Tutorials/assignments*
- *Seminars*
- *Mini projects/projects*
- *Laboratory experiments*
- *Industrial/guest lectures*
- *Industrial visits/in-plant training*
- *Self- learning materials from internets*



Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	H	H	H	M		M				L
2	H	H	H	M		M				L
3	H	H	H							M
4	H	H	H	M		M				L

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION

PROCEDURE

ASSESSMENT

The University's policy on Assessment for Coursework Programs is based on the following five principles:

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.
3. Assessment must enable robust and fair judgements about student performance.
4. Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.
5. Assessment must maintain academic standards.

ASSESSMENT SUMMARY

Task Type	Assessment	Weighting	Learning Outcomes
Summative	Quiz 1	7%	<ul style="list-style-type: none"> • To know and be able to recall the main terminology, concepts, and techniques that applies some of the key issues of the design of Machine Tools.
Summative	Home assignment/ numerical problems on selected topics	8%	<ul style="list-style-type: none"> • Apply theoretical and practice skills in data analysis used for real problems through case studies. • Interact with other students to practice teamwork and communication skills.
Summative	Mid semester exam	25%	Apply a critical-thinking and problem-solving approach towards the principles of machine tool design

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Task Type	Assessment	Weighting	Learning Outcomes
Summative	Final exam	60%	Apply a critical-thinking and problem-solving approach towards the principles of machine tool design.

Assessment Detail

- All exams are closed-book.
- Further details on assignments will be given during the first day of class or subsequent completion of the module(s).
- You will be advised of the dates and times of tests during the first day of class or at least one weeks in advance of the date of the test.
- Alternative test dates for students who cannot be present on the date of the Quiz on medical and compassionate grounds can be requested through the Course Coordinator.

Submission of Assignments:

- i. You will be advised of the date, time and location for physical submission of all assignments during the first day of class or through official Notice from University.
- ii. Submission of Work for Assessment should be submitted in hardcopy with a completed copy of the assessment coversheet. This should be signed to indicate you have read the above university policy statement on plagiarism, collusion and related forms of cheating.
- iii. Extensions of deadlines for assessment tasks may be allowed for reasonable causes and medical grounds of the severity that would justify the case. Students are required to apply for an extension to the Course Co-ordinator before the assessment task is due.
- iv. Assessment tasks must be submitted by the stated deadlines. There will be a penalty for late submission of assessment tasks. The submitted work will be marked 'without prejudice' and 10% of the obtained mark will be deducted for each working day (or part of a day) that an assessment task is late, up to a maximum penalty of 50% of the mark attained.
- v. An examiner may elect not to accept any assessment task that a student wants to submit after that task has been marked and feedback provided to the rest of the class.

Grades for your performance in this course will be awarded in accordance with the University policies as notified time to time and displayed in University website.

Indirect Assessment of Course:

The course will also be indirectly assessed by the faculty using following methodologies:

- i. Grades
- ii. Course evaluations (during the semester and end-of-semester)
- iii. Concept questions, "muddy cards,"
- iv. Rubrics

COURSE INFORMATION SHEET

Course code: PE 5002

Course title: MANUFACTURING PROCESSES-II LAB

Pre-requisite(s): MANUFACTURING PROCESSES-I & II

Co- requisite(s):

Credits: 1.5 L:0 T:0 P: 3

Class schedule per week: 3

Class: M.E/Tech.

Semester / Level: 5/4

Branch: Production Engineering

Name of Teacher:

Course Objectives:

This course enables the students to:

1	Understand the various functions of various types of Machine Tools and operations and their practical usage in manufacturing applications
2	Learn concepts of machining parameters and cutting tools of Lathe equipment and different Turning operations and develop components
3	Gain the concepts of surface Grinding, and milling operations
4	Get practical knowledge of different casting operations like pattern making and sand testing procedures
5	Obtain hands-on experience on various welding equipment and welding operations of practical usage

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Apply the concepts of machining for selection of appropriate machining centers, and machining parameters
CO2	Select appropriate cutting tools Turning and milling equipment and gears
CO3	Apply the concepts of surface Grinding, and milling operations
CO4	Produce different types of patterns and sand castings
CO5	Create different types of welded joints for practical applications.

SYLLABUS

LIST OF EXPERIMENT:

EXPERIMENT NO. I: Capstan Lathe

- a. To study the functioning and operations of a Capstan lathe machine
- b. To make a job on a capstan lathe as per given drawing & make its tool layout & process sheet

EXPERIMENT NO. II: Turret Lathe

- a. To study the functioning & operations of a turret lathe.
- b. To make a job as per given drawing on a turret lathe & make its tool layout & process sheet.

EXPERIMENT NO. III: Cylindrical Grinding

- a. To study the various functioning & operations of a cylindrical grinding machine
- b. To grind outer diameter of a work piece to specified size

EXPERIMENT NO. IV: Single Spindle Automatic Lathe

- a. To study the functioning & operation of a single spindle automat lathe
- b. To make a job on single spindle automat lathe.

EXPERIMENT NO. V: Surface Grinding

- a. To study the various functioning & operation of a surface grinding machine.
- b. To grind all faces of a given work piece as per drawing.

EXPERIMENT NO. VI: Universal Milling Machine

- a. To study the various parts of a universal milling machine.
- b. To know the various operations and functions of a universal milling machine.
- c. To make a helical gear of given dimensions.

EXPERIMENT NO. VII: Tools & Equipment's

- a. To study various cutting tools used on milling machines.
- b. To study of various accessories and attachments used on milling and grinding machines.

EXPERIMENT NO. VIII: Sand Testing (Permeability Test)

- a. To learn about permeability of a molding sand

EXPERIMENT NO. IX: Sand Testing (Core Hardness Test)

- a. To know the factors effecting core hardness
- b. To find with help of experiment the variation in core hardness by changing the composition of additives.
- c. To know the importance of core hardness

EXPERIMENT NO. X: Sand Testing (GFN)

- a. To learn about the GFN (Grain Fineness Number)
- b. How grain size effect mould properties?

EXPERIMENT NO. XI: Pattern Making

- a. To know about pattern making and study & sketch pattern's layout.
- b. To study various pattern making allowances.

EXPERIMENT NO. XII: Arc Welding

- a. To calculate the weld deposition rate and study the effect of variation of current and electrode diameter

EXPERIMENT NO XIII: Compression Molding Machine

- a. To study compression mounding machine

Text Books:

1. Kalpakjian, S., “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2006. (T1)
2. P.N. Rao, Manufacturing Technology Foundry, Forming and Welding, TMH-2003; 2ndEdition, 2003 (T2)
3. Sharma, P.C., A Text book of Production Technology, S. Chand and Co. Ltd.,2004. (T3)

Reference Books:

1. Hajra Choudhury, SK “Elements of Workshop Technology, Vol. I and II”, Media Promoters Pvt Ltd., Mumbai, 2001 (R1)
2. Roy. A. Lindberg, Processes and Materials of Manufacture, PHI / Pearson Education, 2006 (R2)

Gaps in the syllabus (to meet Industry/Profession requirements):

Design of real-time Industrial projects.

POs met through Gaps in the Syllabus:

PO 5

Topics beyond syllabus/Advanced topics/Design:

Design optimization for industrial projects

POs met through Topics beyond syllabus/Advanced topics/Design:

PO 4-5, PO 11-12

Course Delivery Methods:

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	√

Course Evaluation:

Direct Assessment-

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30

Quiz 1	10				
Viva-voce	20				
End Semester Examination	% Distribution				
Examination: Experiment Performance	30				
Quiz 2	10				
Assessment Components	CO1	CO2	CO3	CO4	CO5
Day to day performance & Lab files	√	√	√	√	√
Quiz 1	√	√			
Quiz 2			√	√	√
Viva-voce	√	√	√	√	√
Examination: Experiment Performance	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping of Course Outcomes (Cos) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2		3					3			2	2	3
CO2	2	2		3					3			2	3	2
CO3	3	2		2					3			2	2	3
CO4	3	2		3					3			2	2	3

< 34% = 1, 34-66% = 2, > 66% = 3

Mapping Between Course Outcomes (Cos) and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD3
CO2	CD1, CD3, CD7
CO3	CD1, CD3, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD6, CD7



COURSE INFORMATION SHEET

COURSE CODE:	PE 5003 (Theory) PE 5004 (Laboratory)								
COURSE TITLE:	MACHINE TOOL DESIGN								
PRE-REQUISITE(S):	<ul style="list-style-type: none"> • Knowledge of Mechanics of Solid • Manufacturing Process • Machine Design 								
CREDITS:	<table style="width: 100%; border: none;"> <tr> <td style="text-align: center;">L</td> <td style="text-align: center;">T</td> <td style="text-align: center;">P</td> <td style="text-align: center;">C</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;">6</td> </tr> </table>	L	T	P	C	3	1	2	6
L	T	P	C						
3	1	2	6						
CLASS SCHEDULE PER WEEK:	<ul style="list-style-type: none"> • Lectures- 3 • Totorial-1 • Laboratory- 1 (of Three class) 								

COURSE OBJECTIVES : It expected to teach following concepts to the students

- A.** Selection of suitable drive to run the system.
- B.** Design of machine tools structures, guide-ways.
- C.** Design of Spindle, power screws.
- D.** Dynamics of machine tools.
- E.** Special features of machine tool design.

COURSE OUTCOMES: After completion of the course, the learners will be able to:

- CO 1:** Design gear box.
- CO 2:** Design different machine tools considering static and dynamic loads.
- CO 3:** Understand effect of vibrations on life of machine tools.
- CO 4:** Understand design considerations for Control system and ergonomic concept for machine tool

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES

Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4
A	H	M	M	M
B	L	H	H	M
C	L	L	M	M
D	H	H	H	L
E	L	M	L	H



PE 5003 MACHINE TOOL DESIGN (4 Credits)

Module 1: Introduction

Classification of machine tools, basic motion and general requirements of machine tool design

Module 2: Kinematics of Machine Tools

Types of drives, selection and design requirements, stepped and stepless regulation

Module 3: Layout of spindle speeds

Layout of spindle speeds, preferred numbers, structure diagram, ray diagram, design of gear box for speed and feed

Module 4: Design of Machine Tool Structures

Compliance, stiffness and rigidity, design criterion, materials and basic design procedures for beds, tables and columns

Module 5: Machine Tool Slides, Guideways and Spindle

Function, requirements, constructional features, design criterion and tribological aspects of machine tool guideways and spindles, antifriction and roller slides

Module 6: Machine Tool Vibrations

Sources, effects and elimination of vibration, chatter

Module 7: Control Systems in Machine Tools

Control systems for changing speeds and feeds, ergonomic considerations applied to the design of control members

Text Books

1. N.K. Mehta, –Machine Tool Design–, Tata McGraw Hill, ISBN 0-07-451775-9.
2. Bhattacharya and S. G. Sen., –Principles of Machine Tool–, New central book agency Calcutta, ISBN 81-7381-1555.
3. D. K Pal, S. K. Basu, –Design of Machine Tool–, 4th Edition. Oxford IBH 2005, ISBN 81- 204-0968

Reference Books

1. N. S. Acherkan, –Machine Tool–, Vol. I, II, III and IV, MIR publications.
2. F. Koenigsberger, –Design Principles of Metal Cutting Machine Tools–, The Macmillan Company, New York 1964

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BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



LECTURE PLAN: (PE 5003- MACHINE TOOL DESIGN)

Department offering the course: Production Engineering

Contact Hours: Theory class - 3 periods per week of 50min. each
 Tutorial class - 1 period of 50 min per week
 Laboratory - 1 period of 150 min per week

MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
I	1.	Introduction to the subject, its industrial and research relevance, overview of all the module, evaluation method to be followed	T2	50 min
I	2.	Introduction, Purpose of Machining, Definition of Machining, Principle of Machining and requirements.	T2	50 min
I	3.	Basic functions of Machine Tools, Definition, Configuration of Basic Machine Tools and their use (Centre lathes, shaping machine, Drilling machine, Milling machine and Planing machine).	T2	100 min
I	4.			
I	5.	Specification of Machine Tools, Classification of Machine Tools. Basic functional principles of machine tool operations, Concept of Generatrix and Directrix, Tool – work motions, Machine tool drives.	T2	50
I	6.	Related Problems solving.	T2	50 (T)
II	7.	Kinematics of machine tools- introduction, mechanisms for transmitting the machine tool motions, types of drives in machine tool: Hydraulic, Mechanical etc.	T1&T2	
II	8.	Hydraulic and Mechanical Transmission and its elements.	T1, T2, T3	50
II	9.	Elementary Transmission for transmitting rotary motion: gear, belt Transmission. for transforming rotary motion into translation and vice-versa: slider crank, crank and rocker, cam mechanism, nut and screw transmission, rack and pinion transmission.	T1, T2, T3	50
II	10.	Derives for intermitted motion: Ratchet gear, Geneva mechanism. Reversing and Differential mechanism.	T1, T2, T3	50

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MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
II	11.	Special mechanism and devices, clutches and coupling	T1, T2, T3	50
II	12.	Related Problems solving	T1, T2, T3	50(T)
III	13.	Concept of Stepped and step-less drive,	T1&T3	50
III	14.	Selection of range of speeds, Velocity range for high speed machining based on economy of production. Concept of Geometric, Arithmetic and Logarithmic progression, advantages and disadvantages of each of them.		100
III	15.	Design of speed box, various laws of speed regulations.	T1&T3	50
III	16.	Structured diagram: introduction, process, types, solving examples.	T1&T3	100
III	17.			
III	18.	Ray diagram: introduction, open type, cross type solving examples.	T1&T3	100
III	19.			
III	20.	Design of feed box	T1&T3	50
III	21.	Related Problems solving	T1&T3	50(T)
IV	22.	Design of machine tool structure: compliance, stiffness, rigidity, design criteria, materials for machine tool structure.	T1&T3	50
IV	23.	Design procedure machine tool structure	T1&T3	100
IV	24.			
IV	25.	Design procedure for beds.	T3	50
IV	26.	Design procedure for tables.	T3	50
IV	27.	Design procedure for columns.	T3	50
IV	28.	Related problem solving.	T1&T3	50(T)
V	29.	Fundamental of strength of materials required for design of guide ways and slide ways	T1&T3	50
V	30.	Design of machine tool slides ways, guide ways, function, requirements, Related Problems solving.	T1	100
V	31.			
V	32.	Design of guide ways, constructional features.	T1	
V	33.	Related problem solving.	T1&T3	50(T)
V	34.	Design of spindles, constructional features.	T1&T3	50
V	35.	Tribological aspect of machine tool guideways and spindles (Hydrostatic and Hydrodynamic antifriction and roller slides).	T1&T3	50
V	36.	Related problem solving.	T1&T3	50(T)

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MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
VI	37.	Introduction of Machine tool vibration, types, effects, sources, elimination of vibration.	T1&T3	100
VI	38.			
VI	39.	Machine tool Chatter : introduction , types, effects, sources , analysis (lathe)	T1&T3	100
VI	40.			
VI	41.	Related problem solving.	T1&T3	50 (T)
VII	42.	Introduction to Control systems in machine tool: for changing speeds and feeds, functions, requirements, and classifications (Manual control, Automatic Control, Adaptive Control).	T1	50
VII	43.	Ergonomic considerations applied to the design of control manual system.(design of Push buttons , Toggles, Knobs, Cranks, Levers, Hand Wheels, design of rotary levers and star wheels).	T1	100
VII	44.			
VII	45.	Ergonomic considerations applied to the design of automatic control system.	T1	50
VII	46.	Ergonomic considerations applied to the design of adaptive Control system.	T1	50

Topics beyond syllabus/Advanced topics/Design:

Undertake, analyse, and optimise an artificial machine design exercise, by using commercial software that is commonly used in the industry.

POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE DELIVERY METHODS

- *Lecture by use of boards/LCD projectors*
- *Tutorials/assignments*
- *Seminars*
- *Mini projects/projects*
- *Laboratory experiments*
- *Industrial/guest lectures*
- *Industrial visits/in-plant training*
- *Self- learning materials from internets*



Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	H	H	H					M		M
2	H	H	H					M		M
3	H	H	H					M		M
4	H	H	H	M	L			M		M

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION

PROCEDURE

ASSESSMENT

The University's policy on Assessment for Coursework Programs is based on the following five principles:

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.
3. Assessment must enable robust and fair judgements about student performance.
4. Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.
5. Assessment must maintain academic standards.

ASSESSMENT SUMMARY

Task Type	Assessment	Weighting	Learning Outcomes
Summative	Quiz 1	7%	<ul style="list-style-type: none"> • To know and be able to recall the main terminology, concepts, and techniques that applies some of the key issues of the design of Machine Tools.
Summative	Home assignment/ numerical problems on selected topics	8%	<ul style="list-style-type: none"> • Apply theoretical and practice skills in data analysis used for real problems through case studies. • Interact with other students to practice teamwork and communication skills.
Summative	Mid semester exam	25%	Apply a critical-thinking and problem-solving approach towards the principles of machine tool design
Summative	Final exam	60%	Apply a critical-thinking and problem-solving approach towards the principles of machine tool design



Assessment Detail

- All exams are closed-book.
- Further details on assignments will be given during the first day of class or subsequent completion of the module(s).
- You will be advised of the dates and times of tests during the first day of class or at least one weeks in advance of the date of the test.
- Alternative test dates for students who cannot be present on the date of the Quiz on medical and compassionate grounds can be requested through the Course Coordinator.

Submission of Assignments:

- i. You will be advised of the date, time and location for physical submission of all assignments during the first day of class or through official Notice from University.
- ii. Submission of Work for Assessment should be submitted in hardcopy with a completed copy of the assessment coversheet. This should be signed to indicate you have read the above university policy statement on plagiarism, collusion and related forms of cheating.
- iii. Extensions of deadlines for assessment tasks may be allowed for reasonable causes and medical grounds of the severity that would justify the case. Students are required to apply for an extension to the Course Co-ordinator before the assessment task is due.
- iv. Assessment tasks must be submitted by the stated deadlines. There will be a penalty for late submission of assessment tasks. The submitted work will be marked 'without prejudice' and 10% of the obtained mark will be deducted for each working day (or part of a day) that an assessment task is late, up to a maximum penalty of 50% of the mark attained.
- v. An examiner may elect not to accept any assessment task that a student wants to submit after that task has been marked and feedback provided to the rest of the class.

Grades for your performance in this course will be awarded in accordance with the University policies as notified time to time and displayed in University website.

Indirect Assessment of Course:

The course will also be indirectly assessed by the faculty using following methodologies:

- i. Grades
- ii. Course evaluations (during the semester and end-of-semester)
- iii. Concept questions, "muddy cards,"
- iv. Rubrics



COURSE INFORMATION SHEET

COURSE CODE:	<i>PE 5004 (Sessional)</i>								
COURSE TITLE:	<i>MACHINE TOOL DESIGN SESSIONAL</i>								
PRE-REQUISITE(S):	<ul style="list-style-type: none"> • <i>Knowledge of Mechanics of Solid</i> • <i>Manufacturing Process</i> • <i>Machine Design</i> 								
CREDITS:	<table style="width: 100%; border: none;"> <tr> <td style="text-align: center;">L</td> <td style="text-align: center;">T</td> <td style="text-align: center;">P</td> <td style="text-align: center;">C</td> </tr> <tr> <td style="text-align: center;"><i>0</i></td> <td style="text-align: center;"><i>0</i></td> <td style="text-align: center;"><i>3</i></td> <td style="text-align: center;"><i>2</i></td> </tr> </table>	L	T	P	C	<i>0</i>	<i>0</i>	<i>3</i>	<i>2</i>
L	T	P	C						
<i>0</i>	<i>0</i>	<i>3</i>	<i>2</i>						
CLASS SCHEDULE PER WEEK:	• <i>Sessional - 1 (of Three class)</i>								

COURSE OBJECTIVES :It expected to teach following concepts to the students

- A.** *Selection of suitable drive to run the system.*
- B.** *Design of machine tools structures, guide-ways.*
- C.** *Design of Spindle.*
- D.** *Dynamics of machine tools.*
- E.** *Special features of machine tool design.*

COURSE OUTCOMES: *After completion of the course, the learners will be able to:*

CO 1:*Design gear box.*

CO 2:*Design different machine tools considering static and dynamic loads.*

CO 3:*Understand effect of vibrations on life of machine tools.*

CO 4:*Understand design considerations for Control system and ergonomic concept for machine tool*

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES

Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4
A	<i>H</i>	<i>M</i>	<i>M</i>	<i>M</i>
B	<i>L</i>	<i>H</i>	<i>H</i>	<i>M</i>
C	<i>L</i>	<i>L</i>	<i>M</i>	<i>M</i>
D	<i>H</i>	<i>H</i>	<i>H</i>	<i>L</i>
E	<i>L</i>	<i>M</i>	<i>L</i>	<i>H</i>



PE 5004 MACHINE TOOL DESIGN SESSIONAL (2 Credits)

Module 1: Introduction

Classification of machine tools, basic motion and general requirements of machine tool design

Module 2: Kinematics of Machine Tools

Types of drives, selection and design requirements, stepped and stepless regulation

Module 3: Layout of spindle speeds

Layout of spindle speeds, preferred numbers, structure diagram, ray diagram, design of gear box for speed and feed

Module 4: Design of Machine Tool Structures

Compliance, stiffness and rigidity, design criterion, materials and basic design procedures for beds, tables and columns

Module 5: Machine Tool Slides, Guideways and Spindle

Function, requirements, constructional features, design criterion and tribological aspects of machine tool guideways and spindles, antifriction and roller slides

Module 6: Machine Tool Vibrations

Sources, effects and elimination of vibration, chatter

Module 7: Control Systems in Machine Tools

Control systems for changing speeds and feeds, ergonomic considerations applied to the design of control members

Text Books

1. N.K. Mehta, –Machine Tool Design–, Tata McGraw Hill, ISBN 0-07-451775-9.
2. Bhattacharya and S. G. Sen., –Principles of Machine Tool–, New central book agency Calcutta, ISBN 81-7381-1555.
3. D. K Pal, S. K. Basu, –Design of Machine Tool–, 4th Edition. Oxford IBH 2005, ISBN 81- 204-0968

Reference Books

1. N. S. Acherkan, –Machine Tool–, Vol. I, II, III and IV, MIR publications.
2. F. Koenigsberger, –Design Principles of Metal Cutting Machine Tools–, The Macmillan Company, New York 1964

DEPARTMENT OF PRODUCTION ENGINEERING
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



SESSIONAL PLAN: (PE 5004- MACHINE TOOL DESIGN SESSIONAL)

Department offering the course: Production Engineering

Contact Hours: SESSIONAL - 3 period of 150 min per week (2 Batches)

COURSE WORK No.	Objectives	TOTAL NO. OF CONTACT HRS.
1	To study the specification of various machine tool and draw its block diagrams .	150 Min.
2	Assignment No.1 (Problems)	150 Min.
3	To study the different mechanism used in various machine tool.	150 Min.
4	To draw the given sketch 2-D on CATIA.	150 Min.
5	To draw the given sketch 2-D on CATIA.	150 Min.
6	To draw the given sketch 3-D on CATIA.	150 Min.
7	To draw the different mechanism used in various machine tool such as belt drive, gear drive, rack and pinion, quick return mechanism by the help of CATIA.	150 Min.
8	To draw the sketch of various machine tool parts: Tailstock, Headstock, Carriage, spindle, and various types of Structure s	150 Min.
9	Assignment No.2 (Design of Gear Box)	150 Min.
10	Assignment No.3 (Design of Feed Box)	150 Min.
11	Assignment No.4(Design of Lathe bed structure)	150 Min.
12	Assignment No.5(Design of Spindle)	150 Min.
13	To study types of slide ways and design for wear resistance.	150 Min.
14	Assignment No.5(Design of slide ways)	150 Min.
15	To draw the different controls systems with ergonomic consideration applied to the design of control members in various machine tool such as Design of Knobs, toggles, push buttons, Cranks, Leavers, star wheels.	150 Min.
16	To study types of Sources of Vibrations, Causes and effects, Remedies	150 Min.
17	To evaluate and verify actual and theoretical machining time of Lathe and shaper machine tools.	150 Min.

Topics beyond syllabus/Advanced topics/Design:

Undertake, analyse, and optimise an artificial machine design exercise, by using commercial software (CATIA) that is commonly used in the industry.

POs met through Topics beyond syllabus/Advanced topics/Design:

DEPARTMENT OF PRODUCTION ENGINEERING
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



COURSE DELIVERY METHODS

- *Lecture by use of boards/LCD projectors*
- *Tutorials/assignments to solve the problems.*
- *Self- learning materials from books, internets*

Mapping of Course work with Course Outcomes

Course Work No.	Course Outcomes				
	1	2	3	4	5
1			L		
2	H	H	H	H	
3	H	H	H	H	
4	H	H	H	M	
5	H				
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	H	H	H					M		M
2	H	H	H					M		M
3	H	H	H					M		M
4	H	H	H	M	L			M		M

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION

PROCEDURE

ASSESSMENT

The University's policy on Assessment for Coursework Programs is based on the following five principles:

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.
3. Assessment must enable robust and fair judgements about student performance.
4. Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.
5. Assessment must maintain academic standards.

DEPARTMENT OF PRODUCTION ENGINEERING
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



ASSESSMENT SUMMARY

1. Direct Assessment

Task Type	Assessment	Weighting	Learning Outcomes
Formative Assessment	Progressive Viva-I	15%	<ul style="list-style-type: none"> To know and be able to recall the main terminology, concepts, and techniques that applies some of the key issues of the design of Machine Tools.
Summative	Sessional Record	20%	<ul style="list-style-type: none"> ability to disseminate knowledge in writing
Formative Assessment	Progressive Viva-II	15%	Apply a critical-thinking and problem-solving approach towards the principles of machine tool design
Formative Assessment	Attendance	10%	Punctuality, Dedication
Summative	Final exam (Viva)	20%	Apply a critical-thinking on aspect of Machine tool Design parts and assembly .
Summative	Final exam (Performance)	20%	Knowledge of designing a product as per given drawing using CATIA software and problem-solving approach towards the principles of machine tool design

Grades for your performance in this course will be awarded in accordance with the University policies as notified time to time and displayed in University website.

Assessment Detail

- All exams are closed-book.
- Further details on assignments will be given during the first day of class or subsequent completion of the Course work.
- You will be advised of the dates and times of tests during the first day of class or at least one weeks in advance of the date of the test.
- Alternative test dates for students who cannot be present on the date of the Quiz on medical and compassionate grounds can be requested through the Course Coordinator.

Submission of Sessional/ Lab Records :

DEPARTMENT OF PRODUCTION ENGINEERING
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



- i. You will be advised of the date, time and location for physical submission of all records during the first day of class or through official Notice from University.
- ii. Submission of Work for Assessment should be submitted in hardcopy with a completed copy of the assessment coversheet. This should be signed to indicate you have read the above university policy statement on plagiarism, collusion and related forms of cheating.
- iii. Extensions of deadlines for assessment tasks may be allowed for reasonable causes and medical grounds of the severity that would justify the case. Students are required to apply for an extension to the Course Co-ordinator before the assessment task is due.
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- v. An examiner may elect not to accept any assessment task that a student wants to submit after that task has been marked and feedback provided to the rest of the class.

Grades for your performance in this course will be awarded in accordance with the University policies as notified time to time and displayed in University website.

Indirect Assessment of Course:

The course will also be indirectly assessed by the faculty using following methodologies:

- i. Grades
- ii. Course evaluations (during the semester and end-of-semester)
- iii. Concept questions, "muddy cards,"
- iv. Rubrics



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

Program Educational Objectives (PEO)

- PEO 1:** Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems
- PEO 2:** To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices
- PEO 3:** Enabling graduates to have command over various manufacturing processes and machine tools
- PEO 4:** To develop an attitude for continuous learning and aspiration to excel in all endeavours.
- PEO 5:** Improving inter-personal skill, team spirit and employability while believing on the ethical values

Program Outcomes (PO)

A graduate in Production Engineering shall

- PO 1:** Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems.
- PO 2:** Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice.
- PO 3:** Demonstrate command in manufacturing processes and related machine tools
- PO 4:** Understand the morphology of a production system and its management.
- PO 5:** Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production.
- PO 6:** Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience.
- PO 7:** Development of various managerial skills like interpersonal, communication and documentation
- PO 8:** Development of innovative technical solutions for various challenges in society. Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.
- PO 9:** Be aware of financial, environmental and sustainability implications for each professional action.
- PO 10:** Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE 5005

Course title: Statistical Quality Control

Pre-requisite(s): Knowledge of basics in statistics

Credits: **L T P C**
 3 1 0 4

Class schedule per week: 4 lectures

Course Objectives : This course enables the students:

1.	To understand the meaning and objectives of quality control
2.	Students must learn about various quality costs and their relationships
3.	The construction of various control charts must be explained
4.	Analytical and graphical tools for measuring central tendency and dispersion to be covered
5.	The procedure for sampling plans verses 100% inspection need to be explained to students
6.	To understand construction of OC and AOQ curves
7.	To learn about reliability theories and MTTR, availability and maintainability
8.	To learn the quality certification of ISO and total quality management

Course Outcomes : After completion of the course, the learners will be able to:

1.	Understand the importance and objectives of quality control in an industry
2.	Construct and use quality tools like control charts, histograms, Ogives to understand the process
3.	Understand different aspects of sampling plan like OC curve, AOQ, ATI through their construction and applications
4.	Understand the usefulness of reliability studies in practical case
5.	Understand the detail procedure for ISO certification process and TQM

Syllabus:

MODULE – I

Introduction to Quality Control, Objective, Applications and Cost Consideration, Graphical and Analytical Methods for Central Tendency and Dispersion

MODULE – II

General Theory of Control Charts, Theory and Application of Control Charts for Averages, Range, Standard Deviation, Fraction Defective and Number of Defects, Process Capability Study, Interpretation of Control Chart

MODULE – III

100% Sampling Vs. Statistical Sampling, Elementary Concepts of Acceptance Sampling by Attributes, Concept and Characteristics of O.C. Curves

MODULE – IV

Single, Double and Multiple Sampling Plans, Construction and Use of O.C. Curves for Sampling Plans, MIL – STD Plans, Sequential Sampling Plan

MODULE – V

Basic Concept of Reliability, Reliability and Hazard Functions for Well-Known Distributions, System Reliability, Reliability Improvement

MODULE – VI

Concept of Quality Circle and Quality Loop, ISO–9000 Quality Systems, Quality Audit, Quality Costs and Cost of Quality, Six–Sigma Technique

MODULE – VII

Total Quality Control: Basic Approach, Deming Theory, Quality and Competitiveness in a Global Market Place, Establishing a Quality Culture and Customer Focus, Employee Involvement

Text Books:

- | | |
|---|--|
| 1. Statistical Quality control | M. Mahajan, Dhanpat Rai & Sons |
| 2. Mechanical Reliability | L.S. Srinath, Affiliated East – West Press |
| 3. Inspection Quality Control & Reliability | S.C.Sharma, Khanna Publishers |

Reference Books:

- | | |
|--|-----------------------------------|
| 1. Statistical Quality Control & Reliability | D.H. Besterfield, Prentice Hall |
| 2. Total Quality Management | D.H. Besterfield, Prentice Hall |
| 3. Introduction to statistical quality control | Douglas C. Montgomery, John Wiley |

LECTURE PLAN

Department : Production Engineering

Course: PE 5005: Statistical Quality Control

Academic Year : 2016 – 17

Class : BE

Semester : V

Course Coordinator : Dr. L. N. Pattanaik

Lecture Plan:

Sl. no.	Module no.	Lecture No.	Topic(s) to be covered	Book(s)	Lecture Hrs
1	I	1	Introduction to Quality Control: Definition and History.	---	4
2		2	Quality of design, Quality of conformance, Quality of performance, Quality objectives and applications	T1,R1, R3	
3		3	Quality cost: Prevention cost, Appraisal cost, Internal failure cost, External failure cost. Quality of cost Vs. cost of product, Quality of design Vs. cost of quality.	T1,R1, R3	
4		4	Measure of Central Tendency and Measure of Dispersion (Analytical method) (Graphical method): Frequency histogram, Frequency polygon, Ogive curve	T1,R1, R3	
5	II	5	Theory of control chart: Concept of variability, Variable data Vs. Attribute data, Chance causes Vs. Assignable causes.	T1,R1, R3	8
6		6	Control charts for variables: X-bar and R chart.	T1,R1	
7		7	Control charts for variables: X-bar and σ chart.	T1,R1	
8		8	Control charts for attribute: p chart, np and 100p chart	T1,R1	
9		9	Control charts for attribute: c and u chart.	T1,R1	
10		10	Analysis of control charts for variables: Type I and Type II error, Control chart patterns.	T1,R1	
11		11	Study of process capability, concept of trial and revised control limits and warning limits.	T1,R1	
12		12	Demerit chart for defects	T1,R1	
13	III	13	Acceptance sampling: Definition, 100% Vs. Sampling inspection,	T1,R1	4
14		14	Advantage and limitations of sampling plans	T1,R1	
15		15	Sampling plans for lot-by-lot acceptance by attributes	T1,R1	
16		16	Various sampling methods	T1,R1	

Sl. no.	Module no.	Lecture No.	Topic(s) to be covered	Book(s)	Lecture Hrs
17	IV	17	OC - Curve concept.	T1,R1	7
18		18,19	Type A, type B OC curve, OC - Curve: Construction, Use and Characteristics (Single sampling).	T1,R1	
19		19,20	Producer and consumer risk, AOQ curve construction, ATI	T1,R1	
20		21, 22	Sampling plans: Single, Double and multiple.	T1,R1	
21		23	Sequential sampling plan and MIL-STD plans	T1,R1	
22	V	24, 25	Concept of reliability, Failure patterns for complex products. Design for reliability, Hazard Functions for Well-Known Distributions: Normal, Exponential and Weibull.	T1, T2, R2	5
23		26	System reliability: Series, Parallel and Mixed	T1,T2, R2	
24		27, 28	Concept of Maintainability and Availability, Relation between Reliability, Maintainability and Availability, Methods of improvement	T1, T2, R2	
25	VI	29	Concept of Quality Circle and Quality Loop	T1, T3, R2, R3	6
26		30, 31	Six-Sigma Technique	T1, T3, R2, R3	
27		32	ISO-9000 Quality Systems	T1, T3, R2, R3	
28		33	Quality Audit	T1, T3, R2, R3	
29		34	Quality Costs and Cost of Quality	T1, T3, R2, R3	
30	VII	35	Concept of Total Quality Control, TQC Vs. TQM	T1, T3, R2, R3	6
31		36	Deming Theory (14 points)	T1, T3, R2, R3	
32		37, 38	Quality and Competitiveness in a Global Market Place, Establishing a Quality Culture	T1, T3, R2, R3	
33		39	Quality assurance	T1, T3, R2, R3	
34		40	Customer Focus, Employee Involvement	T1, T3, R2, R3	

Gaps in the syllabus (to meet Industry/Profession requirements)

1. Application of six-sigma to industrial case study
2. TPM concept in reliability

Topics beyond syllabus/Advanced topics/Design:

Case studies on Lean six sigma from industries

POs met through Topics beyond syllabus/Advanced topics/Design: PO2 and PO5

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Guest lectures
CD7	Industrial visits/in-plant training

Mapping Between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
CD1	√	√	√	√	√
CD2		√	√	√	
CD3	√	√	√	√	√
CD4		√	√		
CD5		√	√		
CD6	√	√	√	√	√
CD7	√			√	√

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
1	H	-	L	H	-
2	L	L	L	M	L
3	L	H	M	-	L
4	L	H	L	L	-
5	L	M	H	L	-
6	L	M	H	L	M
7	M	L	M	H	M
8	M	L	L	L	H

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	PO									
	1	2	3	4	5	6	7	8	9	10
1	L	L	M	M	L	-	L	L	M	M
2	H	H	L	L	H	-	-	M	L	-
3	H	H	L	L	H	-	-	M	L	-
4	M	H	H	M	H	L	-	M	M	M
5	L	L	L	M	L	-	M	M	H	M

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Seml Examination Marks	60
Assignment/Quiz	15

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√	√		
End Sem Examination Marks	√	√	√	√	√
Assignment/Quiz	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

WORK STUDY AND ERGONOMICS LAB (PE- 5006)

Course Objectives:

This course enables the students to:

1	Understand the method of draw process chart and learn best way of assembly.
2	expose the students to various work sampling methods and performance evaluation.
3	Evaluate the physical working capacity of various machine.
4	Measure the effect of posture.
5	Understand to evaluate multi activity chart.

SYLLABUS

LIST OF EXPERIMENT:

- 1. EXPERIMENT – 1: Two hand process chart**
Objective: To draw two hand process charts for bolt and washer assembly by old and improved method.
- 2. EXPERIMENT – 2: Assembly of rope clip**
Objective: Assembly of rope clip by old and improved methods.
- 3. EXPERIMENT – 3: Pin board assembly**
Objective: To find the best method for pin board assembly.
- 4. EXPERIMENT – 4: Assembly of bracket**
Objective: Assembly of bracket and bolt by old and improved methods.
- 5. EXPERIMENT – 5: Work sampling method-I**
Objective: To find the idle time by work sampling method.
- 6. EXPERIMENT – 6: Performance evaluation**
Objective: Performance evaluation by card rating.
- 7. EXPERIMENT – 7: Time study-I**
Objective: Time study for drilling and chamfering operations.
- 8. EXPERIMENT – 8: Preparation of flow process chart**
Objective: To prepare flow process chart as per the given narrative.
- 9. EXPERIMENT – 9: Assembly of nuts and bolts**
Objective: Assembly of nuts and bolts in various subjects.

10. EXPERIMENT – 10: Effect of posture

Objective: Effect of posture on the response to cycle ergometer exercise.

11. EXPERIMENT – 11: Multiple activity chart

Objective: To make multiple activity chart from the given operations.

12. EXPERIMENT – 12: Physical working capacity

Objective: Evaluation of physical working capacity of various machines.

13. EXPERIMENT – 13: Time study-II

Objective: Time study for turning operation in center lathe.

14. EXPERIMENT – 14: Work sampling-II

Objective: work sampling study from the given machines.



Department of Production Engineering

Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

Program Educational Objectives (PEO)

1. To develop capability to understand the fundamentals of Science and Production Engineering for analyzing the engineering problems with futuristic approach.
2. To foster a confident and competent graduate capable to solve real life practical engineering problems fulfilling the obligation towards society.
3. To inculcate an attitude for identifying and undertaking developmental work both in industry as well as in academic environment with emphasis on continuous learning enabling to excel in competitive participations at global level.
4. To nurture and nourish effective communication and interpersonal skill to work in a team with a sense of ethics and moral responsibility for achieving goal.

Program Outcomes (PO)

A graduate shall

- a) Be competent in applying basic knowledge of science and engineering for the purpose of obtaining solution to a multi-disciplinary problem.
- b) Gain skillful knowledge of complex engineering problem analysis.
- c) Be able to design system components and processes meeting all applicable rules and regulations.
- d) Be proficient in arriving at innovative solution to a problem with due considerations to society and environment.
- e) Be capable of undertaking suitable experiments/research methods while solving an engineering problem and would arrive at valid conclusions based on appropriate interpretations of data and experimental results.
- f) Continually upgrade his/her understanding and become masterly at modern engineering and soft tools and apply them along with other appropriate techniques and resources.
- g) Exhibit understanding of societal and environmental issues (health, legal, safety, cultural etc) relevant to professional engineering practice and demonstrate through actions, the need for sustainable development.
- h) Be committed to professional ethics, responsibilities and economic, environmental, societal, and political norms.
- i) Demonstrate appropriate inter-personal skills to function effectively as an individual, as a member or as a leader of a team and in a multi-disciplinary setting.
- j) Be able to comprehend and write effective reports and design documentations; give and receive clear instructions; make effective presentations and communicate effectively and convincingly on complex engineering issues with engineering community and with society at large.
- k) Be conscious of financial aspects of all professional activities and shall be able to undertake projects with appropriate management control and control on cost and time.
- l) Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

COURSE INFORMATION SHEET

Course code: PE5007

Course title: WORK STUDY & ERGONOMICS

Pre-requisite(s): Basic Knowledge of industrial work system.

Credits:

L	T	P	C
3	0	2	5

Class schedule per week: 3 lectures

Course Objectives : This course enables the students:

1.	To understand the basic concept as well as scope of work study and Ergonomics.
2.	To analyze existing work method at macro and micro level to eliminate the unwanted activities for improvement of existing method and development of the best work method as well as plant layout..
3.	To estimate standard time for existing as well as proposed work method.
4.	To evaluate job as well as rate the merit of the worker and estimate the wages and wage incentives for fair days work.

Course Outcomes : After completion of the course, the learners will be able to:

1.	Apply the concept of work study and ergonomics for enhancement of industrial productivity.
2.	Analyze the work method and develop an improved work method and design a good plant layout.
3.	Find out the standard time of carrying out task under specified working conditions.
4.	Evaluate the job and rate the merit of the worker.
5.	Evaluate the wages and wage incentives for variety of work.

Syllabus:

Module I

Introductory Concepts

Definition, objective and scope of work study and ergonomics and its historical background, Interrelationship between work study & ergonomics, role of work study & ergonomics in productivity improvement

Module II

Method Engineering

Definition, objectives and methodology of method engineering, Plant layout, types of layout problems, factors affecting plant layout, types of plant layout, techniques and tools of layout, Types of flow patterns

Module III

Motion Economy & Analysis

Principles of motion economy and methodology of motion analysis

Module IV

Work Measurement

Definition, objective and different methods of work measurement, Work Sampling

Module V

Job Evaluation, Merit Rating, Wages & Salary

Definition, objectives and techniques of job evaluation and merit rating.

Definition and principles of wage and salary administration, comparative study of incentive schemes

Module VI

Ergonomics

Man – machine interaction, design of man-machine environment system, workstation design

Module VII

Material handling

Material handling, types of load, objectives and principles of material handling, Diagnosis and analysis of handling problems, material handling equipment and their selection

Text Books

1. **Motion & Time Study** Barnes R.M.\
2. **Human factors in design and engineering** - McCormick
3. **Ergonomics at work** - James Osborne
4. **Work Study** O. P. Khanna

Reference Books

1. **Work Study** I. L. O.

LECTURE PLAN

Department : Production Engineering

Course: PE 5007: Work study and Ergonomics

Academic Year : 2016 – 17

Class : BE

Semester : V

Course Coordinator : Prof. B.K. Singh

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
1	---	1	Pre-requisites and Objectives cum Outcomes of the Course, Course Linkages with other Courses	---	
2	I	2	Definition of work study & ergonomics and its role in enhancement of productivity.	T1,T2	
3		3	Misconception of productivity and reasons for lowering of productivity	T1,T4	
4		4	Objectives and scope of work study	T1,T4	
5		5	Interdisciplinary nature of ergonomics	T2,T3	
6		6	Objectives and scope of ergonomics	T2,T4	
7		II	7	Definition and procedure of method study	T1
8	8		Condition selection of a problem for method analysis	T1	
9	9, 10		Recoding a method by means of charts, diagrams, graphs, models etc.	T1,T4	
10	11, 12		Critical examination, development and implementation of developed method	T1,T4	
11	13, 14		Principles of Plant layout, types and tools and techniques of plant layout	T4	
12	III	15	Principles of motion economy elated to use of human body as well as design of work place	T1	
13		16	Principles of motion economy elated to design of tools and equipments; Therbligs	T1	
14		17	Therbligs and micromotionanalysis	T1	
15		18	SIMO chart and MEMO chart	T1	
16	IV	19	Concept and application of Work measurement	T1,T4	
17		20	Stop watch time study - definition and procedural steps of time study	T1	
18		21	Reasons and rules for elemental breakdown	T1	
19		22	Evaluation of number of cycles to be	T1	

			timed		
20	IV	23, 24	Performance rating techniques	T1,R1	
21		25	Allowances	T1,R1	
22		26	Calculation of standard time	T1,R1	
23		27	Concept of work sampling	T1,R1	
24		28, 29	Procedural steps of work sampling	T1,R1	
25		30	Evaluation of standard time by work sampling	T1,R1	
26		31	PMTS	T1	
27		32	MTM	T1	
28	V	33	Job evaluation and its tools and techniques	T4,R1	
29		34	Merit rating and its tools and techniques	T4	
30		35	Wages and wage incentives	T4,R1	
31		36	Wage incentive plans	T4,R1	
32	VI	37	Ergonomics for design of controls and displays	T2,T3	
33		38	Work station design	T2,T3	
34	VII	39	Concept and Principles of materials handling	T4	
35		40	Tools and techniques of material handling	T4	

Gaps in the syllabus (to meet Industry/Profession requirements)

1. Impact of Automation in manufacturing Industry affecting work study and ergonomics.
2. Simulation of real life industrial system for work study and ergonomics related problems.

POs met through Gaps in the Syllabus: f, h, j, k

Topics beyond syllabus/Advanced topics/Design:

- * Computer aided method analysis and design
- * Computer Aided time study

POs met through Topics beyond syllabus/Advanced topics/Design: i, j, k

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments /Class tests
CD3	Seminars
CD4	Mini projects/Projects

CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of NPTEL materials and internets
CD9	Simulation

Mapping Between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
CD1	√	√	√	√	√
CD2	√	√	√	√	√
CD3	√	√	√		
CD4		√			
CD5	√	√	√		
CD6					
CD7					
CD8	√	√	√	√	√
CD9					

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
1	H	H	M	L	L
2	H	H	L	L	L
3	L	L	H	-	-
4	L	M	L	H	H

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes											
	a	b	C	D	e	f	g	h	i	j	k	l
1	H	H	L	L	-	L	L	L	L	H	-	-
2	H	H	M	M	H	M	L	L	-	L	-	-
3	H	M	M	M	M	M	H	M	-	L	-	-
4	H	H	H	M	M	M	M	-	L	L	H	L
5	H	H	M	M	L	L	-	-	H	H	H	H

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Seml Examination Marks	60
Assignment / Class test	15

Assessment Compoents	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks					
End Sem Examination Marks					
Assignment					

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

Program Educational Objectives (PEO)

- PEO 1:** Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems
- PEO 2:** To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices
- PEO 3:** Enabling graduates to have command over various manufacturing processes and machine tools
- PEO 4:** To develop an attitude for continuous learning and aspiration to excel in all endeavours.
- PEO 5:** Improving inter-personal skill, team spirit and employability while believing on the ethical values

Program Outcomes (PO)

A graduate in Production Engineering shall

- PO 1:** Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems.
- PO 2:** Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice.
- PO 3:** Demonstrate command in manufacturing processes and related machine tools
- PO 4:** Understand the morphology of a production system and its management.
- PO 5:** Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production.
- PO 6:** Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience.
- PO 7:** Development of various managerial skills like interpersonal, communication and documentation
- PO 8:** Development of innovative technical solutions for various challenges in society. Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.
- PO 9:** Be aware of financial, environmental and sustainability implications for each professional action.
- PO 10:** Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE 5011

Course title: Project engineering

Pre-requisite(s): None

Credits:	L	T	P	C
	3	0	0	3

Class schedule per week: 3 lectures

Course Objectives : This course enables the students:

1.	To understand the scope and types of projects
2.	Students must learn about The Project Life Cycle and project constraints
3.	The organizational structure of project management must be explained
4.	Environmental considerations and social cost benefit analysis of projects to be covered
5.	Cost and budgetary aspects of project need to be delivered to students
6.	To understand Project scheduling tools (PERT and CPM)
7.	To learn Project monitoring and computer software applications in project management

Course Outcomes : After completion of the course, the learners will be able to:

1.	Comprehend the project morphology, organizational structure and elements of project
2.	Solve complex scheduling problems in project management using PERT/CPM
3.	Handle real-life projects as in various organizations
4.	Recognize the importance of environmental issues in projects
5.	Prepare project report and budget planning

Syllabus:**MODULE – I**

The scope of project, Characteristics of a project, Stages of a project, Project constraints, Project Management Structures.

MODULE – II

Responsibilities of project manager, Project Productivity, The anatomy of a project

MODULE – III

Environmental considerations in project evaluation, Main issues and secondary issues in Feasibility study, Social cost benefit analysis, Commissioning, Evaluation of competing projects.

MODULE – IV

Budgetary aspects and considerations of a project, Industrial/Engineering projects (Mining, Drilling, Refinery etc.), R & D projects, Turnkey projects

MODULE – V

Networking Modeling of a project, Deterministic & Probabilistic activity network, Line of balance, Time- Cost Trade-off in a project, Mega projects.

MODULE – VI

Project Scheduling Techniques, PERT, CPM Models..

MODULE – VII

Project Monitoring Techniques, Performance and cost evaluation (PACE), Project Staffing Requirements, Resource Leveling, Project Documentation, Computer application in Project Engineering

Text Books:

1. Project Management by Prasanna and Chandra, Tata McGraw Hill.
2. Elements of Project Management by Pete Spinner, Prentice Hall, USA.

Reference Books:

1. Production and Operation Management by Alan Muhlemann, John Oakland and Keith Lockyer, MacMillan India Ltd.
2. A course in PERT and CPM by R. C. Gupta, Dhanpat Rai Publications(P) Ltd, Delhi.
3. Industrial Engineering and Management by O. P. Khanna, Dhanpat Rai & Sons.
4. Production and Operation Management by S. N. Chary, Tata McGraw Hill.

LECTURE PLAN

Department : Production Engineering

Course: PE 5011: Project Engineering

Academic Year : 2016 – 17

Class : BE

Semester : V (Breadth Paper: Open for all branches)

Course Coordinator : Dr. L. N. Pattanaik

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
1	I	1	Definition of a project, Difference among project, program and process		6
2		2	Project scope and scope creep, Project deliverables		
3		3	Types of projects, turnkey and nonturnkey projects, backward and forward integration projects		
4		4	Modernization and expansion projects, industrial and nonindustrial projects		
5		5	Constraints of a project, Schedule, Scope and Budget		
6	II	6	Responsibility of project managers		7
7		7	Project life cycle, stages of a project		
8		8	Organizational structure of project		
9		9	Functional and product organizational structure		
10		10	Matrix and modified matrix structure		
11		11	Project organization and selection of organizational structure		
12		12	Deliverables of project and productivity of projects		
13	III	13	Project feasibility tests, economic, financial and marketing feasibility		4
14		14	Appraisals of projects based on technical, financial and marketing		
15		15	Social cost benefit analysis		
16		16	Green cost benefit analysis of projects, Environmental laws and regulations		
17		17	Project contracts, turnkey and nonturnkey project contracts		

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
18	IV	18	Issues in project outsourcing, causes of subcontracting		7
19		19,20	Tender process and selection of contractor		
20		21, 22	Break even analysis, Make-or-buy decision, numerical examples		
21		23	Mode of payment to contractors and liquefied damage		
22	V	24, 25	Project scheduling, Gantt chart, Program-progress chart		5
23		26	Introduction to network based scheduling, activity and event		
24		27, 28	Rules for constructing network diagrams, Activity-on-Arc (AoA) and Activity on node (AoN)		
25	VI	29	Fulkerson's rule, difference between PERT and CPM		6
26		30, 31	CPM and critical path, numerical problems in CPM		
27		32	Cost and time trade-off, crashing of a project		
28		33	Numerical Examples on project crashing		
29		34	PERT based network, Use of three time estimates		
30	VII	35,36	Line of balance (LoB), numerical example		6
31					
32		37, 38	Resource leveling using network, numerical examples		
33		39	Performance evaluation of projects		
34		40	Software in project managements, features and applications		

Gaps in the syllabus (to meet Industry/Profession requirements)

1. Service sector related projects
2. Role of logistics and supply chains on project management

Topics beyond syllabus/Advanced topics/Design: Multi-criteria decision making in project management

POs met through Topics beyond syllabus/Advanced topics/Design: PO1, PO2 and PO5

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Industrial visits/in-plant training

Mapping Between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
CD1	√	√	√	√	√
CD2	√	√	√	√	√
CD3	√	√	√	√	√
CD4		√	√	√	
CD5	√				

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
1	H	-	-	-	L
2	H	L	-	-	L
3	H	-	-	-	-
4	L	-	M	H	L
5	L	-	L	L	H
6	L	H	L	L	-
7	-	L	L	L	H

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	M	-	-	-	-	-	H	H	H	-
2	M	H	-	-	-	-	-	H	L	L
3	L	M	L	L	H	-	H	H	-	L
4	-	-	-	L	L	-	L	-	H	-
5	L	L	-	-	-	-	H	L	-	L

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Seml Examination Marks	60
Assignment	15

Assessment Compoents	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√	√		
End Sem Examination Marks	√	√	√	√	√
Assignment		√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

Program Educational Objectives (PEO)

1. Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems
2. To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices
3. Enabling graduates to have command over various manufacturing processes and machine tools
4. To develop an attitude for continuous learning and aspiration to excel in all endeavours.
5. Improving inter-personal skill, team spirit and employability while believing on the ethical values.

Program Outcomes (PO)

- a. Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems.
- b. Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice.
- c. Demonstrate command in manufacturing processes and related machine tools
- d. Understand the morphology of a production system and its management.
- e. Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production.
- f. Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience.
- g. Development of various managerial skills like interpersonal, communication and documentation
- h. Development of innovative technical solutions for various challenges in society
Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.
- i. Be aware of financial, environmental and sustainability implications for each professional action.
- j. Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE 6001

Course title: Tool Design

Pre-requisite(s): Basic knowledge of forming & machining operations

Credits: L T P C
 3 0 0 3

Class schedule per week: 3 lectures

Course Objectives:

1.	To understand the basic principles and types of location & clamping
2.	Students must learn about various types of jigs and fixtures and their design
3.	The components of die set assembly and types of dies must be explained
4.	Design of blanking and piercing die and calculation for blank diameter for forming dies must be explained.
5.	The procedure for design of single point cutting tool, drill bits and milling cutter to be explained to students
6.	To understand the graphical methods for design of form tool.
7.	To learn about materials of tooling and their properties.
8.	To learn about the economic aspects of tools

Course Outcomes: After completion of the course, the learners will be able to:

1.	Understand the principals location and clamping and learn about various location methods and clamping devices.
2.	Design turning, Milling, Drilling & Indexing Jigs and fixtures
3.	Understand components of dies assembly, classification of dies and their basic principles of operation
4.	Design blanking and piercing and drawing dies.
5.	Design of single point cutting tools, form tools, drills and milling cutters
6.	Understand the types and choice of tool materials
7.	Understand the economic aspects of tools.

Syllabus:

MODULE – I

Jigs & Fixtures: Principal of design and construction, Location and clamping

MODULE – II

Basic concept for design of turning, Milling, Drilling & Indexing Jigs and fixtures

MODULE – III

Classification of dies, components of dies assembly, Simple dies, compound dies, combination dies and progressive dies

MODULE – IV

Punch and die clearance, centre of pressure, calculation of blank diameter

MODULE – V

Design of tools for the production of holes, and surfaces of revolution, and flat surfaces like single point tools, form tools,

MODULE – VI

drills, milling cutters

MODULE – VII

Materials for cutting tools, cutting dies and forming dies, Economics of Tooling

Text Books

1. **Production Engineering Design (Tool Design)** Umesh Chandra & Surender Kumar, Satya Prakashan, New Delhi
2. **Tool Design by C. Donaldson** G.H.Lecain and V.C.Goold, Tata McGraw Hill

Reference Books:

1. **Principles of Tool Design** S.K. Basu
2. **Jigs & Fixtures** Fred H. Colvin
3. **Handbook, Fundamentals of Tool Design** ASTME
4. **Basic Die Making** Osterguard E., Mc-Graw Hill Book Co.
5. **Metal Cutting & Tool Design** V.Arshinov, Mir Publication.
6. **Design and Production of Metal-Cutting Tools** P.Rodin, Mir Publishers, Moscow.
7. **Fundamentals of Tool Design** Frank W. Wilson
8. **Properties and Selection of Tool Material** Kortesoja, Victor A., ASM.

LECTURE PLAN

Department : Production Engineering

Course: PE 6001: Tool Design

Academic Year : 2016 – 17

Class : BE

Semester : VI

Course Coordinator : Prof. Ritesh Kumar Singh

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
1	1	2	Fundamental concepts of Jigs & Fixtures	T1	7
2		2&3	Principal of Jigs & Fixtures design and construction	T1	
3		4&5	Location in Jigs & Fixtures: Basic principals of location, location from various surfaces, Location methods and devices, chip control, redundant location and fool proofing.	T1	
4		6&7	Clamping in Jigs & Fixtures: Requirements of clamping systems, types of clamping systems	T1	
	II	8&9	Design of drilling jigs: Types of drill jigs, Jig bushes and their classification, elements of drill jigs, drill jig design.	T1	7
		10&11	Design of turning fixture: Design principles, elements of milling fixtures, balancing of turning fixtures, types of turning fixtures, turning fixture design.	T1	
		12&13	Design of Milling fixture: Design principles, elements of milling fixtures, types of milling fixtures, design of milling fixture.	T1	
		14	Design of indexing fixture: Classification and application of indexing, Indexing devices, types of indexing jigs & fixtures.	T1	
	III	15	Introduction; Die set construction, purpose and selection.	T1	5
		16,17,18	Types of die construction (Simple dies, compound dies, combination dies and progressive dies), their characteristics, and applications.	T1	
		19	Die life and die wear.	T1	

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
	IV	20-23	Design of Blanking and piercing dies: Shearing operations, Shearing action, punch and die clearance, cutting forces, clearance and punch force, reduction of cutting forces, stripping force, centre of pressure, scrap strip layout	T1&T2	7
		24	Design of die elements	T1&T2	
		25&26	Design of Drawing dies: Introduction, metal flow, calculation of number of draws, drawing forces, calculation of blank dimension, drawing radii and clearance, Design procedure for a drawing die	T1&T2	
	V	27&28 29 30 31	Single point cutting tool: <ul style="list-style-type: none"> • Tool nomenclature, tool signature • types of single point cutting tools • Shank design, • Cutting edge design, provision for chip control 	T1	7
		32 33	Design Form tools: <ul style="list-style-type: none"> • Introduction, and classification, Graphical method for design of flat form tools, • Design of circular form tools 	T1&T2	
	VI	34	Design of drill bit: <ul style="list-style-type: none"> • Types of drill bits, nomenclature of twist drills 	T1&T2	7
		35&36	<ul style="list-style-type: none"> • Design of cutting and mounting elements 		
		37&38	Design of milling cutters: <ul style="list-style-type: none"> • Elements of milling cutter, types of milling cutter 		
		39&40	<ul style="list-style-type: none"> • Design of milling cutters 		
	VII	41&42	Materials for cutting tools: Qualities of tool materials, selection of tool materials,.	T1&T2	5
		43&44	major cutting tool materials, Materials for cutting tools, cutting dies and forming dies		
		45	Economics of tooling:		

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of NPTEL materials and internets
CD9	Simulation

Mapping Between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes						
	CO1	CO2	CO3	CO4	CO5	CO6	CO7
CD1	√	√	√	√	√	√	√
CD2	√	√	√	√	√	√	√
CD3							
CD4							
CD5							
CD6							
CD7							
CD8	√	√	√	√	√	√	√
CD9							

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes						
	CO1	CO2	CO3	CO4	CO5	CO6	CO7
1	H	M					
2	M	H					
3			H	M			
4			M	H			
5					H		
6					H		
7	L	L	L	L	L	H	
8							H

DEPARTMENT OF PRODUCTION ENGINEERING
B.I.T. MESRA : RANCHI.

PE 6002 TOOL DESIGN SESSIONAL

Syllabus

Experiment No.

1. To study various location and clamping devices used/exist in the laboratory.
2. To study the various JIGS & FIXTURE existing/used in the laboratory.
3. To design and draw a particular JIG for a given component.
4. To design and draw a FIXTURE for a particular component.
5. To design and draw a combination / progressive die to produce a washer.
6. To design and draw a forming die to produce a particular part.
7. To design and draw the cutting and holding portions of a single point cutting tool.
8. To design a drill bit to machine a hole of given diameter in a plate of specific material ension.
9. To select and design a milling cutter.
10. Design a circular/flat form tool for machining a workpiece of dimension given in the figure.

Course Objective

This course enables the students to:

1. Develop understanding of various location and clamping arrangements in Jigs and Fixture.
2. Design Jigs and Fixtures for parts to be manufactured.
3. Design different types of dies i.e blanking piercing, forming, compound, combination and progressive for press operations.
4. Design different types of cutting tools like single point cutting tool, drills, milling cutter and form tools for machining of flat and circular surfaces.

Text books:

1. Production Engineering Design (Tool Design) by Surender Kumar, Umesh Chandra and S.C. Srivastava, Satya Prakashan.
2. Tool Design by C. Donaldson, G.H.Lecain, V.C.Goold, and Joyjeet Ghose, Tata McGraw Hill.

COURSE INFORMATION SHEET

Course code: PE 6004

Course title: AUTOMATION AND ROBOTICS LAB

Credits: 1.5 L:0 T:0 P: 3

Class schedule per week: 3

Course Objectives:

This course enables the students to:

1	Understand the various types of CAM Software's like Fanuc, Siemen's, etc. and their practical usage in manufacturing applications
2	Learn concepts of machining parameters and cutting tools for CNC milling and turning jobs and Develop industrial components by interpreting 3D part models/ part drawings
3	Gain the concepts of CAM Software, CNC technology, to convert a CNC-lathe into a CNC-Milling machine and vice-versa
4	Be acquainted with standard industrial robot, its sub-systems and prepare a demonstration of a simple programmed task
5	Give a hands-on experience in a rigging an industrial pneumatics and electro-pneumatics circuit and PLCs

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Apply the concepts of machining for selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.
CO2	Create and validate NC part program data using manual data input (MDI) for manufacturing of required component using CNC milling or turning applications through CAM Software's like Fanuc, Siemen's, Unimat etc.
CO3	Apply the concepts of CNC technology to convert a CNC-lathe into a CNC-Milling machine and vice-versa and also to carry out machining using programmed part programs.
CO4	Calibrate program a standard industrial robot and analyse the control behaviour of a robot controller
CO5	Create a typical pneumatic and electro-pneumatic circuit and program a PLC and create a simple demonstration.

SYLLABUS

LIST OF EXPERIMENT:

1. EXPERIMENT – 1:

Objective: To write a manual part program for step turning operation for a given drawing and simulate in FANUC/SIEMENS CNC lathe simulator.

2. EXPERIMENT – 2:

Objective: To write a manual part program for radius cutting and taper turning operation for a given drawing and simulate in FANUC/SIEMENS CNC lathe simulator.

3. EXPERIMENT – 3:

Objective: To write a program for grooving and threading operation for a given drawing. and simulate in FANUC/SIEMENS CNC lathe simulator.

4. EXPERIMENT – 4:

Objective: To Convert a modular CNC-mill machine into CNC-Lathe machine and write a program for step turning operation in CNC Lathe.

5. EXPERIMENT – 5:

Objective: To write a manual part program for taper turning operation for a given drawing in CNC Lathe

6. EXPERIMENT – 6:

Objective: To write a part program for profile milling operation using linear and circular interpolation cutting for a given drawing and simulate in FANUC/SIEMENS CNC milling

7. EXPERIMENT – 7:

Objective: To write a manual part program for circular and rectangular pocketing for a given drawing and simulate in FANUC/SIEMENS CNC milling simulator

8. EXPERIMENT – 8:

Objective: To write a manual part program for Profile cutting with sub-program and right compensation for given drawing and simulate in FANUC/SIEMENS CNC milling

9. EXPERIMENT – 9:

Objective: To study and learn how to operate CNC milling machine - FANUC/SIEMENS controller.

10. EXPERIMENT – 10:

Objective: To machine a part for a given drawing on a CNC milling machine.

11. EXPERIMENT – 11:

Objective: To study the functional details of robots; program and simulate the pick and place operation of a Robot

12. EXPERIMENT – 12:

Objective: To study the various types of sensors and PLC Programming

Text Books:

1. Mikell P. Grover “Automation, Production Systems and Computer-Integrated

- Manufacturing” Pearson Education, New Delhi. **(T1)**
- Rao, P.N. “CAD/CAM: Principles and Applications”, McGraw Hill Publication, 2nd Edition, 2004. **(T2)**
 - Mikell P. Grover, E. Zimmer, “Computer Aided Design and Manufacturing (CAD/CAM)”, Pearson Publication, 2nd Edition, 2006. **(T3)**

Reference Books:

- David Bedworth, “Computer Integrated Design and Manufacturing” Tata McGraw Hill, New Delhi, 1998. **(R1)**
- Radhakrishan P., Subramaniam S., “CAD CAM and CIM”, New Age International, 2002 **(R2)**

Gaps in the syllabus (to meet Industry/Profession requirements):

Design of real-time Industrial projects.

POs met through Gaps in the Syllabus:

PO 5

Topics beyond syllabus/Advanced topics/Design:

Design optimization for industrial projects

POs met through Topics beyond syllabus/Advanced topics/Design:

POs 4,5, 11,12

Course Delivery Methods:

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	√

Course Evaluation:

Direct Assessment-

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Quiz 1	10
Viva-voce	20
End Semester Examination	% Distribution
Examination: Experiment Performance	30

Quiz 2	10				
Assessment Components	CO1	CO2	CO3	CO4	CO5
Day to day performance & Lab files	√	√	√	√	√
Quiz 1	√	√			
Quiz 2			√	√	√
Viva-voce	√	√	√	√	√
Examination: Experiment Performance	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping of Course Outcomes (Cos) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2		3					3			2	2	3
CO2	2	2		3					3			2	3	2
CO3	3	2		2					3			2	2	3
CO4	3	2		3					3			2	2	3

< 34% = 1, 34-66% = 2, > 66% = 3

Mapping Between Course Outcomes (Cos) and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD3
CO2	CD1, CD3, CD7
CO3	CD1, CD3, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD6, CD7

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COURSE INFORMATION SHEET

COURSE CODE:	<i>PE 6005 (Theory)</i>		
COURSE TITLE:	<i>PRODUCTION PLANNING AND CONTROL</i>		
PRE-REQUISITE(S):	<i>Knowledge of manufacturing processes.</i>		
CREDITS:	L		C
	3		3
CLASS SCHEDULE PER WEEK:	<ul style="list-style-type: none"> • Lectures- 3 		

COURSE OBJECTIVES : *It expected to teach following concepts to the students*

- A. To introduce to various inherent concepts of production systems, planning systems and control systems of Manufacturing Industry.*
- B. Types of forecasting models.*
- C. Identify different strategies employed in manufacturing industries to plan production and inventory control.*
- D. Facility design.*
- E. Plant maintenance.*

COURSE OUTCOMES: *After completion of the course, the learners will be able to:*

- CO 1:** *To understand the functions of production, planning and control.*
- CO 2:** *Make forecasts in the manufacturing sectors using selected quantitative and qualitative techniques.*
- CO 3:** *Understand the importance and function of inventory and to be able to apply selected techniques for its control and management under dependent and independent demand circumstances.*
- CO 4:** *Solve routing and scheduling problems.*

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES

Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4
A	<i>H</i>	<i>M</i>	<i>M</i>	<i>L</i>
B	<i>L</i>	<i>H</i>	<i>L</i>	<i>L</i>
C	<i>L</i>	<i>L</i>	<i>H</i>	<i>L</i>
D	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>
E	<i>M</i>	<i>L</i>	<i>L</i>	<i>M</i>



PE 6005 PRODUCTION PLANNING & CONTROL (3 Credits)

Module 1

Introduction to Production Planning and Control

Production system, type of manufacturing systems and their characteristics, objectives and functions of production planning and control

Module 2

Preplanning

Demand forecasting, common techniques of demand forecasting, estimating factors of production, product mix and batch size decisions, aggregate planning

Module 3

Production Planning

Routing, Loading and scheduling with their different techniques, dispatching, Progress Report, Expediting and corrective measures

Module 4

Inventory Control

Field and scope of inventory control, inventory types and classification, Inventory control models, static model, dynamic model both deterministic and stochastic, Economic lot size, reorder point and their application,

Module 5

Materials management & purchasing

ABC analysis, VED analysis, modern practices in purchasing and store Keeping, concept of productivity

Module 6

Facility design

facility design process, facility design problems and their analysis, Factors affecting the location and site selection, techno economic analysis, multi-plant location, Concept of location theory and models.

Module 7

Plant maintenance

Importance of maintenance in plant, types of maintenance, inspection decisions, economics of maintenance, evaluation of maintenance policy, terotechnology .

Text Books:

- | | |
|---------------------------------------|--|
| 1. Production & Operations management | Jay Heizer and Barry Render, Prentice Hall |
| 2. Production & Operations management | S N Chary, Mc. Graw Hill |

Reference Books:

- | | |
|---|-------------------------------|
| 1. Production and Inventory control | G.W. Plossel |
| 2. Industrial Engg. & Production Management | M. Mahajan, Dhanpat Rai & Co. |
| 3. Operation Research | Kanti Swarup |

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LECTURE PLAN: (PE 6005 PRODUCTION PLANNING & CONTROL)

Department offering the course: Production Engineering

Contact Hours: Theory class - 3 periods per week of 50min. each

MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
I	1.	Introduction to the subject, its industrial and research relevance, overview of the entire modules, evaluation method to be followed.	T1,T2 & R2	50 min
I	2.	Introduction to production systems.	T1,T2 & R2	50 min
I	3.	Classification / Types of Production / Manufacturing systems.	T1,T2 & R2	50 min
I	4.	Objectives and functions of production planning and control.	T1 & R2	50 min
I	5.	Generalized procedural model of PPC.	T1 & R2	50 min
II	6.	Overview of Demand forecasting.	T1,T2 & R2	50 min
II	7.	Common techniques of demand forecasting.	T1,T2 & R2	50 min
	8.	Related problem solving.	T1 & T2	50 min
II	9.	Estimating factors of production.	T2 & R2	50 min
II	10.	Product mix and batch size decisions.	T2 & R2	50 min
II	11.	Concept of Aggregate planning.	T1 & T2	50 min
II	12.	Related problem solving.	T1 & T2	50 min
III	13.	Overview of Routing, Loading and scheduling.	T1&T3	50 min
III	14.	Routing, Loading and scheduling with their different techniques.	T1,T2 & R2	50 min

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MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
III	15.	Related problem solving.	T1,T2 , R2 & R3	50 min
III	16.	Concept of Dispatching,	T2 & R2	50 min
III	17.	Progress Reporting	T2 & R2	50 min
III	18.	Expediting and corrective measures.	T2 & R2	50 min
IV	19.	Field and scope of inventory control.	T1,T2 & R1	50 min
IV	20.	Inventory types and classification.	T1,T2 & R1	50 min
IV	21.	Inventory control models (static model, deterministic)	T1,T2 & R1	50 min
IV	22.	Related problem solving.	T1,T2 & R1	50 min
IV	23.	Inventory control models (static model, stochastic)	T1,T2 & R1	50 min
IV	24.	Related problem solving.	T1,T2 & R1	50 min
IV	25.	Inventory control models (dynamic model ,deterministic)	T1,T2 & R1	50 min
IV	26.	Related problem solving.	T1,T2 & R1	50 min
IV	27.	Inventory control models (dynamic model ,stochastic)	T1 & R1	50 min
IV	28.	Related problem solving.	T1,T2 & R1	50 min
IV	29.	Economic lot size, reorder point and their application.	T1,T2 & R1	50 min
V	30.	Concept of ABC analysis	T1,T2 & R2	50 min
V	31.	Concept of VED analysis	T1,T2 & R2	50 min
V	32.	Modern practices in purchasing and store Keeping.	T2 & R2	50 min
V	33.	Concept of productivity	T2 & R2	50 min

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MODULE NO.	LECTURE NO	THEORY TOPIC(S) TO BE COVERED	PREFERRED BOOK(S)	TOTAL NO. OF CONTACT HRS.
V	34.	Related problem solving.	T1,T2 & R2	50 min
VI	35.	Facility design process.	T1,T2 & R2	50 min
VI	36.	Facility design problems and their analysis.	T1,T2 & R2	50 min
VI	37.	Factors affecting the location and site selection.	T2 & R2	50 min
VI	38.	Techno economic analysis.	T2 & R2	50 min
VI	39.	Multi-plant location.	T2 & R2	50 min
VI	40.	Concept of location theory and models.	T2 & R2	50 min
VII	41.	Importance of maintenance in plant.	T2 & R2	50 min
VII	42.	Types of maintenance.	T2 & R2	50 min
VII	43.	Inspection decisions, economics of maintenance.	T2 & R2	50 min
VII	44.	Evaluation of maintenance policy.	T2 & R2	50 min
VII	45.	Terotechnology	T2 & R2	50 min

COURSE DELIVERY METHODS

- *Lecture by use of boards/LCD projectors*
- *Tutorials/assignments*
- *Seminars*
- *Mini projects/projects*
- *Laboratory experiments*
- *Industrial/guest lectures*
- *Industrial visits/in-plant training*
- *Self- learning materials from internets*



Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	L	L	M	H		L				L
2	H	H		L	L	L	M			M
3	H	H	M	L	M					M
4	H	H	H	M		M				M

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION

PROCEDURE

ASSESSMENT

The University's policy on Assessment for Coursework Programs is based on the following five principles:

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.
3. Assessment must enable robust and fair judgements about student performance.
4. Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.
5. Assessment must maintain academic standards.

ASSESSMENT SUMMARY

Task Type	Assessment	Weighting	Learning Outcomes
Summative	Quiz 1	7%	<ul style="list-style-type: none"> • To know and be able to recall the main terminology, concepts, and techniques that applies some of the key issues of the design of Machine Tools.
Summative	Home assignment/ numerical problems on selected topics	8%	<ul style="list-style-type: none"> • Apply theoretical and practice skills in data analysis used for real problems through case studies. • Interact with other students to practice teamwork and communication skills.
Summative	Mid semester exam	25%	Apply a critical-thinking and problem-solving approach towards the principles of machine tool design

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Task Type	Assessment	Weighting	Learning Outcomes
Summative	Final exam	60%	Apply a critical-thinking and problem-solving approach towards the principles of machine tool design.

Assessment Detail

- All exams are closed-book.
- Further details on assignments will be given during the first day of class or subsequent completion of the module(s).
- You will be advised of the dates and times of tests during the first day of class or at least one weeks in advance of the date of the test.
- Alternative test dates for students who cannot be present on the date of the Quiz on medical and compassionate grounds can be requested through the Course Coordinator.

Submission of Assignments:

- i. You will be advised of the date, time and location for physical submission of all assignments during the first day of class or through official Notice from University.
- ii. Submission of Work for Assessment should be submitted in hardcopy with a completed copy of the assessment coversheet. This should be signed to indicate you have read the above university policy statement on plagiarism, collusion and related forms of cheating.
- iii. Extensions of deadlines for assessment tasks may be allowed for reasonable causes and medical grounds of the severity that would justify the case. Students are required to apply for an extension to the Course Co-ordinator before the assessment task is due.
- iv. Assessment tasks must be submitted by the stated deadlines. There will be a penalty for late submission of assessment tasks. The submitted work will be marked 'without prejudice' and 10% of the obtained mark will be deducted for each working day (or part of a day) that an assessment task is late, up to a maximum penalty of 50% of the mark attained.
- v. An examiner may elect not to accept any assessment task that a student wants to submit after that task has been marked and feedback provided to the rest of the class.

Grades for your performance in this course will be awarded in accordance with the University policies as notified time to time and displayed in University website.

Indirect Assessment of Course:

The course will also be indirectly assessed by the faculty using following methodologies:

- i. Grades
- ii. Course evaluations (during the semester and end-of-semester)
- iii. Concept questions, "muddy cards,"
- iv. Rubrics

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COURSE INFORMATION SHEET

COURSE CODE:	PE 6006 (Lab/ Course work)								
COURSE TITLE:	COMPUTER AIDED DESIGN								
PRE-REQUISITE(S):	<ul style="list-style-type: none"> • Knowledge of engineering drawing. • Awareness of mechanical design 								
CREDITS:	<table style="width: 100%; border: none;"> <tr> <td style="text-align: center;">L</td> <td style="text-align: center;">T</td> <td style="text-align: center;">P</td> <td style="text-align: center;">C</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">3</td> <td style="text-align: center;">2</td> </tr> </table>	L	T	P	C	0	0	3	2
L	T	P	C						
0	0	3	2						
CLASS SCHEDULE PER WEEK:	<ul style="list-style-type: none"> • Three class/ week 								

COURSE OBJECTIVES : The general objectives of the course are to enable the students to:

- A.** Use basic and advanced features of current CAD software like PRO-E / DELCAM / CATIA / UGNX.
- B.** Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings.
- C.** Improve visualization ability of machine components and assemblies before their actual fabrication through modeling, animation, shading, rendering, lighting and coloring,
- D.** Model complex shapes including freeform curves and surfaces.

COURSE OUTCOMES: After completion of the course, the students will be able to:

- CO 1:** Design a part or assembly of parts using Computer-Aided Design software.
- CO 2:** Use parametric modeling techniques to reflect engineering requirements.
- CO 3:** Apply top-down design principles to model a design.
- CO 4:** Make appropriate selection of CAD functionality to use as tools in the design process.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES

Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4
A	H	M	M	M
B	H	H	M	M
C			H	H
D			H	H



PE 6006 COMPUTER AIDED DESIGN (2 Credits)

- 1. EXERCISE-I**
Objective: Make the given drawing using grid and snap
- 2. EXERCISE-II**
Objective: To practice Padding, Pocketing, Revolving.
- 3. EXERCISE-III**
Objective: To draw Nut, Bolt and various types of Threads.
- 4. EXERCISE-IV**
Objective: To practice Chamfer, Fillet, Mirror, Offset.
- 5. EXERCISE-V**
Objective: To practice Hole, Pattern command.
- 6. EXERCISE-VI**
Objective: To practice Rib, Shell.
- 7. EXERCISE-VII**
Objective: To practice sweep command.
- 8. EXERCISE-VIII**
Objective: To practice blend command.
- 9. EXERCISE-IX**
Objective: To learn about datum plane and axis.
- 10. EXERCISE-X**
Objective: To Assemble Footstep Bearing.
- 11. EXERCISE-XI**
Objective: To assemble Plummer block.
- 12. EXERCISE-XII**
Objective: To assemble Bench Vice.

COURSE DELIVERY METHODS

- *By use of boards/LCD projectors.*
- *Tutorials/Assignments.*
- *Lab / Course work*



Mapping of lab experiments with Course Outcomes

Experiment	Course Outcomes			
	1	2	3	4
1	H	H		
2	H	H		
3	H	H		
4	H	H	M	M
5	H	H	M	M
6	H	H	M	M
7	H	H	H	M
8	H	H	H	M
9	H	H	H	H
10	H	H	H	H
11	H	H	H	H
12	H	H	H	H

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	H	H					M	M		H
2	H	H					M	M		H
3	H	H					H	H	L	H
4	H	H					H	H	L	H

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE
ASSESSMENT

The University's policy on Assessment for Coursework Programs is based on the following five principles:

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.
3. Assessment must enable robust and fair judgements about student performance.
4. Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.
5. Assessment must maintain academic standards.

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ASSESSMENT SUMMARY

1. Direct Assessment

Task Type	Assessment	Weighting	Learning Outcomes
Formative Assessment	Quiz 1	15%	To know and be able to recall the main terminology, concepts, and techniques that applies some of the key issues of the CAD software.
Summative	Lab Record	20%	Ability to disseminate knowledge.
Formative Assessment	Quiz 2	15%	Apply a critical-thinking and problem-solving approach towards the principles of computer aided design.
Formative Assessment	Attendance	10%	Punctuality, Dedication
Summative	Final exam (Viva)	15%	Apply a critical-thinking on aspect of computer aided design.
Summative	Final exam (fabrication)	25%	Knowledge of assembly a product as per given drawing.

Grades for your performance in this course will be awarded in accordance with the University policies as notified time to time and displayed in University website.

2. INDIRECT ASSESSMENT OF COURSE:

The course will also be indirectly assessed by the faculty using following methodologies:

- i. Faculty Feed back
- ii. Grades
- iii. Course evaluations (during the semester and end-of-semester)
- iv. Rubrics



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

Program Educational Objectives (PEO)

1. Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems
2. To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices
3. Enabling graduates to have command over various manufacturing processes and machine tools.
4. To develop an attitude for continuous learning and aspiration to excel in all endeavours.
5. Improving inter-personal skill, team spirit and employability while believing on the ethical values.

Program Outcomes (PO)

A graduate in Production Engineering shall

- a) Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems
- b) Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice
- c) Demonstrate command in manufacturing processes and related machine tools
- d) Understand the morphology of a production system and its management
- e) Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production
- f) Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience
- g) Development of various managerial skills like interpersonal, communication and documentation
- h) Development of innovative technical solutions for various challenges in society
- i) Be aware of financial, environmental and sustainability implications for each professional action
- j) Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE6007

Course title: Manufacturing Automation & Robotics

Pre-requisite(s): Basic machining processes

Credits:	L	T	P	C
	3	0	0	3

Class schedule per week: 3L

Course Objectives : This course enables the students:

1.	To recognize the meaning of automation, NC, CNC, DNC, and AC machining and their applications
2.	To develop skill in part programming and acquire knowledge about controllers, transfer lines, and feeding mechanism
3.	Apply concepts for the planning, design, analysis and implementation of flexible manufacturing systems.
4.	To study about robot and planning implementation and economic rationalization of robotized projects.

Course Outcomes : After completion of the course, the learners will be able to:

1.	Know the various aspects of automation in manufacturing.
2.	Recognize the fundamentals of NC, CNC, DNC, and adaptive control machining
3.	Capable of part programming and knowledge about various control systems, and transfer lines.
4.	Implement FMS concept in a manufacturing environment and product development through automation.
5.	Select and operate robots and how to plan effective implementation and application of robotic automation.

Syllabus

MODULE – I

Manufacturing automation, components and types of automation, automation scenario and factory configuration, role of mechatronics in factory automation.

MODULE – II

Basic ideas, classification and structure of NC systems, NC-coordinate system, Constructional features and feedback devices for CNC machine tools, part programming and related languages, DNC and adaptive control.

MODULE – III

Electric and servo control in machine tools, stepper motor, PLC, transfer mechanism, buffer storage and control functions for transfer devices, feeding mechanism definition and concept, flexible automation.

MODULE – IV

Computer integrated manufacturing, Flexible manufacturing systems: concept, need, structure & operation, objectives and benefits.

MODULE – V

Robot technology: basic elements, classification, physical configuration, basic robot motions, robot's specifications, end effector /grippers.

MODULE – VI

Robot applications: application characteristics and areas such as material handling, welding, assembly, inspection, processing operation, spray painting etc

MODULE – VII

Planning and implementation of robotized and FMS projects

Text Books:

- | | |
|---|------------------|
| 1. Automation, Production System, and CIM | M.P. Groover |
| 2. CNC Machines | P. Radhakrishnan |
| 3. Robot Technology | M.P. Groover |
| 4. System approach to Computer Integrated Design and Manufacturing: Nanua Singh | |

References Books:

- | | |
|---|------------------------------|
| 1. Numerical Control of Machine Tools | Y. Koren |
| 2. Technology of CAD/CAM | A.K. Jha and S. Kumar |
| 3. Manufacturing Technology II | P.N. Rao |
| 4. Performance Modeling of Automated Manufacturing System | : N. Viswannadham& Y Narhari |
| 5. Industrial Robots and CIM | Surender Kumar |
| 6. Robotics for Engineers | YoramKoren ,McGraw Hill ,USA |
| 7. Robot Technology Fundamentals | James G. Keramas |

LECTURE PLAN

Department : Production Engineering

Course: PE6007 Manufacturing Automation & Robotics

Academic Year:2016 – 17

Class :BE

Semester :VI

Course Coordinator :Dr.Vijay Pandey & Dr. Rajeev Agrawal

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
1.	I	1	Manufacturing automation, components and types of automation		1
2.		2	Reasons, advantages, disadvantages		1
3.		3	Levels of automation, various examples of automation		1
4.		4	Automation scenario and factory configuration		1
5.		5	Role of mechatronics in factory automation.		1
9.	II	6	Basic ideas, classification and structure of NC systems, NC-coordinate system		1
10.		7	Constructional features and feedback devices for CNC machine tools		1
11.		8	DNC and adaptive control		1
12.		9	Computer assisted part programming: APT		1
13.		10	APT statements		1
14.		11	Part programming exercise		1
15.		12	Manual part programming: G & M codes		1
16.		13	Part programming exercise		2
17.		14	Part programming exercise		
18.	III	15	Electric and servo control in machine tools		5
19.		16	Stepper motor, PLC		
20.		17	Automated flow lines and transfer mechanisms		
21.		18	Buffer storage and control functions for transfer devices		
22.		19	Feeding mechanism		
24.	IV	20	Introduction to Manufacturing Systems: Input-Output Model, Plant Configurations		1
25.		21	Key characteristics of various manufacturing system		1
26.		22	Performance measures :Manufacturing Lead Time, Flexibility, Performability, Quality etc.		1
27.		23	Discuss the principle of various advanced		1

			manufacturing technologies which include GT, FMS and CIM, Architecture and case study of CIM		
28.		24	Flexibility Performance Measures, FMS Planning and implementation issues		1
29.		26	Quantitative analysis's of FMS, Operational problems of FMS, Layout consideration,		1
32.	V	27,28	Robot Anatomy and related attributes,		2
33.		29	Robot control system, Robot Drives and Actuators		1
34.		30	Factors in the selection and design of Grippers		1
35.		31	Robot programming		1
36.	VI	32,33	Industrial robot applications, Factors related to use Robot Performance		2
37.		33	Engineering analysis of Industrial robots		1
38.		34,35	Robot selection		2
39.	VII	36,37	Planning & Implementation of Robotized Projects and FMS		2
40.		38,39	Economic Justification Of Robots and FMS		2
		40	Future Application and Challenges and Case Studies		1

Topics beyond syllabus/Advanced topics: Factory of future & Industrial cases

POs met through Topics beyond syllabus/Advanced topics: a, f, h, j

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets

Mapping Between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
CD1	√	√	√	√	√
CD2			√		
CD3		√	√	√	√
CD4				√	√
CD5	√	√		√	√
CD6				√	√

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
1	H	H	L	L	L
2	M	M	H	L	-
3				H	M
4				M	H

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	a	b	c	d	e	f	g	h	i	j
1	H	H	L	L	-	-	-	M	-	L
2	M	H	H	M	-	L	-	-	-	M
3	H	H	M	-	M	L	-	M	-	M
4	H	H	L	H	M	-	-	M	M	H
5	H	H	L	L	-	-	L	L	H	M



Department of Production Engineering

Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

Program Educational Objectives (PEO)

- PEO 1: Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems
- PEO 2: To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices
- PEO 3: Enabling graduates to have command over various manufacturing processes and machine tools
- PEO 4: To develop an attitude for continuous learning and aspiration to excel in all endeavors.
- PEO 5: Improving inter-personal skill, team spirit and employability while believing on the ethical values.

Program Outcomes (PO)

A graduate in Production Engineering shall

- PO 1: Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems.
- PO 2: Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice.
- PO 3: Demonstrate command in manufacturing processes and related machine tools
- PO 4: Understand the morphology of a production system and its management.
- PO 5: Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production.
- PO 6: Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience.
- PO 7: Development of various managerial skills like interpersonal, communication and documentation

PO 8: Development of innovative technical solutions for various challenges in society recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

PO 9: Be aware of financial, environmental and sustainability implications for each professional action.

PO 10: Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE 6009

Course title: ENGINEERING ECONOMY

Pre-requisite(s): Knowledge of basic principles of power system and its analysis

Credits:	L	T	P	C
	3	0	0	3

Class schedule per week: 3 lectures

Course Objectives : This course enables the students:

1.	To know the fundamentals of Accounting and the reports required at the end of financial period
2.	To explain how to determine selling price of a product manufactured in a factory
3.	To explain use of breakeven analysis as a tool for decision making in a business
4.	To assess the best feasible investment proposal among the alternatives based on the common index
5.	To know the methods of calculating depreciation and reflecting them in financial reports at the end of accounting years

Course Outcomes : After completion of the course, the learners will be able to:

1.	Explain about accounting system and how to make balance sheet of organization
2.	Calculate cost and its element and correlate with company break even.
3.	Identify and analyze the value of money with respect to time and solve different problem of different methods.
4.	Solve the problem of different alternatives method for analyzing of project cost and time, study about replacement method and its solution.
5.	Evaluate and formulate depreciation and its element and to take decision under different Uncertainty.

Syllabus:

Module 1

Accounting of Business Transactions

Accounting principles, journal and ledger entries, balance sheet, profit and loss statement, ratio analysis

Module 2

Cost and Cost Analysis

Cost structure, methods of allocating overhead costs, standard cost, concept of opportunity cost, sunk cost, fixed cost and variable cost

Module 3

Break Even Analysis

Drawing of break even charts, effect of different variable on breakeven point, cost comparison of two or three alternatives

Module 4

Time Value of Money

Single sum and series of cash flow, uniform and gradient series, multiple compounding periods in a year, continuous compounding, bonds

Module 5

Comparison of Alternative Proposals

Bases of comparison- present worth amount, annual equivalent amount, future worth amount, rate return, defining mutually exclusive alternatives, decision criteria for selection of investment proposals, comparison of alternatives, with unequal service life, sensitivity analysis

Module 6

Replacement Analysis

Reasons for replacement, evaluation of replacement involving excessive maintenance cost, decline in efficiency inadequacy and obsolescence

Module 7

Depreciation and Decision Making Under Uncertainty

Methods of depreciation and their comparison, decision making on the basis of expected value decision tree in the evaluation of alternatives

Text Books:

- | | |
|-------------------------------|-------------------|
| 1. Modern Accountancy | I.M. Pandey (T1) |
| 2. Engineering Economy | E.P. Degarmo (T2) |

Reference Books:

- | | |
|------------------------|------------------|
| 1. Engineering Economy | S.J. Thusen (R1) |
| 2. Engineering Economy | Smita Sinha (R3) |

LECTURE PLAN

Department : Production Engineering

Course: PE-6009 Engineering Economy

Academic Year : 2016 – 17

Class : BE

Semester : VI

Course Coordinator : Mr. Binay Kumar

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
1	---	1	Pre-requisites and Objectives cum Outcomes of the Course, Course Linkages with other Courses	---	1
2	I	2	Use of accounting & aspects of accounting for different section of Engineering	T1	8
3		3	Introduction of Journal, Ledger and example to how to make both.	T1	
4		4	Introduction of Journal, Ledger and example to how to make both.	T1	
5		5	Making Trial balance sheet, loss and profit account	T1	
6		6	Trading account, Final account sheet	T1	
7		7	Different example of Final account	T1	
8		8	Accounting ratio analysis	T1	
9		II	9	Introduction of cost and its elements	
10	10		Cost structure and allocation of different cost	T1	
11	11		Example of different problem related to cost analysis	T1, R2	
13	III	13	Introduction of breakeven analysis and its application	T1, T2, R1	4
14		14	Break even analysis by manual method	T1, T2, R1	
15		15	Break even analysis by graphical method	T1, T2, R1	
16		16	Problem solving by both method	T1, T2, R1	
17	IV	17	Introduction of value of money with respect to time.	T2, R2	4
18		18	Evaluate different methods with respect to engineering aspects	T2, R2	

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
19		19,20	Solving problem related to time value of money	T1,R2	
20	V	21	Introduction of alternative proposal and its application	R1,R2	7
21		22	Present worth amount, annual equivalent amount, future worth amount,	R1,R2	
22		23	Rate of return, defining mutually exclusive alternatives	R1,R2	
23		24,25	decision criteria for selection of investment proposals, comparison of alternatives	R1,R2	
24		25,26	unequal service life, sensitivity analysis	R1,R2	
25		VI	29,30	Introduction of replacement analysis and reasons for replacement	
26	30, 31		evaluation of replacement involving excessive maintenance cost	R1,R2	
27	32,33		decline in efficiency inadequacy and obsolescence	R1,R2	
28	34		Numerical solution of replacement	R1,R2	
30	VII	35	Introduction of depreciation and application	R1,R2	6
31		36,37	Methods of depreciation and their comparison,	R1,R2	
32		38, 39	decision making on the basis of expected value	R1,R2	
33		40	decision tree in the evaluation of alternatives	R1,R2	

Gaps in the syllabus (to meet Industry/Profession requirements)

- 1.
- 2.

POs met through Gaps in the Syllabus: 3,6,7

Course Delivery Methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Industrial/guest lectures
CD5	Self- learning such as use of NPTEL materials and internets

Mapping Between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
CD1	H	H	H	H	H
CD2	H	H	H	H	H
CD3					H
CD4	H				H
CD5	H				

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
1	H	M			H
2	H	H	M		
3	H		H		
4				H	M
5				M	H

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	1	2	3	4	5	6	7	8	9	10
1	H	H			H		H	H	M	H
2	H	H			H					L
3	H	H		M	H		M	L		
4	H	H		M	H		M	L		
5	H	H		M	H		H	H		L

DEPARTMENT OF PRODUCTION ENGINEERING
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



COURSE INFORMATION SHEET

COURSE CODE:	PE 7002 (Laboratory)								
COURSE TITLE:	MODELLING AND SIMULATION LAB								
PRE-REQUISITE(S):	<ul style="list-style-type: none"> • Knowledge in random numbers • Basics of Discrete event simulation • Analytical ability 								
CREDITS:	<table style="width: 100%; border: none;"> <tr> <td style="text-align: center;">L</td> <td style="text-align: center;">T</td> <td style="text-align: center;">P</td> <td style="text-align: center;">C</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">3</td> <td style="text-align: center;">2</td> </tr> </table>	L	T	P	C	0	0	3	2
L	T	P	C						
0	0	3	2						
CLASS SCHEDULE PER WEEK:	• Laboratory (of Three class/ week/group)								

COURSE OBJECTIVES : It expected to give following hands-on-experience to the students

- A.** To impart skill to use simulation software
- B.** To develop the ability to build models before simulation.
- C.** To think of various practical applications of simulation in manufacturing
- D.** To manually solve small simulation problems using random numbers and probability distributions.
- E.** To minimize the system design and development time

COURSE OUTCOMES: After completion of the course, the learners will be able to:

- CO 1:** Understand the basics of Discrete event simulation.
- CO 2:** Can build soft models in computer program/ software for a given situation
- CO 3:** Will be able to develop a simulation table or program.
- CO 4:** Analyse the output from a simulation model
- CO 5:** Design the optimal system using simulation tool

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE OUTCOMES

Course Objectives	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
A	H		M	H	
B		H	H		
C					H
D		L	H		
E		M			H



PE7002 MODELLING AND SIMULATION LAB (2 Credits)

1. Introduction

- 1.1 Simulation and Modeling Concept
- 1.2 Simulation Software

2. Simulation Exercise (Manual)

- Ex. 1 Bank Operation
- Ex. 2 Robotic Work cell
- Ex. 3 Drill Press Operation
- Ex. 4 Grocery Shop

3. Simulation Exercise Using GPSS

- Ex. 1 A Food Store
- Ex. 2 A Self-Service Cafeteria
- Ex. 3 Ambulance Dispatch
- Ex. 4 Factory Maintenance
- Ex. 5 Ships Un/Loading Cargo at a Harbor
- Ex. 6 A Hospital's Emergency Room

4. Monte Carlo Simulation

Reference Books

- 1. Jerry Banks, Discrete event system simulation, Pearson new International Edition
- 2. Averil M. Law and David Kelton, Simulation modelling and analysis, McGraw Hill

DEPARTMENT OF PRODUCTION ENGINEERING

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LECTURE PLAN: **(PE7002_MODELING AND SIMULATION LAB)**

Department offering the course: Production Engineering

Target audience: Final Year Bachelor of Engineering (Production Engg.) Students

Contact Hours: Laboratory - 1 period of 150 min per week

EXPERIMENT NO	THEORY TOPIC(S) TO BE COVERED	TOTAL NO. OF CONTACT HRS.
1.	SIMULATION AND MODELING CONCEPT Objective: To explain the basics of modelling and simulation like discrete events, activities, queue and random numbers in simulation	150 min
2.	SIMULATION SOFTWARE Objective: To study the various simulation software and their features particularly useful in manufacturing and logistics	150min
3.	SIMULATION EXERCISE (MANUAL) Objective: To use random numbers in solving simulation problems	150 min
4.	EX. 1 BANK OPERATION Objective: Simulation of a BANK is to be performed using manual approach using probability distributions for arrival and service time	150min
5.	EX. 2 ROBOTIC WORK CELL Objective: Simulation of a ROBOTIC work cell is to be performed using manual approach using probability distributions for machine operation, loading unloading by robot	150 min
6.	EX. 3 DRILL PRESS OPERATION Objective: Simulation of a DRILL PRESS is to be performed using manual approach using probability distributions for operation	150min
7.	EX. 4 GROCERY SHOP Objective: Simulation of a grocery shop is to be performed using manual approach using probability distributions for arrival and service for customers	150 min
8.	SIMULATION EXERCISE USING GPSS Objective: To learn the software GPSS and its features for simulation	150min
9.	EX. 1 A FOOD STORE Objective: Simulation of a food store is to be performed using GPSS software and analyse the output	150 min
10.	EX. 2 A SELF-SERVICE CAFETERIA Objective: Simulation of a self-service cafeteria is to be performed using GPSS software and analyse the output	150min
11.	EX. 3 AMBULANCE DISPATCH Objective: Simulation of an ambulance dispatch service is to be performed using GPSS software and analyse the output	150 min
12.	EX. 4 FACTORY MAINTENANCE Objective: Simulation of a factory maintenance service is to be performed using GPSS software and analyse the output	150min

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EXPERIMENT NO	THEORY TOPIC(S) TO BE COVERED	TOTAL NO. OF CONTACT HRS.
13.	EX. 5 SHIPS UN/LOADING CARGO AT A HARBOR Objective: Simulation of loading and unloading of ships in a harbour is to be performed using GPSS software and analyse the output	
14.	EX. 6 A HOSPITAL'S EMERGENCY ROOM Objective: Simulation of the emergency room of a hospital is to be performed using GPSS software and analyse the output	

COURSE DELIVERY METHODS

- *Short lectures and hand on training on simulation software*

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	H		L		M			H		L
2	H	H	H	H		H			M	
3		H		H	L	H	L	M	M	M
4	H	H	H	M			L			
5	H				H	M		L		H

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION

PROCEDURE

ASSESSMENT

The University's policy on Assessment for Coursework Programs is based on the following five principles:

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.
3. Assessment must enable robust and fair judgements about student performance.
4. Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.
5. Assessment must maintain academic standards.

ASSESSMENT SUMMARY

1. Direct Assessment

Task Type	Assessment	Weighting	Learning Outcomes
Formative Assessment	Progressive Viva 1	15%	To assess the progress in understanding of various modelling and simulation concepts
Summative	Lab Record	20%	Ability to disseminate knowledge in writing

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BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI - 835215 (INDIA)



Task Type	Assessment	Weighting	Learning Outcomes
Formative Assessment	Progressive Viva 2	15%	To assess the progress in understanding of various applications of software in modelling and simulation
Formative Assessment	Attendance	10%	Sincerity towards duty and punctuality
Summative	Final exam (Viva)	20%	Assessment critical-thinking ability on modelling and simulation subject
Summative	Final exam (Performance)	20%	Application of programming and simulation model development

Grades awarded in accordance with the University policies as notified time to time and displayed in University website.

2. INDIRECT ASSESSMENT OF COURSE:

The course will also be indirectly assessed by the faculty using following methodologies:

- i. Faculty Feed back
- ii. Grades
- iii. Course evaluations (during the semester and end-of-semester)
- iv. Rubrics

COURSE INFORMATION SHEET

Course code: PE 6003

Course title: Material Deformation Processes

Pre-requisite(s): Metallurgy, Manufacturing Processes fundamentals, Strength of materials.

Credits:

L	T	P	C
3	0	0	3

Class schedule per week: 3 lectures

Course Objectives : This course enables the students:

1.	To impart knowledge about mechanical properties of materials and analyse various types of metal forming processes
2.	To conceptualize theory of elasticity and plasticity, friction, lubrication
3.	To study the methods of analyzing plane-strain and axi-symmetric deformation processes
4.	To acquaint with modern/un-conventional deformation processes

Course Outcomes : After completion of the course, the learners will be able to:

1.	Understand the principles of various material deformation processes
2.	Learn the importance of various mechanical and metallurgical factors, those control forming processes
3.	Analyze the forming processes mathematically, in terms of their operating parameters and outputs
4.	Familiarize about recent trends and techniques adopted in the field of material deformation processes.

Syllabus:

Module 1

Basic deformation processes

Basic concepts of hot and cold working processes and forming operations.

Module 2

Theory of Plasticity

State of stress at a point, equilibrium equations, stress tensor, spherical tensor and deviator stress tensor, principal stress, deformation tensor

Engineering and true stress –strain, flow curve, idealized stress-strain model, plastic deformation equations, levy–mises equations, prandtl–reuss equations, strain hardening, strain rate and bauschinger effects

Module 3

Flow Rule and Yield Criterion

Velocity field and strain rate, compatibility equation, von – mises and tresca yield criterion, biaxial and triaxial yield surfaces, experimental verification of yield criterion, lode–stress parameter

Module 4

Friction and Lubrication

Interfacial friction laws–Coulombs friction law, constant shear factor law, composite friction law and hydrodynamic friction law, friction mechanism during plastic deformation, lubrication mechanisms– boundary, hydrodynamic and solid lubrication, metal working lubricants–types and characteristics

Module 5

Plain Strain Deformation Processes

Basic concepts of slip-line method, slab method (equilibrium technique) and energy method (upper bound technique), analysis of following deformation processes

Forging of strip: pressure distribution and forging load

Rolling of strip: pressure distribution, roll–separating force and driving torque

Module 6

Axi-Symmetric Deformation Processes

Analysis of following deformation processes:-

Forging of disc: pressure distribution and forging load

Extrusion of cylindrical rod: extrusion load and frictional power loss

Drawing of cylindrical wire: drawing load and maximum allowable reduction

Module 7

Emerging Deformation Processes

Isothermal forging, water hammer forging, liquid metal forging (squeeze casting), continuous extrusion (conform extrusion), hydro–static extrusion, hydro–dynamic wire drawing, spray forming, explosive forming

Textbooks:

1. **Principle of Industrial Metal Working**

G.W. Rowe, Edward Arnold , London

2. **Principles of Metal Working**

S. Kumar, IBH & Co., New Delhi

References

1. **Engineering Plasticity**

R.A. C. Slater, Macmilan, USA

2. **Metal Working Processes and Analysis**

B. Avitzur, McGraw Hill, USA



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

Program Educational Objectives (PEO)

PEO 1: Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems

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PEO 3: Enabling graduates to have command over various manufacturing processes and machine tools

PEO 4: To develop an attitude for continuous learning and aspiration to excel in all endeavors.

PEO 5: Improving inter-personal skill, team spirit and employability while believing on the ethical values.

Program Outcomes (PO)

A graduate in Production Engineering shall

PO 1: Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems

PO 2: Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice

PO 3: Demonstrate command in manufacturing processes and related machine tools

PO 4: Understand the morphology of a production system and its management

PO 5: Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production

PO 6: Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience

PO 7: Development of various managerial skills like interpersonal, communication and documentation

PO 8:-Development of innovative technical solutions for various challenges in society

PO 9: Be aware of financial, environmental and sustainability implications for each professional action

PO 10: Develop the right attitude for continuous learning and knowledge of latest developments

COURSE INFORMATION SHEET

Course code: PE 7004

Course title: Material Deformation Processes Lab

Pre-requisite(s): Metallurgy, Manufacturing Processes fundamentals, Strength of materials.

Credits:

L	T	P	C
0	0	3	2

Class schedule per week: 3 periods/week

Course Objectives : This course enables the students:

1.	To impart knowledge about mechanical properties of materials
2.	To analyse various types of metal forming processes
3.	To conceptualize theory of elasticity and plasticity, friction, lubrication
4.	To perform comparative analysis among different materials

Course outcomes : After the completion of this course, students will able to:

1.	Explain about mechanical properties of materials
2.	Analyse various types of metal forming processes, particularly, forging process
3.	Evaluate various properties like hardness, stress, strain etc.
4.	To perform comparative analysis among different materials

List of Experiments

Experiment No. 1

Objective: To study the working principle of forging hammer (pneumatic type).

Experiment No. 2

Objective: To study the working principle of forging presses (mechanical and hydraulic types).

Experiment No. 3

Objective: To study the % reduction, hardness and stress distribution of mild steel specimens forged under cold conditions at different strokes given by pneumatic hammer and their microstructures before and after forging.

Experiment No. 4

Objective: To study the % reduction, hardness and stress distribution of mild steel specimens forged under hot conditions at constant temperature (constant blowing period) at different strokes given by pneumatic hammer and their microstructures before and after forging.

Experiment No. 5

Objective: To study the % reduction, hardness and stress distribution of mild steel specimens forged under hot conditions at varying temperature (varying blowing period) at constant strokes given by pneumatic hammer and their microstructures before and after forging.

Experiment No. 6

Objective: To study the % reduction, hardness and stress distribution of mild steel specimens forged under cold and static conditions for varying forging loads and constant forging time and their microstructures before and after forging.

Experiment No. 7

Objective: To study the % reduction, hardness and stress distribution of mild steel specimens forged under cold and static conditions at varying forging time and constant forging load and their microstructures before and after forging.

Experiment No. 8

Objective: To study the % reduction, hardness and stress distribution of copper, aluminum and mild steel specimens at room temperature and compare their formability characteristics at varying loads and their microstructures before and after forging.



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

Program Educational Objectives (PEO)

1. Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems
2. To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices
3. Enabling graduates to have command over various manufacturing processes and machine tools
4. To develop an attitude for continuous learning and aspiration to excel in all endeavours.
5. Improving inter-personal skill, team spirit and employability while believing on the ethical values.

Program Outcomes (PO)

- a. Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems.
- b. Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice.
- c. Demonstrate command in manufacturing processes and related machine tools
- d. Understand the morphology of a production system and its management.
- e. Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production.
- f. Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience.
- g. Development of various managerial skills like interpersonal, communication and documentation
- h. Development of innovative technical solutions for various challenges in society. Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.
- i. Be aware of financial, environmental and sustainability implications for each professional action.
- j. Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE 7005

Course title: Competitive Manufacturing Strategies

Pre-requisite(s): Nil

Credits: L T P C
 3 0 0 3

Class schedule per week: 3 lectures

Course Objectives:

1.	To understand the concept manufacturing as strategy, WTO and competitive advantages
2.	Students must learn about the product verity, manufacturability, vendor development and vendor rating.
3.	Students must understand the process of JIT manufacturing
4.	The concept of TQM, reengineering and MRP must be explained to the students
5.	The effectiveness ERP, simulation and intelligent manufacturing as tool of competitive manufacturing
6.	To learn about the various types of Manufacturing systems i.e. Dedicated manufacturing system, Flexible manufacturing system (FMS), cellular manufacturing system (CMS), and Re-configurable manufacturing system (RMS)
7.	To learn about the concepts of CIM, FOF, Network based manufacturing, and E-Manufacturing.

Course Outcomes: After completion of the course, the learners will be able to:

1.	Understand the concept of product verity and manufacturing and related functions as competitive strategy
2.	comprehend JIT and MRP based systems
3.	Select proper manufacturing system for a given product and market scenario.
4.	Understand latest advancements in manufacturing like intelligent manufacturing, CIM, network based manufacturing and e-manufacturing and the role of ERP and simulation in manufacturing.

Syllabus

Module-I

The competitive environment in the market, The WTO agreement and its effect on Indian Industries, Manufacturing as a competitive strategy, Competitive Advantages and Disadvantages

Module-II

Product Variety, Modular Design, Design for manufacturability, Selection of manufacturing technologies, Vendor Development, Vendor rating.

Module-III

Just in time manufacturing, Kanban system, and Agile Manufacturing

Module-IV

Reengineering, TQM, MRP

Module-V

ERP, and simulation as tools for competitive manufacturing, Intelligent Manufacturing

Module-VI

Selection of manufacturing systems for different manufacturing scenarios - Dedicated manufacturing system, Flexible manufacturing system (FMS), cellular manufacturing system (CMS), and Re-configurable manufacturing system (RMS); Elementary of DMS, FMS, CMS, and RMS.

Module-VII

Concept of CIM, FOF, Network based manufacturing, and E-Manufacturing

Books Recommended:

- Manufacturing Excellence in Global Markets W. Euershelm
- Manufacturing Systems Design & Analysis B. Wa.
- Computer Automation in Manufacturing T.O.Boucher
- Intelligent Manufacturing Planning P. Gu.

7th Semester

PE 7006 PROJECT (4 Credits)

COs:

CO1	Students will able to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO2	Students will acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience.
CO3	Students will able to collaborate through working in a team to achieve common goals.
CO4	Students will able to learn on their own, reflect on their learning and take appropriate action to improve it.
CO5	Students will able to prepare a technical report in the form of a thesis and effectively communicate using multimedia tools through oral presentation

Project work:

Students are assigned to work in project groups, with each project group having 3 to 4 members. The project groups are to work on a task that is designed to be broad enough to allow candidates to display their various skills and abilities. The groups are expected to complete the task within stipulated time, where they will define the project focus, analyse and evaluate the information gathered, prepare an oral presentation, and submit a written report. Department Committee shall be appointed by the Head of the Department for the evaluation of the project work.

ADVANCED MANUFACTURING PROCESSES (PE- 7011)

Course Objectives:

This course enables the students:

A.	To understand the concepts of advanced casting processes like Squeeze casting; Rheo-casting; Thixo-casting;
B.	To identify suitable hybrid welding processes for joining dissimilar materials.
C.	To understand the latest forming Techniques like Super plastic forming, Thixoforming, etc.
D.	To understand the principles of powder metallurgy processes and their applications.
E.	To understand the Processing methods of Plastics.

SYLLABUS

Module 1

ADVANCES IN CASTING

Newer casting processes - plaster mold and ceramic mold casting – vacuum casting – Evaporative pattern casting, ceramic shell investment casting, slush casting, squeeze casting and semisolid metal forming-Rapid solidification for Amorphous alloys.

Module 2

ADVANCED WELDING

Cold welding, diffusion welding, forge welding, friction welding, explosive welding,, hard vacuum welding, soft vacuum welding, Underwater Welding Processes, Concept of robotized welding and welding automation

Module 3

ADVANCED FORMING:

HERF techniques, Super plastic forming techniques, Orbital forging, Ring Rolling, Incremental forming, Isothermal forging, Hot and cold iso-static pressing, High speed extrusion, Rubber pad forming, Water, hammer forming, Explosive forming,

Module 4

POWDER METALLURGY PROCESSES

Methods of Powder production – Blending of metal powders- Compaction of metal powders- Sintering – hot pressing –Isostatic pressing – hot and cold (HIPing and CIPing), selective laser Sintering – Other shaping processes – Metal Injection moulding, pressureless compaction, ceramic moulds – spray deposition - Finishing of sintered parts.

Module 5

MANUFACTURING PROCESSES FOR PLASTICS

Extrusion, Injection, Blow and rotational moulding of plastics-Thermoforming-Compression moulding – Transfer moulding – Foam moulding - Processing of reinforced plastics and composite –Moulding – compression, vacuum bag – contact – resin transfer – transfer / injection. Filament winding.

Module 6

MANUFACTURING PROCESSES FOR MEMS

Introduction to MEMS – semiconductors and silicon – crystal growing and wafer preparation – Films and film deposition – Oxidation- Lithography- diffusion and Ion implementation – Etching - wet etching – dry etching – wire bonding and packaging – printed circuit boards .

Module 7

Micro machining- LIGA micro fabrication process – Solid free form fabrication.



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

Program Educational Objectives (PEO)

1. Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems
2. To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices
3. Enabling graduates to have command over various manufacturing processes and machine tools
4. To develop an attitude for continuous learning and aspiration to excel in all endeavours.
5. Improving inter-personal skill, team spirit and employability while believing on the ethical values.

Program Outcomes (PO)

- a. Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems.
- b. Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice.
- c. Demonstrate command in manufacturing processes and related machine tools
- d. Understand the morphology of a production system and its management.
- e. Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production.
- f. Demonstrate expertise in various manufacturing processes owing to sufficient practical hands-on-experience.
- g. Development of various managerial skills like interpersonal, communication and documentation
- h. Development of innovative technical solutions for various challenges in society. Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.
- i. Be aware of financial, environmental and sustainability implications for each professional action.
- j. Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE 6015

Course title: Value Engineering

Pre-requisite(s): Basic knowledge of forming & machining operations

Credits: L T P C
 3 0 0 3

Class schedule per week: 3 lectures

Course Objectives:

1.	To understand the concept of Value Engineering
2.	Students must learn about the need analysis and the processes of generating creative ideas.
3.	Students must understand the process of design.
4.	The process of value engineering and its tools and techniques must be explained to the students.
5.	The effectiveness of value engineering and acceptance problem associated with VE must be explained to the students.
6.	To learn about the economic aspects of product and build up of cost in product.
7.	To learn about the application of VE in product design and manufacturing and other supporting activities of manufacturing.

Course Outcomes: After completion of the course, the learners will be able to:

1.	Understand the concepts of value engineering
2.	Performing need analysis and use structured methods of generation of new creative ideas for product design.
3.	Apply the various tools, techniques and processes of value engineering on different product/processes.
4.	Perform value analysis/Engineering of product process or system.

Syllabus:

Module-I

Concept and evolution of VE, value cost and quality, types of values, value ratio, value assessment, value engineering, value analysis and cost reduction, unnecessary costs and its reasons and elimination, Product life cycle.

Module-II

Analysis of needs and generation of Ideas, need analysis, need and customer satisfaction, ideas and ideonomies. Creative thinking and brain storming, requirements and phases of creativity.

Module-III

Design requirements and design process, Task analysis, Principles of modern design, concept of concurrent engineering, preparation of specifications, Design for manufacturability.

Module-IV

Methodologies and techniques of VE/VA, phases of VA/VE programmes, Function cost worth analysis, FAST, factor comparison method, decision and confidence level matrix, DARSIRI method..

Module-V

Value engineering and decision making, acceptance problems and its social influences, effectiveness of VE.

Module-VI

Build up of product cost, cost reduction and cost control, applications of group technology in value engineering projects/programmes, Value engineering and standardization.

Module-VII

Applications and case studies in industrial and Business operations – engineering, design, and materials Management.

TEXT BOOKS:

1. Value Engineering – S.S. Iyer
2. Value Engineering and value Analysis by L. D. Miles.
3. Kumar S. and Agrawal A., “Value Engineering & Cost Control”, Dhanpat Rai & Co., New Delhi
4. Economic Product Design – Herm Buck & Butler,.

LECTURE PLAN

Department : Production Engineering

Course: PE 60015: Value Engineering

Academic Year : 2016 – 17

Class : BE

Semester : VII

Course Coordinator : Prof. Ritesh Kumar Singh

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
1	I	1	Concept & evolution of Value Engineering	T1& T2	9
2		2	Concept of value& types of values	T1& T2	
3		3	Function, defining function, identification of level of function	T1& T2	
4		4	Value ratio, Determining value and factors to be considered,	T1& T2	
5		5&6	value analysis and cost reduction, unnecessary costs and its reasons and elimination,	T1& T2	
6		7	Value Analysis Procedure, principals of value engineering	T3	
7		8	Relation between value, cost and quality, Product life cycle.	T3	
8		9	Application & benefits of value engineering	T3	
9	II	10	Identification and analysis of needs, steps in needs analysis,	T3	7
10		11	Preliminary need analysis, need and customer satisfaction	T3	
11		12	Problem definition and need analysis: case study	T3	
12		13	Ideas and ideonomies, Generation of Ideas, elements of ideonomies	T3	
13		14	Ideation	T3	
14		15	Creative thinking and brain storming,	T3	
15		16	requirements and phases of creativity.	T3	
16	III	17	Design requirements and design process	T3	6
17		18	Morphology of design	T3	

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
18		19	Task analysis	T3	
19		20	Principles of modern design, concept of concurrent engineering	T3	
20		21	preparation of specifications	T3	
21		22	Design for manufacturability.	T3	
22	IV	23-26	Methodologies and techniques of VE/VA, phases of VA/VE programmes,	T1,T2&T3	9
23		27	Function cost worth analysis,	T1,T2&T3	
24		28	FAST	T1,T2&T3	
25		29	factor comparison method	T1,T2&T3	
26		30	decision and confidence level matrix	T1,T2&T3	
27		31	DARSIRI method	T1,T2&T3	
28	V	32	Value engineering and decision making,	T1&T3	5
29		33&34	acceptance problems and its social influences, Case study	T3	
30		35&36	effectiveness of VE.	T3	
31	VI	37	Build up of product cost	T3&T4	5
32		38	cost reduction and cost control	T3&T4	
33		39-40	applications of group technology in value engineering projects/programmes,	T4	
34		41	Value engineering and standardization.	T4	
35	VII	42-45	Applications and case studies in industrial and Business operations – engineering, design, and materials Management.	T1,T2& T3	4

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of NPTEL materials and internets
CD9	Simulation

Mapping Between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes			
	CO1	CO2	CO3	CO4
CD1	√	√	√	√
CD2	√	√	√	√
CD3				
CD4				
CD5				
CD6				
CD7				
CD8	√	√	√	√
CD9				

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes			
	CO1	CO2	CO3	CO4
1	H			M
2		H	L	
3		H	L	
4	M		H	H
5	L		M	M
6	L		M	M
7	L	L	L	H

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	a	b	c	d	e	f	g	h	i	J
1	L	M			M			L	L	
2	L	M			M			M		L
3	H	M			H		L	H	H	M
4	H	M		L	M			L	L	

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Seml Examination Marks	60
Assignment	15

Assessment Components	CO1	CO2	CO3	CO4
Mid Sem Examination Marks	50%	50%		
End Sem Examination Marks	30%	30%	30%	10%
Assignment	100%	100%	100%	100%



Department of Production Engineering Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

Program Educational Objectives (PEO)

PEO 1: Developing capability to comprehend the fundamentals of Production and Industrial Engineering for application to engineering problems

PEO 2: To produce skilled and competent graduates capable of facing the challenges of real life and engineering practices

PEO 3: Enabling graduates to have command over various manufacturing processes and machine tools

PEO 4: To develop an attitude for continuous learning and aspiration to excel in all endeavours.

PEO 5: Improving inter-personal skill, team spirit and employability while believing on the ethical values

Program Outcomes (PO)

- a) A graduate in Production Engineering shall
- b) **PO 1:** Apply engineering and technological knowledge to solve a wide range of Production and Industrial engineering problems.
- c) **PO 2:** Develop the ability and expertise in the students to apply latest tools and techniques for complex problem solving and engineering practice.
- d) **PO 3:** Demonstrate command in manufacturing processes and related machine tools
- e) **PO 4:** Understand the morphology of a production system and its management.
- f) **PO 5:** Capable of implementing various industrial engineering tools to enhance productivity and quality while controlling the production.
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- h) **PO 7:** Development of various managerial skills like interpersonal, communication and documentation
- i) **PO 8:** Development of innovative technical solutions for various challenges in society. Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.
- j) **PO 9:** Be aware of financial, environmental and sustainability implications for each professional action.
- k) **PO 10:** Develop the right attitude for continuous learning and knowledge of latest developments.

COURSE INFORMATION SHEET

Course code: PE7019

Course title: Advanced Operation Research

Pre-requisite(s): Knowledge of basic principles of power system and its analysis

Credits:	L	T	P	C
	3	0	0	3

Class schedule per week: 3 lectures

Course Objectives : This course enables the students:

1.	Outline the characteristics of a decision theory approach to decision making.
2.	How optimality strategies are formulated in conflict and complete environment
3.	Describe, Selects and give examples the best strategy according to decisions under certainty, risk, and complete uncertainty.
4.	Defines builds and develop solutions to the model of Queuing system
5.	Introduced simulation concepts by means of examples and illustrated areas of application.
6.	Simulation examples will be given in queuing, inventory, reliability and network analysis.
7.	To learn and analyzes the Dynamic programming, general nonlinear programming problems

Course Outcomes : After completion of the course, the learners will be able to:

1.	Gaining insight in the applications of the different methods and techniques in practice
2.	Learn about the real-life cases during the course, and a range of solution approaches will be highlighted
3.	Solved the problems and the solution will be analyzed and explained in a critical way.
4.	Able to define the steps that need to be taken for problems.
5.	Aware of the various pitfalls that pop up during the analysis of data and the solving of a mathematical models/ problem.

Syllabus:

Module 1

Revised simplex method, sensitivity analysis, decision theory: steps in decisions theory approach, types of decision-making environments

Module 2

Decision making under uncertainty, theory of games: two – person zero sum games, pure and mixed strategies, rules of dominance, solution methods without saddle point

Module 3

Replacement and maintenance models, failure mechanism of items, replacement of items deteriorating with time

Module 4

Queuing theory: essential features of queuing system s, operating characteristics of queuing system, classification of Q-models. (M/M/I) (∞ /FCFS/M/M/1: ∞ /SIRO, M/M/1: N/FCFS, M/M/S: N/FCFS).

Module 5

Dynamic Programming: characteristics of D.P. dynamic programming under certainty, calculus and tabular method of solution.

Module 6

Simulation: introduction, stochastic simulation and random numbers, simulation of inventory & queuing and PERT problems.

Module 7

Non-Linear programming methods: general N.L.P.P. graphical solution, quadratic programming-Beales method.

Text Books:

1. Operations Research by Prem Kumar Gupta, D. S. Hira , S. Chand
2. Operations Research, by Kanti Swaroop, Gupta P.K. Man Mohan, Sultan Chand and Sons
4. Quantitative techniques for Managerial Decisions by L.C. Jhamb, Everest Publishing house
5. Operations Research by P. Ramamurthy, New Age International Publisher

Reference Books:

1. Operations Research, Hilter & Liberman
2. Operations Research , H.A.Taha , Macmillan Publishing Company , New York

LECTURE PLAN

Department : Production Engineering

Course: PE 7019: Advanced Operation Research

Academic Year : 2016 – 17

Class : BE

Semester : VII

Course Coordinator : Dr. Rajeev Agrawal

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
1	---	1	Introduction and Course Overview Origins and Impacts of Operations Research	---	1
2	I	2	Advantages of Revised Simplex Algorithm Method over Simplex Method	T1	4
3		3	Sensitivity Analysis (Post-Optimality analysis)	T1	
4		4	Decision making environments, Steps in Decision theory approach,	T1	
5	II	5	Decision making under conditions of Certainty, Decision making under conditions of Uncertainty	T1	8
6		6	Decision making under conditions of risk :Expected value criterion, Expected Opportunity Loss criterion	T1	
7		7	Expected Value of Perfect Information	T1	
8		8	Expected Monetary Value for Items that have a Salvage Value	T1	
9		9	Use of Incremental Analysis, Maximum Likelihood criterion, Expected value criterion for continuously distributed random variables, Decision trees, Advantages and limitation of decision trees	T1	
10		10	Theory of Games, competitive Games, Rules for Game Theory and examples, Two-person Zero sum Game	T1	
11		11	Pure strategies, Mixed strategies: $2 \times 2, 2 \times n, m \times 2,$	T1, R1	
12		12	Arithmetic Method, Algebraic Method, Graphic Method, Method of Matrices and	T1, R1	

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
			Method of subgames for finding Optimum Strategies and Game Value,		
t	III	13	Replacement Theory and Model, Costs Associated with Maintenance	T1, R1	6
14		14	Types Of Replacement Problems, General Approach To Solution To Replacement Problem	T1, R1	
15		15,16	Replacement of items whose efficiency reduces or Maintenance cost increases with time or due to age and money value is not considered,	T1	
16		17,18,19	Replacement of Items whose Maintenance Costs Increases with Time and Value of Money also Changes with Time, Replacement of Items whose Maintenance Cost Increases with Time and Money Value also Changes, comparing of replacement alternatives by using criteria of Present value, replacement of items that fail completely and suddenly and Are expensive to be replaced	T1	
17	IV	20	Waiting Line Theory or Queuing Model, Characteristics of Arrivals or input, Service Mechanism or Service Facility, Queue discipline or Service discipline	T1	6
18		21	Queuing problems, distribution of arrival and service time	T1	
19		22	Queue models, Minimum cost service rates	T1,R2	
20		23,24	Birth – Death process, Finite Queue Length Model, Limited Population or Source Model	T1,R2	
21		25	Multi Channel Queuing Model	T1,R2	
22	V	26, 27	Dynamic Programming, Characteristics Of Dynamic Programming Computational Procedure In Dynamic Programming	T1,R2	5
23		28	Product allocation problem	T1, T2	
24		29, 30	Cargo load problem, Solve the given L.P. Model by using dynamic programming technique	T1, T2	
25	VI	31	Understand the seven steps of conducting a Simulation, Monte Carlo Simulation	T1, T2	5
26		32	Develop random number intervals and use them to generate outcomes,	T1, T2	
27		33	Simulation of Inventory problems	T1, T2	

Sl. no.	Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of Lecture Hrs
28		34	Simulation of Queuing Problems	T1, T2	
29		35	Simulation of PERT problems	T1, T2	
30	VII	36	Introduction to Non-linear Programming	T1, T2	5
31		37	Mathematical Formulation Of The Problem	T1, T2	
32		38	Non-linear Programming problems	T1, T2	
33		39	Quadratic Programming Problem	T1, T2	
34		40	Beale's Method	T1, T2	

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus: f, h, j, k

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design: i, j, k

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors
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Mapping Between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes						
	CO1	CO2	CO3	CO4	CO5	CO6	CO7
CD1	√	√	√	√	√	√	√
CD2	√	√	√	√	√	√	√
CD3							
CD4							
CD5							
CD6							
CD7							
CD8	√	√	√	√	√		
CD9							

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes						
	CO1	CO2	CO3	CO4	CO5	CO6	CO7
1	M	-	H	L	H		
2	H	H	L	M	L		
3	M	-	H	-	M		
4	L	M	L	H	H		
5							

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
1	H	H	-	-	-	L	-	-	-	H	-
2	H	H	M	M	H	M	L	L	-	M	-
3	H	M	M	M	M	M	H	M	-	L	-
4	H	H	H	M	M	M	M	-	L	L	H
5	H	H	M	M	L	L	-	-	H	H	H

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Seml Examination Marks	60
Assignment	15

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem. Examination Marks					
End Sem. Examination Marks					
Assignment					

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome



Department of Production Engineering **Birla Institute of Technology, Mesra, Ranchi - 835215 (India)**

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Program Outcomes (PO)

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- PO 7:** Development of various managerial skills like interpersonal, communication and documentation
- PO 8:**-Development of innovative technical solutions for various challenges in society
- PO 9:** Be aware of financial, environmental and sustainability implications for each professional action
- PO 10:** Develop the right attitude for continuous learning and knowledge of latest developments

COURSE INFORMATION SHEET

Course code: PE7021

Course title: Maintenance Engineering

Pre-requisite(s):

Credits: **L** **T** **P** **C**
 3 0 0 3

Class schedule per week: 3 lectures

Course Objectives: This course enables the students:

1.	To acquaint with maintenance strategies
2.	To understand reliability, maintainability and availability concepts
3.	To conceptualize reliability-centred maintenance and Terotechnology
4.	To familiarize with the methods of maintenance cost estimation, testing methods, control indices
5.	To acquaint with Industrial hazards and safety

Course Outcomes: After completion of the course, the learners will be able to:

1.	Apply the tools and techniques used in maintainability, reliability and risk analysis
2.	Analyse failure data, failure distribution, system reliability models
3.	Select and plan for maintenance strategies in different situations
4.	Estimate cost for maintenance, evaluate maintainability control indices
5.	Assessment of industrial hazards and safety

Syllabus:

Module 1

Definition, Importance, Purpose and results of maintainability efforts, maintainability in product life cycle, maintainability tools; failure mode, effect and critical analysis, fault tree analysis, cause and effect diagram, total quality management,

Module 2

Reliability, maintainability, both-tub curve, concept of repair ability

Module 3

Principle, relative advantage, limitation and application of various maintenance strategies like, preventive maintenance, predictive maintenance, Reliability based maintenance, computer integrated maintenance

Module 4

Concept and strategies for zero-technology, and condition based maintenance

Module 5

Maintainability testing, costing, budgeting and control index for maintained system

Module 6

Industrial safety-concept and relevance, occupational diseases, electrical and mechanical hazards, personal protective equipment and clothing

Module 7

Safety responsibility and function of various functionaries and departments, profitably employee training and safety

Text Books

1. **Engineering Maintainability** B.S. Dhillon, Eastern Economy Edition PHI
2. **Reliability Engineering and Technology** A.K. Gupta, Macmillan India Limited
3. **Industrial Maintenance Management** S.K. Srivastav, S. Chand & Company
4. **Effective Maintenance Management** E.T. Newbrough, Mc Graw Hill
5. **Industrial Safety Management** N.K. Tarafadar, K. J. Tarfdar, Dhanpat Rai

LECTURE PLAN

Department: Production Engineering

Course: PE 7021 Maintenance Engineering

Academic Year: 2016 – 17

Class: BE

Semester: VII

Course Coordinator: Dr. S. Datta

Module no.	Lecture Hr. Serial no's	Topic(s) to be covered	Preferred Book(s)	Total no. of classes
1	1	Introduction to maintenance and maintenance management, different maintenance functions	T1	8
	2	Maintainability in product life cycle, design for maintainability	T1	
	3	Maintainability factors: time, frequency, cost	T1	
	4	Analysis tools: Cause-and-Effect diagram	T1	
	5	FMEA/FMECA	T1	
	6	Fault Tree Analysis	T1	
2	1	Introduction to Reliability, Types of failure, bath-tub curve	T1,T2	10
	2	Failure data analysis: failure rate, hazard rate, failure density	T2	
	3	Numerical problems	T2	
	4	Probability density function, mathematical representation of reliability	T2	
	5	Failure distributions: exponential, normal, log-normal	T2	
	6	Weibull distribution	T2	
	7	Numerical problems	T2	
	8	System reliability models: series and parallel	T2	
	9	Numerical problems	T2	
	10	Availability, reliability-maintainability-availability trade-off	T2	
3	1	Classification of maintenance strategies	T2	7
	2	Reactive/run-to-failure maintenance	T2	
	3	Preventive and predictive maintenance	T2	

	4	Corrective and improvement maintenance	T2	
	5	Reliability centred maintenance	T2	
	6	TPM, autonomous maintenance	T2	
	7	Computer integrated maintenance	T2	
4	1	Condition-based maintenance, condition monitoring techniques	T2	5
	2	Vibration monitoring	T2	
	3	Lubricant monitoring	T2	
	4	Thermography, Acoustic emission	T2	
	5	Terotechnology	T2	
5	1	Maintainability testing	T1	3
	2	Maintenance costing, budgeting	T1	
	3	Control index for maintained system	T1	
6	1	Industrial safety-concept and relevance	T1	4
	2	Occupational diseases	T1, T3	
	3	Industrial hazards - electrical and mechanical hazards	T1, T3	
	4	Personal protective equipment and clothing	T1, T3	
7	1	Safety responsibility and function of various functionaries and departments	T1, T3	3
	2	Employee training and safety	T1, T3	
	3	Hazard assessment techniques	T1, T3	

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Self- learning such as use of NPTEL materials and internets

Mapping between COs and Course Delivery (CD) methods

Course Delivery (CD) methods	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
CD1	√	√	√	√	√
CD2	√	√	√	√	√
CD3	√		√		√

Mapping between Course Objectives and Course Outcomes

Course Objectives	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
1			H		
2	H	H			
3	M		H		
4				H	
5	M				H

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	M	H					L			
2	H	H								M
3				M			M			M
4									H	M
5	M	M							M	M

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination Marks	25
End Semester Examination Marks	60
Assignment	15

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem. Examination Marks	√	√	√		
End Sem. Examination Marks	√	√	√	√	√
Assignment	√	√	√		√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

8th Semester

PE 8002 INDUSTRIAL PROJECT & COMPREHENSIVE VIVA
(6 Credits)

COs:

CO1	Students will able to identify and understand current trends and real-world issues in production engineering
CO2	Students will able to formulate project specifications, identify a set of feasible solutions and prepare and implement project plan
CO3	Students will able to use critical thinking skills to review, analyse and interpret data and results
CO4	Students will able to demonstrate work knowledge of ethics and professional responsibility at various stages such as project formulation, design, implementation and presentation
CO5	Students will able to publish the results of the research work in journal or conference proceedings, present the work effectively and communicate with confidence in the defence of the work

Industrial Project & Comprehensive Viva:

Students have to solve a particular problem from their definition and literature review to the effective solution of the same. Students in a group of 3 to 4 work on a subject approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completion of the work to the satisfaction of the supervisor. The progress of the project is assessed on the basis of at least three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work shall be assessed on the basis of oral presentation and viva-voce, and the project report jointly by external and internal examiners made up of the Head of the Department.

COURSE INFORMATION SHEET

Course code: MPE 1004

Course title: COMPUTER AIDED DESIGN AND DRAFTING LAB

Pre-requisite(s): None

Co-requisite(s):

Credits: 02 L: 0 T: 0 P: 4

Class schedule per week: 4

Class: M.Tech.

Semester / Level: I/5

Branch: Production Engineering

Name of Teacher:

Course Objectives:

This course enables the students to:

1	To learn the concepts and principles of Computer aided Design & Drafting (CAD)
2	To understand the various types of CAD Software's like CATIA V5, Unigraphics NX, etc. and their practical usage in Manufacturing applications
3	Understand concepts of Designing various components of Manufacturing jobs
4	Develop Industrial components by interpreting 3D part models/ part drawings
5	Understand the concepts of CAD Software, Design & Assemble various parts of Manufacturing with focus on Industrial Applications

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Apply the concepts of concepts of designing using 3D modeling software
CO2	Create Designs of various real-world Industrial components by using mechanical design Software's like CATIA, Unigraphics, etc.
CO3	Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Design, Drafting & Analysis.
CO4	Apply the concepts of CAD Drawings and Assemble various components of Manufacturing with focus on Industrial Applications
CO5	Develop Prototype models by interpreting 3D part model/ part drawings & Assemblies

SYLLABUS

List of experiments:

Experiment No. 1

Introduction to Basics of Computer Aided Design. Sketcher, Drafting & 3D Modeling.

Experiment No. 2

Exercise on Padding, Pocketing & Revolving.

Experiment No. 3

Exercise on Nut, Bolt & Threads

Experiment No. 4

Exercise on Chamfer, Fillets, Mirror & Offset

Experiment No. 5

Exercise on Hole & Patterns

Experiment No. 6

Exercise on Ribs & Shell

Experiment No. 7

Exercise on Sweep

Experiment No. 8

Exercise on Blend

Experiment No. 9

Exercise on Datum plane & Axis

Experiment No. 10

Exercise on Assembly-I: Foot-step Bearing

Experiment No. 11

Exercise on Assembly-II: Plumber-Block

Experiment No. 12

Exercise on Assembly-III: Bench-Vice assembly

Books recommended:

TEXT BOOK

1. Rao, P.N. "CAD/CAM: Principles and Applications", McGraw Hill Publication, 2nd Edition, 2004. **(T1)**
2. Mikell P. Grover, E. Zimmer, "Computer Aided Design and Manufacturing (CAD/CAM)", Pearson Publication, 2nd Edition, 2006. **(T2)**

REFERENCE BOOK

1. David Bedworth, "Computer Integrated Design and Manufacturing" Tata McGraw Hill, New Delhi, 1998. **(R1)**
2. Radhakrishan P., Subramaniam S., "CAD CAM and CIM", New Age International, 2002 **(R2)**

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

Gaps in the syllabus (to meet Industry/Profession requirements) :

Design of real-time Industrial projects.

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

Design optimization for industrial projects, Fractional order controller

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	3	3	3	3	3
C02	3	2	1	3	2	2
C03	2	3	3	2	3	2
C04	3	2	2	3	2	3
C05	3	3	3	3	3	3

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
C01	CD1, CD3
C02	CD1, CD3, CD7
C03	CD1, CD3, CD7
C04	CD1, CD3, CD6, CD7
C05	CD1,CD2,CD3,CD6, CD7

COURSE INFORMATION SHEET

Course code: MPE 1007

Course title: MANUFACTURING STRATEGIES & SUSTAINABLE DEVELOPMENT

Pre-requisite(s): None

Co- requisite(s): None

Credits: 3 L:03 T: 00 P: 00

Class schedule per week: 3

Class: M. Tech

Branch: Production Engineering (AMS)

Name of Teacher:

Course Objectives

This course enables the students:

A.	To learn the concepts of manufacturing strategies
B.	To know the fundamentals of design steps in manufacturing and testing
C.	To estimate between manufacturing and marketing
D.	To describe the principles of different sustainable development frameworks and apply them during the planning of developmental activities
E.	To understand the concept of sustainable manufacturing, various policies and indicators for measuring sustainable development

Course Outcomes

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

CO1	Evaluate the manufacturing strategies and its components
CO2	Design the manufacturing steps according to need.
CO3	Analyze the system of manufacturing and marketing
CO4	Define sustainable development frameworks.
CO5	Solve problems on sustainable manufacturing.

Syllabus

Module 1

Introduction of manufacturing strategies, developing a manufacturing strategy. Manufacturing Organizational structures, Categories of manufacturing system, processing strategies, Plant layout.

Module 2

Manufacturing and testing strategies; design for manufacture assessment, Competitive priorities: quality, delivery, flexibility and cost, improvement activities. Implementation of manufacturing policies.

Module 3

Interface between manufacturing and marketing, inter-relationship among manufacturing Managers, suppliers, customers and competitors. Human resource issues.

Module 4

Environmental, Social and Economical dimensions of sustainability , Need for sustainability and ways to achieve sustainability, Concept of sustainability, Factors governing sustainable development, Linkages among sustainable development- Environment and poverty Determinants of sustainable development

Module 5

Sustainable Development Indicators, Need for indicators, Various qualitative and statistical indicators for sustainable development, Sustainable manufacturing and policies, Sustainable quality systems

Text books:

1. Voss C. A, Manufacturing strategy, 1992, Chapman & Hall
2. Steve Brown, Manufacturing the future, 2000, Prentice Hall
3. Terry Hill, Manufacturing strategy, 1989, Homewood, IL
4. Sayer, J. and Campbell, B., 2003 The Science of Sustainable Development: Local Livelihoods and the Global Environment, Cambridge University Press
5. Dornfield David, Green Manufacturing, Springer, 2012.

Reference books:

1. David O' Sullivan, "Manufacturing System Redesign- Creating the Integrated Manufacturing Environment", PTR Prentice Hall
2. Peter Bernus, Laszlo Nemes & Theodore J. Williams, "Architectures for Enterprise Integration", Chapman & Hall.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Master of Engineering in
Automated Manufacturing System

MPE 1009 PLANNING AND CONTROL OF PRODUCTION SYSTEMS (3 Credits)

Course outcome (CO):

- Identify Various types of production systems
- Understand the fundamentals of facility locations, demand forecasting.
- Obtain knowledge about production planning, capacity planning, inventory planning.
- Know production monitoring and control techniques.

Syllabus:

Module I: Generalized model of a production system, decisions in the life cycle of a production system, evaluation of investments in new product and services, risk analysis using decision trees, product mix decisions, different kinds of production systems, mass, batch, job, FMS, and cellular production.

Module II: Mathematical models for facility location and layout, demand forecasting.

Module III: Production Planning Models, Hierarchical Production Planning, Aggregate planning, Desegregation of Aggregate Plan, Master Production Scheduling, Capacity planning, loading & dispatching.

Module IV: Basic material and Information Flow, Inventory planning, Material Requirements Planning and Lot Sizing, manufacturing resource planning & ERP.

Module V: Production monitoring & control, Production Control principles and techniques, performance criteria & evaluation, resource balancing.

Module VI: PPC in Process Industries, Planning and Control of JIT Systems.

Recommended Books:

1. Bedworth, D. D. and J. E. Bailey, Integrated Production Control, System-Management, Analysis and Design, John Wiley, 1983.
2. Elsayed E.A. and Boucher T. O. Analysis and Control of Production systems, Prentice Hall, 1985.
3. King J. R., Production Planning and Control, Pergamon Press, Oxford, 1975.
4. Bestwick, P.F. and Lockyer, K., Quantitative Production Management, Pitman Publications, 1982.
5. Hax, A. C. and Candea, D., Production an Inventory Management, Prentice-Hall, 1984. p73
6. Johnson, L. A. and Momtgomery, D. C., O. R. in Production Planning, Scheduling and Inventory Control, John Wiley and Sons, 1974.
7. Korgaonkar, M. G. JIT Manufacturing, Macmillan Publication Co. 1992.

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in
Automated Manufacturing System

MPE 1011 ERGONOMICS & WORK SYSTEM DESIGN (3 Credits)

Course Outcome (CO):

- Scopes and application of ergonomics, conceptual framework of man machine system design.
- Obtain knowledge about developments in industrial work station design.
- Get idea about design of man-machine/ machine-man communication system.
- Familiarize with robotic work station design, consideration of physical factors of environment such as noise, vibration, light and heat in work system design.
- Know the design of human centred manufacturing system

Syllabus:

Module 1: Introduction: Historical developments, interdisciplinary character, scopes and application of ergonomics, conceptual framework of man machine system design.

Module 2: Work Space Design: Basic concepts, economization of motion at the work place, selection of working posture, methods of designing industrial work station, developments in industrial work station design, role of computers in work station design

Module 3: Design of Man-Machine Communication System: Criteria for design of man-machine communication system (controls), nature of variables being controlled, types of control and control resistances, factors affecting design of man-machine communication system, case examples.

Module 4: Design of Machine-Man Communication System: Criteria for design of machine-man communication system (displays), needs, types and selection of displays, case examples.

Module 5: Ergonomics of Advanced Manufacturing System (AMS): Role of humans in AMS, identification of ergonomic problems, design of human centered manufacturing system.

Module 6: Robot Ergonomics: Analysis of work characteristics, robot – man chart, planning work methods and processes, robotic work station design, performance measurement.

Module 7: Environmental Ergonomics: Consideration of physical factors of environment such as noise, vibration, light and heat in work system design.

BOOKS RECOMMENDED:

1. The ergonomics of work space and machines – A design manual – T.S. Clark & E.N. Corlett, Taylor & Francis.
2. Ergonomics at work – David J. Osborne, Dennis Publications, Richard.
3. Human factors in Engineering and design – McCormick, E. J.; Sanders, Mark S., McGraw-Hill, Inc., New York.
4. A Guide to the Ergonomics of Manufacturing. – Martin Helander London, UK: Taylor and Francis .
5. Occupational Ergonomics: Principles and Applications, Tayyari, F. and Smith, J.L., Chapman & Hall, London, 1997. (Now under Cluwer Academic Publishers Copyright).

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in
Automated Manufacturing System

MPE 1101 MANUFACTURING AUTOMATION (3 credits)

Course Outcome (CO):

- Understand the concept and types of automation
- Assessment of degree and level of automation
- Justification of automation
- Knowledge about various components of automation like sensors, actuators, PLC
- Understanding transfer lines and advanced industrial automation

Syllabus:

MODULE I: Fundamentals of manufacturing: Production System Facilities, Manufacturing support systems, Different types of manufacturing systems, Automation in Production Systems, Manufacturing Operations, Product, Production Relationships.

MODULE II: Mathematical Concepts & Models: Production Concepts & Mathematical Models, Costs of Manufacturing Operations, Numericals.

MODULE III: Automation Principles & Strategies, concept of automation; types of automation; flexibility, degree, level and yardstick of automation; Components of automation: Sensors, Actuators, and ADC, DAC and input output devices.

MODULE IV: Industrial Control: Industrial Control Systems, Mechanical, Electrical, Hydraulic, Pneumatic, Electronic and Hybrid systems. Concepts features & parameters governing the Selection of various components Necessary for Building the elements.

MODULE V: PLC: Discrete Control using PLC & PLC network, Introduction, Micro PLC, Programming a PLC, Logic Functions, input & output Modules, PLC Processors, PLC Instructors, Documenting a PLC System, Timer & counter Instructions, Comparison & data Handling instructions, Sequencing Instructions, Mask Data representation.

MODULE VI: Development of small automation systems using mechanical devices, sensors, actuators and digital control devices, applications in manufacturing. Industrial Applications and case studies.

BOOKS RECOMMENDED:

1. Automation, Production Systems and Computer Integrated Manufacturing by Milkell P. Groover, Prentice Hall of India.
2. Robots and Manufacturing Automation by C. Roy, Asfahl John Wiley & Sons
3. Performance modeling of automated Manufacturing Systems - Viswanandham, PHI.
4. Fluid Power System - Goodwin, McGraw Hill Press Limited, 1976.
5. Fluid Power with Applications - Anthony Esposito, Prentice Hall, 1997.
6. Mechatronics - W, Bolton, Longman, Addison Wesley.

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

COURSE INFORMATION SHEET

Course code: MPE 1102

Course title: COMPUTER AIDED MANUFACTURING LAB

Pre-requisite(s):

Co- requisite(s):

Credits: 1.5 L:0 T:0 P: 3

Class schedule per week: 3

Class: B.Tech.

Semester / Level: VII/4

Branch: Production Engineering

Name of Teacher:

Course Objectives:

This course enables the students to:

1	Understand the various types of CAM Software's like Fanuc, Siemen's, etc. and their practical usage in manufacturing applications
2	Learn concepts of machining parameters and cutting tools for CNC milling and turning jobs and Develop industrial components by interpreting 3D part models/ part drawings
3	Gain the concepts of CAM Software, CNC technology, to convert a CNC-lathe into a CNC-Milling machine and vice-versa
4	Be acquainted with standard industrial robot, its sub-systems and prepare a demonstration of a simple programmed task
5	Give a hands-on experience in a rigging an industrial pneumatics and electro-pneumatics circuit and PLCs

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Apply the concepts of machining for selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.
CO2	Create and validate NC part program data using manual data input (MDI) for manufacturing of required component using CNC milling or turning applications through CAM Software's like Fanuc, Siemen's, Unimat etc.
CO3	Apply the concepts of CNC technology to convert a CNC-lathe into a CNC-Milling machine and vice-versa and also to carry out machining using programmed part programs.
CO4	Calibrate program a standard industrial robot and analyse the control behaviour of a robot controller
CO5	Create a typical pneumatic and electro-pneumatic circuit and program a PLC and create a simple demonstration.

SYLLABUS

LIST OF EXPERIMENT:

1. EXPERIMENT – 1:

Objective: To write a manual part program for step turning operation for a given drawing and simulate in FANUC/SIEMENS CNC lathe simulator.

2. EXPERIMENT – 2:

Objective: To write a manual part program for radius cutting and taper turning operation for a given drawing and simulate in FANUC/SIEMENS CNC lathe simulator.

3. EXPERIMENT – 3:

Objective: To write a program for grooving and threading operation for a given drawing, and simulate in FANUC/SIEMENS CNC lathe simulator.

4. EXPERIMENT – 4:

Objective: To Convert a modular CNC-mill Unimat machine into CNC-Lathe Unimat machine and write a program for step turning operation in Unimat CNC Lathe.

5. EXPERIMENT – 5:

Objective: To write a manual part program for taper turning operation for a given drawing in Unimat CNC Lathe

6. EXPERIMENT – 6:

Objective: To write a part program for profile milling operation using linear and circular interpolation cutting for a given drawing and simulate in FANUC/SIEMENS CNC milling

7. EXPERIMENT – 7:

Objective: To write a manual part program for circular and rectangular pocketing for a given drawing and simulate in FANUC/SIEMENS CNC milling simulator

8. EXPERIMENT – 8:

Objective: To write a manual part program for Profile cutting with sub-program and right compensation for given drawing and simulate in FANUC/SIEMENS CNC milling

9. EXPERIMENT – 9:

Objective: To study and learn how to operate CNC milling (VMC 300) machine-Siemens controller.

10. EXPERIMENT – 10:

Objective: To machine a mill part for a given drawing on a CNC milling machine (VMC 300).

11. EXPERIMENT – 11:

Objective: To study the functional details of ARISTO robots; programmed and simulate the pick and place operation of a Robot

12. EXPERIMENT – 12:

Objective: To study the various types of sensors and PLC Programming

Text Books:

1. Mikell P. Grover “Automation, Production Systems and Computer-Integrated Manufacturing” Pearson Education, New Delhi. (T1)
2. Rao, P.N. “CAD/CAM: Principles and Applications”, McGraw Hill Publication, 2nd Edition, 2004. (T2)
3. Mikell P. Grover, E. Zimmer, “Computer Aided Design and Manufacturing (CAD/CAM)”, Pearson Publication, 2nd Edition, 2006. (T3)

Reference Books:

1. David Bedworth, “Computer Integrated Design and Manufacturing” Tata McGraw Hill, New Delhi, 1998. (R1)
2. Radhakrishan P., Subramaniyam S., “CAD CAM and CIM”, New Age International, 2002 (R2)

Gaps in the syllabus (to meet Industry/Profession requirements):

Design of real-time Industrial projects.

POs met through Gaps in the Syllabus:

PO 5

Topics beyond syllabus/Advanced topics/Design:

Design optimization for industrial projects

POs met through Topics beyond syllabus/Advanced topics/Design:

PO 4-5, PO 11-12

Course Delivery Methods:

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	√

Course Evaluation:

Direct Assessment-

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Quiz 1	10
Viva-voce	20
End Semester Examination	% Distribution
Examination: Experiment Performance	30
Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Day to day performance & Lab files	√	√	√	√	√
Quiz 1	√	√			
Quiz 2			√	√	√
Viva-voce	√	√	√	√	√
Examination: Experiment Performance	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping of Course Outcomes (Cos) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2		3					3			2	2	3
CO2	2	2		3					3			2	3	2
CO3	3	2		2					3			2	2	3
CO4	3	2		3					3			2	2	3

< 34% = 1, 34-66% = 2, > 66% = 3

Mapping Between Course Outcomes (Cos) and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD3
CO2	CD1, CD3, CD7
CO3	CD1, CD3, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD6, CD7

Master of Engineering in
Automated Manufacturing System

MPE 1103 COMPUTER AIDED MANUFACTURING (3 Credits)

Course Outcome (CO):

- Understand the fundamentals Numerical control Types, Structures.
- Obtain knowledge about CNC machines, tooling, part programming.
- Get idea about geometric modeling.
- Familiarize with Computer Aided Inspection, CAPP.

Syllabus:

Module I: CAM and Its Historical Development, Introduction to NC/CNC, Overview of CNC Machines.

Module II: Classification of CNC Machines, Major Components of a CNC system (electrical components & mechanical component).

Module III: CNC Tooling, CNC Work-holding devices, DNC, Adaptive Control Machining.

Module IV: Computer assisted part Programming-APT, CNC Part Programming

Module V: Advanced Programming Features, Radius and Length Compensation Schemes, Canned Cycles, Geometric Modeling for CNC machining, CAD/CAM based CNC programming, CNC Program verification.

Module VI: Data communication and LANs in Manufacturing, Computer Aided Inspection, Inspection metrology, contact and non-contact inspection, CMM, surface measurement.

Module VII: Computer Aided Process Planning, Reverse Engineering.

BOOKS RECOMMENDED:

1. Automation, Production system and CIM, Prentice Hall of India, New Delhi.
2. Computer Aided Manufacturing, P N Rao, N. K. Tewari, T. K. Kundra, Tata McGraw-Hill, New Delhi.
3. Computer Aided Manufacturing, T.C. Chang, R.A. Wysk, H.P. Wang, Pearson
4. CNC Programming: Principles and applications by Mattson and Mike
5. CNC Programming hand book : A comprehensive to practical by Smid and Peter
6. CNC Programming made easy by B.K. Jha, Vikash Publishing house, New Delhi.
7. CNC Programming by P. Radhakrishnan.

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in
Automated Manufacturing System

MPE 1105 QUALITY ENGINEERING AND ROBUST DESIGN (4 Credits)

Course Outcome (CO):

- Understand the fundamentals of quality, control charts.
- Learn the techniques of acceptance sampling, process measurement and control.
- Get idea about Root Cause Identification and Corrective Action
- Learn DOE, ANOVA etc.
- Know about robust design and six sigma

Syllabus:

Module I: Introduction: Quality Planning, Analysis & Control, Control charts for attributes and variables, cumulative sum and exponentially weighted moving average control charts,

Module II: Sampling Procedures & Measurement Techniques: acceptance sampling for attributes, sampling plan, Dodge-Romig sampling, Acceptance sampling by variables. Inspection principles and strategies, Online and off line methods of inspection.

Module III: Root Cause Identification and Corrective Action. : Pareto Diagrams, Cause-Effect Diagrams, Run Charts, Affinity Diagram, Interrelationship diagram(ID), Tree diagram, Matrix Diagram, Prioritization Matrices, QFD, Process Decision Program Chart(PDPC), Activity Network Diagram

Module IV: The Design of Experiments: Introductions and DOE process steps; orthogonal array selection and utilization.

Module V: Analysis and Interpretation Methods for Experiments: Observation Methods, Ranking Methods, Column Effect Method, Plotting Methods, Analysis of Variance (ANOVA), Confirmation Experiments

Module VI: Robust Design: Application and Benefit of Robust Design, off line and online quality control, quality loss function, Taguchi Technique, S/N Analysis.

Module VII: Quality in Design and manufacturing, basic concept of six sigma, Design of Six sigma (DFSS), DMAIC

BOOKS RECOMMENDED:

1. Grant E.L. & Leavenworth (1964): Statistical Quality Control, McGraw Hill
2. Bowley A.H. & Goode H.P. (1952): Sampling Inspection by Variables, McGraw Hill
3. Dale H Besterfield, Carol Besterfield-Michna, Glen H Besterfield, Mary Besterfield-Sacre, "Total Quality Management", Pearson Education
4. Douglas C Montgomery , "Introduction to statistical Quality control" John Wiley & Sons, Inc
5. Douglas C Montgomery , "Introduction to statistical Quality control" John Wiley & Sons, Inc
6. Phillips J Ross, "Taguchi Techniques for Quality Engineering", McGraw-Hill Professional.
7. Tapan P Bagchi, "Taguchi Methods Explained: Practical steps to Robust Design" Prentice-Hall of India

Evaluation Process: Three Quizzes and End-semester examination (4 Credits)

Master of Engineering in
Automated Manufacturing System

MPE 1115 MODELING AND SIMULATION (3 Credits)

Course outcomes (CO):

- Introducing simulation tool
- Explaining the concept and types of models
- Understanding discrete and continuous simulation
- Introducing various simulation languages and software
- Understanding the role of probability distributions in simulation
- Explaining the verification and validation of simulation models

Syllabus:

Module 1: Introduction to modeling and simulation concepts, Suitability of simulation as a tool, System analysis and components, Simulation terminology, Model of a system and types of models, Discrete *verses* continuous systems, Discrete event system simulation, Static and Dynamic System simulation, Pros and cons of simulation.

Module 2: Event *verses* activity, General principles of event-driven simulation, Simulation of queueing systems, Simulation of inventory systems and other simulation examples

Module 3: Simulation of manufacturing and material handling systems, modeling of manufacturing systems, models of material handling systems, Modeling downtime and failures, Case studies, Simulators and languages for manufacturing and material handling: SIMFACTORY, ProModel, AutoMod, AIM, Witness, Arena and SIMSCRIPT.

Module 4: Statistical models in simulation, Terminology and concepts, Useful statistical models: Discrete and continuous distribution, Poisson, Uniform, Exponential and Normal distribution, Empirical distribution.

Module 5: Input modeling, Identifying the distribution with data, Selecting the family of distribution, parameter estimation, Verification and validation of simulation models, Input-output validation using historical data, Analysis of simulation results, Output analysis.

Books:

1. Simulation Modelling and Analysis by Law and Kelton, McGraw Hill, New York.
2. Introduction to simulation and SLAM II by Pritsker, John Wiley, New York.
3. Discrete-Event System Simulation by Jerry Banks, Carson and Nelson, Prentice Hall of India Pvt. Ltd.

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in
Automated Manufacturing System

Breadth Subject: Semester 1

Breadth subject I - MPE 1117 Product Design & Manufacturing (3 credits)

Course Outcomes (CO):

Upon completion of the subject, students will be able to

- a. Understand the concept of Design for Manufacturing
- b. Understand the Role of DFM in product specification and standardization
- c. knowledge Design rules for manufacturing and assembly processes
- d. Knowledge of morphological analysis
- e. Understanding product portfolios and architecture
- f. Implement the design and management of manufacturing
- g. Analyze concepts of integrated design and manufacturing Case studies on design for manufacturing and assembly.

MODULE I: Product Development, Product development verses design, Modern product development theories and methodologist in design. Product Life Cycle Management,

MODULE II: Quality Functional Deployment, Benchmarking and establishing engineering specification

MODULE III: Brain storming, Morphological analysis, Decision making, concept selection process, selection charts, measurement theory,

MODULE IV: Design for manufacturing and assembly. Design for the environment, design for assembly, Design for Ecology

MODULE V: Product tear down and experimentation, Product portfolios and portfolio architecture.

MODULE VI: Product modularity, modular design

MODULE VII: Robust Design, optimization in Design

Text Book:

1. Product Design: Techniques in Revenue Engineering and New product development, Kevin Otto, Kristin wood Pearson Education Inc.
2. Product Design and manufacturing, AK Chitale; R.C. Gupta, Prentice – Hall India

Reference Book:

1. Product Design for manufacturing and Assembly Geoftry Boothroyd, peter dewhurst, Winstn Knight Marcel Dekker Inc., USA.
2. Product Design : A practical guide to systematic methods of new product development, Mike Baxter, Champman and Hall.
3. Product Design: fundamentals and methods NFM Roozenburg, J Eekels, John Wiley and sons Ltd
4. Product Design and Manufacture John R.Lindbeck, Prentice Hall International

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in
Automated Manufacturing System

MPE 2001 ROBOTICS & ROBOT APPLICATIONS (3 Credits)

Course outcomes (CO):

- Know the basic components, configurations and drives of industrial robots.
- Learn about the end effectors and grippers
- Understand kinematics and dynamics of a robot
- Study about various types of sensors used in robots
- Develop Programming (off line) for robots
- Justify the application of robots in field
- Select appropriate robots for various manufacturing

Module I: Introduction: Historical development, basic components, classification, specification, drive and configuration of industrial robots.

Module II: Robot End Effectors: Classification and working principles of robotic grippers / end effectors, gripper force analysis, robot - wrist - gripper interface, selection of grippers.

Module III: Robot Kinematics: Types of robot joints, coordinate system in robot kinematics, direct and inverse kinematics, D – H transformation, trajectory planning, and robot dynamics.

Module IV: Robotic Sensors: Need, characteristics and classification of robotic sensors, conceptual framework and working principle of contact and non-contact sensors; vision sensor.

Module V: Robot Programming: Classification of robot languages, robot teaching, robot level languages, task level languages, and off line programming. Concept of artificial intelligence in robotics.

Module VI: Robot Application Planning: Planning for implementation of robot, principles of robot's motion economy, Robot work cell design, performance evaluation, justification of industrial robots.

Module VII: Industrial Application Robots: Selection and use of robots in metal casting, welding, material handling, machining, inspection, assembly and painting.

BOOKS RECOMMENDED:

1. Robotics, Control, Sensing, Vision and Intelligence – King Sun Fu, Rafael C. González, C. S. George Lee, McGraw-Hill.
2. Robotics for Engineers – Yoram Koren, McGraw-Hill Companies.
3. Industrial Robotics Technology Programming Application – M.P. Groover, Tata McGraw-Hill.
4. Robot Technology Fundamentals – James G. Keramas, Cengage Learning India.
5. Robotics Technology and Flexible Automaton – S.R Deb, Tata McGraw-Hill.

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in
Automated Manufacturing System

MPE 2003 INTEGRATED MANUFACTURING & RESOURCE PLANNING (3 Credits)

Course outcome (CO):

- Know the basics of Computer Integrated Manufacturing (CIM)
- Know about Flexible Manufacturing Systems (FMS) and its similarity with CIM
- Understand integration, interfacing and commonality in manufacturing
- Understand data handling and communication required for CIM
- Learn various configurations of FMS
- Know about various automated material handling devices and their functions
- Understand various decision making and planning activities in FMS

Syllabus:

Module I: CIM, Computer based integration between various functions - manufacturing, sales, design, materials etc, Flexible Manufacturing Systems (FMS) as mini CIM, Computer Integrated Production Management, Key elements of integration, interfacing & commonalities., Concept, objective, structure, benefits & operation of IMS/FMS

Module II: File formats, data management for CIM, Issues in File Transfer and Integration of CNC Machines, MAP/TOP, shop floor & computer process monitoring; FMS system Design, development and utilization: Overview of basic elements and features of flexible manufacturing systems; classification of systems and configurations;

Module III: Material handling and storage systems like Robots, AGVs, AS/RS etc. AGV loading, routing and design problems. Design of AS/RS.

Module IV: Decision problems in design, operation and control of the FMS. part type selection and tool management problem, Lot sizing decisions, fixtures and pallet selection problems, layout problems.

Module V: Machine grouping and loading problems in FMS, Production scheduling, scheduling rules, Routing and sequencing decisions.

Module VI: Integrated resource planning, Capacity planning, resource profiles, cause, analysis & remedial decisions for breaking bottlenecks.

Module VII: Group technology and cellular manufacturing system, classification and coding systems, cell formation approaches, Petrinet modeling for FMS.

BOOKS RECOMMENDED:

1. S.Kant Vajpayee, EEE, PHI.
2. J.Harrington, CIM, Krieger, 1979.
3. Kumar Surender, "Industrial Robots & Computer Integrated Manufacturing", Oxford & IBH Publishing Co., New Delhi.
4. R. Stover, An analysis of CAD/CAM application with Introduction to CIM, Prentice Hall Inc., Englewood Cliffs, NY.
5. D. Bedworth et al., Computer Integrated Design and Manufacturing, McGraw Hill, 1991.
6. B. Scholz and Reiter, C.I.M.Interfaces, Chapman Hall, 1992.
7. D. L. Goetsh, Fundamentals of CIM Technology, Delmar Publication, 1988.
8. Viswanadham N. and Narahari Y., Performance Modelling of Automated Manufacturing Systems, Prentice Hall India, 1994.
9. Ranky P. G., FlexibleManufacturing Cells and Systems in CIM, CIM Ware Ltd., Guildford, Surrey, England, 1990.
10. Askin R. G. and Standridge C. R., Modelling and Analysis of Manufacturing Systems, John Wiley and Sons, 1994.

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Manufacturing Simulation Lab (MPE 2004)

Syllabus/List of Experiments

1. Introduction

1.1 Simulation and Modeling Concept

1.2 Simulation Software

2. Simulation Exercise (Manual)

Ex. 1 Bank Operation

Ex. 2 Robotic Work cell

Ex. 3 Drill Press Operation

Ex. 4 Grocery Shop

3. Simulation Exercise Using GPSS

Ex. 1 A Food Store

Ex. 2 A Self-Service Cafeteria Ex. 3 Ambulance Dispatch

Ex. 4 Factory Maintenance

Ex. 5 Ships Un/Loading Cargo at a Harbor Ex. 6 A Hospital's Emergency Room

4. Monte Carlo Simulation (Minitab[®])

COURSE OUTCOMES (COs): *After completion of the course, the learners will be able to:*

CO 1: *Understand the basics of Discrete event simulation.*

CO 2: *Can build soft models in computer program/software for a given situation*

CO 3: *Will be able to develop a simulation table or program.*

CO 4: *Analyse the output from a simulation model*

CO 5: *Design the optimal system using simulation tool*

Master of Engineering in
Automated Manufacturing System

MPE 2011 OPTIMIZATION TECHNIQUES (3 Credits)

Course outcome (CO):

- To cover various optimization techniques and their applications
- To explain the optimization of linear systems using simplex method
- To understand the goal programming method
- Understanding optimization of non-linear problems using quadratic and polynomial programming
- To solve sequential systems like scheduling using dynamic programming

Syllabus:

Module 1: Introduction to optimization analysis: Use of optimization methods: Statement of the problem.

Module 2: Optimization of linear systems: Introduction, Definition & theories; simplex method; initial feasible basics; Duality and sensitivity analysis.

Module 3: Goal programming: the weights methods, the preemptive methods

Module 4: Optimization of Non-linear systems: Introduction, Separable programming; Quadratic programming: polynomial programming: gradient methods.

Module 5: Optimization of sequential systems: Dynamic programming optimization of planning & scheduling. Markovian Decision Process

Module 6: Petri net models & its applications in manufacturing systems

BOOKS RECOMMENDED:

1. J. N. Siddall, “ Analytical Decision Making in Engineering Design” – Prentice Hall Publication
2. Hamady A Taha, “Operation Research”, Pearson Education

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in
Automated Manufacturing System

MPE 2013 MANUFACTURING SYSTEM DESIGN (3 Credits)

Module I: Evolution of manufacturing systems; Elements of manufacturing systems and their interaction; Recent Manufacturing strategies; Dynamics of manufacturing systems; Performance evaluation of manufacturing systems.

Module II: Production control strategies; the importance of optimization in manufacturing; Global Optimization Methods; concept of artificial intelligence and its application for optimization.

Module III: Design requirements of manufacturing system, Architecture and methodologies of manufacturing system.

Module IV: Framework of Manufacturing Systems and supply Management, performance measurement and tools of Manufacturing Systems and supply Management

Module V: Design of Information system for manufacturing; Parts oriented production information system; Development of knowledge based manufacturing system

Module VI: Human centered manufacturing system; basic concept of KANSI and its role in manufacturing system; Social system for manufacturing system

BOOKS RECOMMENDED:

1. Robert E Stein, “Re-Engineering the Manufacturing System” Marcel, Dekker
2. Gideon Malevi, “ Restructuring the Manufacturing Process Applying the Matrix Method”, APICS
3. Ulrich Rembold, Christan Blume, Ruediger Dillmann, “Computer Integrated Manufacturing Technology and Systems”, Marcel, Dekker,
4. Peter Bernus, Laszlo Nemes & Theodore J. Williams, “Architectures for Enterprise Integration”, Chapman & Hall
5. David O’ Sullivan, “Manufacturing System Redesign- Creating the Integrated Manufacturing Environment”, PTR Prentice Hall

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in Automated Manufacturing System

MPE 2017 ADVANCED MANUFACTURING SCIENCES (3 Credits)

Course outcome (CO):

- To learn about different manufacturing processes and the economic considerations
- Understanding the theory of metal cutting and various models of it
- To understand the sciences of unconventional machining processes
- To know about the process of metal casting in detail
- To learn the theories of metal forming in hot and cold working
- To understand the physics of arc welding and its various parameters

Module I: Introduction to Manufacturing: Evolution and development of manufacturing, Classification of manufacturing processes, Importance of manufacturing, Economic & technological considerations in manufacturing. Introduction to manufacturing materials.

Module II: Mechanics of Metal Machining: Introduction to basic machining operations and types. Mechanics of orthogonal metal cutting, theory of orthogonal metal cutting. Mechanics of oblique metal cutting.

Module III: Nonconventional machining processes: A brief review of non conventional machining processes. Analysis of nonconventional machining processes such as ECM, AJM and USM.

Module IV: Metal casting: Introduction to metal casting processes, Purpose of the gating system, Components of gating system and its functions, Design of gating system, Types of gates, Gating ratio and its functions,

Module V: Metal casting (contd...): Functions, types and applications of the riser, design of riser and its shape, size and location, use of insulating material and exothermic compounds in risers.

Module VI: Metal Forming Processes: Elastic & plastic deformation, yield criteria. Hot working and cold working of metals. Analysis (equilibrium equation method) of forging process; for load estimation with sliding friction sticking friction and mixed condition for slab and disc.

Module VII: Physics of Arc Welding: Welding arc initiation, Arc structure, Arc characteristics, Arc stability, Arc blow, Modes of metal transfer, Forces affecting metal transfer.

Books:

1. *Manufacturing Sciences* by Ghosh and Mullick, Affiliated East-West Press (P) Ltd., New Delhi (1985).
2. *Fundamental of Metal Cutting and Machine Tools* by B. L. Juneja, G. S. Sekhon, NitinS eth
3. *Non Conventional Machining*, by P. K. Mishra, Narosa Publishing House (2006).
4. *A Text Book of Foundry Technology*, by Mand Lal and O.P. Khanna, Dhanpat Rai and Sons, New Delhi 1986.
5. *Fundamentals of Material Deformation Processes*, B. L. Juneja, 1st Edition, New Age Publishers.
6. *A Textbook of Welding Technology* by O.P. Khanna, Dhanpat Rai Publishers.

Reference Books:

1. *Metal Cutting Theory and Practice* by Amitabha Battacharya, Central Book Publishers, 1984
2. *Metal Cutting Principles* by M. C. Shaw, Oxford University Press.
3. *Manufacturing Processes for Engineering Materials* by Kalpakjian, Schmid, 4th edition,, Prentice Hall 2003
4. *Modern Machining Process* by Pandey and Shah, Tata McGraw Hill
5. *New Technology* by A. Bhattacharaya, Institution of Engineers (I) (1995).
6. *Foundry Technology* by P.R. Beeley, Buttersworth
7. *Principles of Metal Casting* by Richard Heine, Carl Loper, Philip Rosenthal, McGraw Hill, 2004
8. *Welding Handbook*, American Welding Society, Ninth edition

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in
Automated Manufacturing System

MPE (2021) Supply Chain Management (Credits 3)

Course Outcomes (CO):

- Gaining insight in the applications of the different methods and techniques in practice
- Learn about the real-life cases during the course, and a range of solution approaches will be highlighted
- Solved the problems and the solution will be analyzed and explained in a critical way.
- Able to define the steps that need to be taken for problems.
- Aware of the various pitfalls that pop up during the analysis of data and the solving of a mathematical models/ problem.

Module 1. Introduction

Objectives of Supply Chain Management (SCM), key components of supply chain i.e. sourcing, distribution strategy, customer service strategy; supply chain. Management as Integrated logistics, generic activities, architecture of supply chain, future potential of SCM.

Module 2. Supply chain strategies

Evaluation of supply chain strategies, supply chain performance measures, vendor management, JIT, Link to supply chain, evaluation of SCM strategies, customer focus in SCM, inventory and logistic management, vendor management, Just-in- Time (JIT). Supply chain design considerations.

Module 3. Logistic Management

Logistical operation, integration, network design, logistical performance cycle, customer service global logistic, logistical resources, logistic planning.

Module 4. Warehouse and transport management

Concept of strategic storage, warehouse functionality, warehouse operating principles, developing warehouse resources, material handling and packaging in warehouse, transportation management, transport functionality and principles, transport infrastructure, transport economics and pricing, transport decision making.

Module 5. Inventory management

Cost associated with inventory decisions, selective control, economic order quantity, safety stock and service level, P and Q system, probabilistic models. Recent Trends in SCM:

Module 6. Recent Trends in SCM

Tierisation of supplies, Reverse logistics, JIT II, Milk Round System (MRS), bar coding, Hub and Spoke Concept and other latest concepts. IT – enabled supply chain: Electronic data interchange, enterprise resource planning (ERP), Application of IT, Scope of emerging distributed cooperative tele-manufacturing over internet.

References

1. Chopra, “Supply Chain Management”, Pearson Education Asia, New Delhi
2. Christopher, “Logistics and Supply Chain Management”, Pearson Education Asia, New Delhi
3. Taylor and Brunt, “Manufacturing Operations and Supply Chain Management (The Lean Approach)”, Business Press Thomson Learning, NY.
4. Arjan J. Van Weele, “Purchasing and Supply Chain Management (Analysis Planning and Practice)”, Engineering, Business Press, Thomson Learning NY.
5. Donald B., “Logistic Management - The Integrated Supply Chain process”, McGraw Hill,

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in
Automated Manufacturing System

MPE 2105 SOFT COMPUTING IN MANUFACTURING AUTOMATION (4 Credits)

Course outcome (CO):

- Know about soft computing tools and their difference from hard computation
- Understand ANN, Fuzzy Logic and GA and their capabilities to solve complex problems
- Understand Artificial Neural Network and its various learning/training algorithms
- Solve practical problems and application of ANN to predict the outcome
- Differentiate between fuzzy set versus crisp set
- Learn about various operations and properties of fuzzy sets
- Learn about fuzzification and defuzzification methods
- Apply a fuzzy rule based system to a practical problem
- Know the fundamentals of genetic algorithm (GA)

Syllabus:

Module I: Introduction of soft computing and its role in solving complex industrial automation problems. Artificial neural network, fuzzy logic, genetic algorithm and hybrid systems as soft computing tools

Module II: Artificial Neural Networks: Basic concepts, Components of Neural Network, Single layer perception, Multi-layer Perception, Learning Processes, Fundamentals of Back propagation networks, Learning and tuning Parameters. Application of ANN in manufacturing and automation.

Module III: Fuzzy Logic: Basic concepts of Fuzzy Logic, Fuzzy sets and their operations. Fuzzy memberships and relations, Fuzzification and defuzzification methods, Fuzzy rule generation, Applications of FL in manufacturing, automation and knowledge extraction;

Module IV: Genetic Algorithms: An Overview, Introduction to fundamentals of techniques and applications of genetic algorithms, Selection, fitness function, Cross over, Mutation, Reproduction. GA in problem solving, Implementation of GA. Application of GA in manufacturing and Automation

Module V: Fundamentals of hybrid systems like Neuro-Fuzzy, Neuro-Genetic, and Fuzzy Genetic hybrids

Recommended books:

1. Fuzzy Logic- Intelligence control and information – Jhon Yen and Reza Langar, Person Education
2. Neural Network Fuzzy logic and Genetic Algorithm: Synthesis and Applications – S.Rajasekaran, G.A Vijayalakshmi Pai.
3. Neural Network A Comprehensive Foundation- Simon Haykin, Person Education
4. Genetic Algorithms in Search, Optimization and Machine Learning- D.E. Goldberg, Addison-Wesley, 1989.
5. Fuzzy logic with engineering applications - Ross, T. J, 1997, McGraw-Hill, New York.

Evaluation Process: Three Quizzes and End-semester examination (4 Credits)

Master of Engineering in
Automated Manufacturing System

Breadth Subject: Semester 2

Breadth subject II - MPE 2115 Rapid Prototyping & Tooling

Course outcome (CO):

- Differentiate between conventional and rapid prototyping approach
- Understand the need and place for RP in an integrated manufacturing environment
- Know about all the RP techniques on the basis of different classifications
- Visualize and understand the operation of different RP machines and processes like stereolithography, selective laser sintering, FDM, SGC, 3D printing etc.
- Learn the basics of programming requirement in RP

Syllabus:

Module I: Product Development and Rapid Prototyping:

Product Development and Product Prototyping; Product Prototyping and Its Impact on Prototype Design and Innovation, Impact on Cost, Quality, and Time, Key Process Requirements for Rapid Prototyping; Fundamentals of Rapid Prototyping; Rapid Prototyping Process Chain. Basic concept & process detail, their advantages applications & limitation of various RP systems:

Module II: *Liquid-Based Rapid Prototyping Systems:* 3D Systems' Stereolithography Apparatus (SLA), Cubital's Solid Ground Curing (SGC), D-MEC's Solid Creation System (SCS).

Module III: *Solid-Based Rapid Prototyping Systems:* Cubic Technologies' Laminated Object Manufacturing (LOM), Stratasys' Fused Deposition Modeling (FDM).

Module V: *Powder-Based Rapid Prototyping Systems:* 3D Systems' Selective Laser Sintering (SLS), EOS's EOSINT Systems, Z Corporation's Three-Dimensional Printing (3DP), Extrude Hone's Prometal 3D Printing Process, Optomec's Laser Engineered Net Shaping (LENS), Soligen's Direct Shell Production Casting (DSPC), Fraunhofer's Multiphase Jet Solidification (MJS).

Module VI: Rapid Prototyping Data Formats: STL Format, STL File Problems, STL File Repair, other standard file Formats.

Module VII: Rapid prototyping and Tooling: Application of various Rapid prototyping systems in Direct and Indirect Tooling.

BOOKS RECOMMENDED:

1. Rapid Prototyping, Principles and Application, by Chua C. K., Leong K. F. and Lim C. S., World scientific publishing Co. Pvt. Ltd., Singapore
2. Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development, by Frank W. Liou, CRC Press, Taylor & Francis Group.
3. Rapid prototyping & Manufacturing Fundamental of sterolithiography, by Paul F. Jacobs, SME Publications.
4. Rapid Prototyping by Amitabh Ghosh, East West Press Pvt. Ltd.

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

Master of Engineering in Automated Manufacturing System

MPE (2119) RELIABILITY & MAINTENANCE TECHNOLOGY (3 Credits)

Course outcome (CO):

- Introducing to failure, reliability and life assessment, Obtain knowledge about failure data analysis - MTBF, MTTF, different configurations of system reliability
- Understanding the concepts of availability and maintainability
- Understanding various types of maintenance like preventive and predictive
- Explaining the techniques of condition based monitoring
- Newer concepts of maintenance like TPM and RCM

MODULE 1: Definition and Fundamental aspects of reliability, Failure data analysis: Mean Failure rate, MTTF, MTBF, graphical plot, Hazard Models: constant hazard, linearly Increasing Hazard, Weibull Model, Density Function and Distribution Function, Distribution Function and Reliability Analysis, standard deviation and variance, hazards rate as conditional reliability

MODULE 2: System reliability : series configuration, parallel configuration, mixed configuration, An-r- out-of-n structure, systems not reducible to mixed configurations, mean time to failure systems, logic diagram,, Markov Models, Markov Graphs.

MODULE 3: Reliability Improvement and Analysis: Improvement of component, Redundancy, element redundancy, unit redundancy, standby redundancy, optimization, reliability-cost trade off, fault tree construction, reliability calculation from fault tree, Boolean algebra, truth table, De Morgan's Theorem

MODULE 4: Maintainability: Definition and application of Maintainability Engineering, Engineering aspects of failure & classification of failures, Factors affecting Maintainability, Maintainability design criteria, operating and down time categories, FMEA, Concept of Repairability and Availability

MODULE 5: Description of various maintenance strategies, actions along with their relative advantages, Limitations & applications: Breakdown Maintenance, Corrective Maintenance, Preventive Maintenance, Predictive maintenance, Condition Based Maintenance: Industrial application of Condition Based Maintenance techniques, vibration & noise monitoring, oil analysis, orbit analysis, thermography, performance monitoring, Computerized Maintenance Management System (CMMS)

MODULE 6: Reliability Centered Maintenance, Terotechnology, Total Productive Maintenance

MODULE 7: Industrial Hazards and Safety: concept and relevance, occupational diseases, electrical and mechanical hazards, personal protective equipment and clothing, Safety responsibility and function of various functionaries and departments, safety & profitably employee training and safety

BOOKS RECOMMENDED:

1. Garg, H.P., "Industrial Maintenance" Laxmi Book Depot, New Delhi.
2. Langlay, B.C., "Plant Maintenance", Prentice Hall, New Jersey.
3. David J Smith, "Reliability Maintainability and Risk, Macmillan Education Ltd
4. DimitriKececioglu, Maintainability, Availability and Operational *Readiness Engineering Hand Book, Prentice Hall*
5. L. S. Srinath, "Reliability Engineering", Affiliated East- West Press Pvt Ltd.
6. Kapur, K.C. & Lamberson, L.R., "Reliability in Engg. Design", John Wiley & Sons, New York.
7. Reliability Engineering and Technology A.K. Gupta, Macmillan India Limited
8. Engineering Maintainability B.S. Dhillon, Eastern Economy Edition PHI
9. Industrial Maintenance Management S.K. Srivastav, S. Chand & Company
10. Industrial Safety Management N.K. Tarafadar, K. J. Tarfdar, Dhanpat Rai

Evaluation Process: Three Quizzes and End-semester examination (3 Credits)

COURSE INFORMATION SHEET

Course code: MPE3001 & MPE4001

Course title: Thesis (Research Work)

Pre-requisite(s):

Co- requisite(s):

Credits: 15 (3rd sem)

30 (4th sem)

Class schedule per week: NA

Class: M.E.

Semester: III & IV

Branch: Production Engineering

Course Objectives : This course enables the students:

1.	Use the relevant knowledge and skills acquired during the domain course to solve the problem.
2.	Extract relevant literature survey information and formulate project specifications, and implement project plan
3.	Use appropriate techniques and tools to conduct experiments, analyse data and draw appropriate results-based conclusions and identify applications
4.	Draw appropriate conclusions based on the results and identify applications
5.	Prepare a technical report in the form of a thesis and effectively communicate using multimedia tools through oral presentation

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

1.	Identify and understand current trends and real-world issues in production engineering
2.	Formulate project specifications, identify a set of feasible solutions and prepare and implement project plan
3.	Use critical thinking skills to review, analyse and interpret data and results
4.	Demonstrate work knowledge of ethics and professional responsibility at various stages such as project formulation, design, implementation and presentation
5.	Publish the results of the project work in journal or conference proceedings,

	present the work effectively and communicate with confidence in the defence of the work
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Course Evaluation:

- Project work can be carried out independently.
- Internship shall be independent.
- Marks for 3rd semester: 300 and for 5th semester: 500
- Department Committee shall be appointed by the Head of the Department for progressive evaluation (60%). For end semester evaluation (40%), there should be an external examiner from allied department (3rd semester) and from another institute of repute.
- The Guide of the candidate shall not participate in the evaluation process by the department committee.
- Appropriate proportion of marks by committee, guide and external examiner will be notified during evaluation process.

COURSE INFORMATION SHEET

Course code: MPE3001 & MPE4001

Course title: Thesis (Research Work)

Pre-requisite(s):

Co- requisite(s):

Credits: 15 (3rd sem)

30 (4th sem)

Class schedule per week: NA

Class: M.E.

Semester: III & IV

Branch: Production Engineering

Course Objectives : This course enables the students:

1.	Use the relevant knowledge and skills acquired during the domain course to solve the problem.
2.	Extract relevant literature survey information and formulate project specifications, and implement project plan
3.	Use appropriate techniques and tools to conduct experiments, analyse data and draw appropriate results-based conclusions and identify applications
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2.	Formulate project specifications, identify a set of feasible solutions and prepare and implement project plan
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4.	Demonstrate work knowledge of ethics and professional responsibility at various stages such as project formulation, design, implementation and presentation
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Course Evaluation:

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- Internship shall be independent.
- Marks for 3rd semester: 300 and for 5th semester: 500
- Department Committee shall be appointed by the Head of the Department for progressive evaluation (60%). For end semester evaluation (40%), there should be an external examiner from allied department (3rd semester) and from another institute of repute.
- The Guide of the candidate shall not participate in the evaluation process by the department committee.
- Appropriate proportion of marks by committee, guide and external examiner will be notified during evaluation process.

COURSE INFORMATION SHEET

Course code: PE 101

Course title: WORKSHOP PRACTICE

Pre-requisite(s): Nil

Co- requisite(s): Nil

Credits: 1.5 L:0 T:0 P: 3

Class schedule per week: 3

Class: B.Tech.

Semester / Level: I or II / First

Branch: All

Name of Teacher:

Course Objectives:

This course enables the students to:

1	Familiarize with the basic manufacturing processes.
2	Impart knowledge and skill to use tools, machines, equipment, and measuring instruments.
3	Practice on manufacturing of components using workshop trades.
4	Educate students of safe handling of machines and tools.
5	Exercise individual as well as group activity with hands-on training in different workshop trades.

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Be conversant with the basic manufacturing processes.
CO2	Identify and apply suitable tools and instruments for machining, welding, fitting, carpentry, foundry and forging.
CO3	Manufacture different components using various workshop trades.
CO4	Take safety and precautionary measures of self and machines during operations.
CO5	Develop skills to work as an individual or in a team during trade practices.

SYLLABUS

LIST OF EXPERIMENT:

MACHINE SHOP

1. EXPERIMENT – I: Center Lathe

Objective: To study lathe machine and to machine a given job on center lathe as per drawing.

2. MACHINE SHOP

EXPERIMENT-II: Shaper Machine

Objective: To study Shaper machine and to machine a given job on shaper as per drawing.

3. CARPENTRY SHOP

EXPERIMENT-I: Carpentry Tools and Instruments

Objective: To study the various tools, instruments and equipment used in carpentry practice.

4. CARPENTRY SHOP

EXPERIMENT-II: Carpentry Practice

Objective: To perform the carpentry work by making a wooden job using different tools.

5. FITTING SHOP

EXPERIMENT-I: Fitting Tools and Measuring Instruments

Objective: To study the various tools used in fitting shop and perform fitting operations (like marking, chipping, hack-sawing, filing, drilling etc.)

6. FITTING SHOP

EXPERIMENT-II: Fitting Assembly Practice

Objective: To make a job clamping plate as per given drawing by fitting operations and to check for its assembly with a given component.

7. FORGING SHOP

EXPERIMENT-I: Forging Tools

Objective: To study different tools and equipment used in hand forging practice.

8. FORGING SHOP

EXPERIMENT-II: Forging Practice

Objective: To learn about hand forging practice by making a job (make a square bar from round blank and bend it at a sharp corner of 90 degree as per drawing).

9. FOUNDRY SHOP

EXPERIMENT-I: Green Sand Moulding

Objective: To get acquainted with various tools and equipment used in making green sand mould (to practice green sand mould making with single piece pattern).

10. FOUNDRY SHOP

EXPERIMENT-II: Aluminium Casting

Objective: To get acquainted with melting and pouring of metal in a mould (given two-piece patterns of handle) and to make aluminium casting.

11. WELDING SHOP

EXPERIMENT-I: Manual Metal Arc Welding

Objective: To study arc welding processes including arc welding machines (AC & DC), electrodes and equipment. To joint two pieces of given metal by arc welding process.

12. WELDING SHOP

EXPERIMENT-II: Gas Welding

Objective: To study gas welding processes including types of flames produced, filler metals and fluxes etc. To joint two pieces of given metal by gas welding process.

Books recommended:

TEXT BOOK

1. S K Hajra Choudhury, A K. Hajra, "Elements of Workshop Technology: Vol- I and Vol -II", Media Promotors Pvt Ltd. (T1)
2. B S Raghuvanshi, "A course in Workshop Technology", Dhanpat Rai Publications. (T2)

REFERENCE BOOK

1. P.N. Rao, "Manufacturing Technology Vol-1and Vol-II", Tata McGraw Hill. (R1)
2. Kalpakjian, "Manufacturing Engineering and Technology", Pearson. (R2)

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery Methods:

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	√

Course Evaluation:

Direct Assessment-

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Quiz 1	10
Viva-voce	20
End Semester Examination	% Distribution
Examination: Experiment Performance	30
Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Day to day performance & Lab files	√	√	√	√	√
Quiz 1	√	√	√		
Quiz 2	√	√	√		
Viva-voce	√	√	√	√	
Examination: Experiment Performance	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping of Course Outcomes (Cos) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2				1					2	3	2	2
CO2	3	1	2									1	3	2	3
CO3	3	2	2	1								2	2	2	3
CO4	2					2						1	1	1	2
CO5	2	2	2	1		1			3	1		1	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

COURSE INFORMATION SHEET

Course code: PE 501

Course title: MANUFACTURING AUTOMATION

Pre-requisite(s): None

Co- requisite(s): PE 502

Credits: 03 L:3 T:0 P:0

Class schedule per week: 3

Class: M. Tech.

Semester / Level: I/05

Branch: Production Engineering

Name of Teacher:

Course Objectives:

This course enables the students to:

1.	To learn the concepts and principle of manufacturing automation
2.	To understand the various types of controls, components of automation and their practical use in manufacturing application
3.	Automation Using Pneumatic Systems in various application areas
4.	Understand the Automation Using Hydraulic Systems
5.	To provide knowledge levels needed for PLC programming and operating

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Able to implement concepts of automation in machine tools and plant
CO2	Students will understand the fundamentals of control in automation as they apply to manufacturing.
CO3	Design of Pneumatic Circuit for manufacturing application
CO4	Design of Hydraulic Circuit for manufacturing application
CO5	Ability to apply PLC timers and counters for the control of industrial processes

SYLLABUS

Module 1: [8 L]
Fundamentals of Manufacturing; Production system facilities; Manufacturing support systems;
Different types of manufacturing systems; Automation in Production Systems

Module 2: [8 L]
Manufacturing operations; Product, Production relationships; Production Concepts &
Mathematical Models, Costs of Manufacturing Operations, Case studies

Module 3: [8 L]
Automation Principles & Strategies, Concept of automation; Basic elements and types of
automation; flexibility, degree, levels and yardstick of automation;
Components of Automation: Sensors, Actuators, ADC, DAC and Input/output devices.

Module 4: [8 L]
Industrial Control: Industrial control systems; Mechanical, Hydraulic, Pneumatic, Electrical,
Electronic and hybrid systems; Concepts, features and parameters governing the selection of
various components of Industrial control systems.

Module 5: [8 L]
PLC: Discrete Control using PLC & PLC network, Micro PLC, Programming a PLC, Logic
Functions, input & output Modules, PLC Processors, PLC Instructors, Documenting a PLC
System, Timer & counter Instructions, data Handling instructions, Sequencing Instructions, Mask
Data representation.

Books recommended:

TEXT BOOK

1. Mikell P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing" Pearson Education, New Delhi. ISBN: 0132393212.
2. Andrew Parr, "Hydraulic and Pneumatics", Butterworth-Heinemann. ISBN:0750644192.
3. Bolton. W. "Pneumatic and Hydraulic Systems" Elsevier Science & Technology Books. ISBN:0750638362.
4. N. Viswanandham, Y. Narhari "Performance Modeling of Automated Manufacturing Systems" Prentice-Hall. ISBN: 0136588247.
5. W Bolton., "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering" Prentice-Hall. ISBN: 0131216333.

REFERENCE BOOK

1. Antony Esposito, "Fluid power with Applications" Pearson Education India. ISBN:8177585800.
2. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall of India, New Delhi. ISBN: 8120309871.
3. S. R. Mujumdar, "Pneumatic system", Tata McGraw Hill. ISBN: 0074602314.

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

Gaps in the syllabus (to meet Industry/Profession requirements) :

Design of real-time industrial projects.

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

Design optimization for industrial projects, Fractional order controller

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	-	-
CO2	3	-	1	3	-	2
CO3	2	3	3	2	-	2
CO4	3	2	2	3	2	3
CO5	3	3	3	3	3	3

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD2, CD3
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD3,CD6,
CO4	CD1, CD2, CD3,CD6
CO5	CD1,CD2,CD3,CD6

COURSE INFORMATION SHEET

Course code: PE 502

Course title: COMPUTER AIDED MANUFACTURING LAB

Pre-requisite(s): None

Co- requisite(s): PE 501

Credits: 03 L:0 T:0 P: 4

Class schedule per week: 4

Class: M. Tech.

Semester / Level: I/05

Branch: Production Engineering

Name of Teacher:

Course Objectives:

This course enables the students to:

1	To learn the concepts and principles of Computer aided Manufacturing (CAM)
2	To understand the various types of CAM Software's like Fanuc, Siemen's, etc. and their practical usage in manufacturing applications
3	Understand concepts of machining for selection of appropriate machining parameters, and cutting tools for CNC milling and turning jobs
4	Develop industrial components by interpreting 3D part models/ part drawings
5	Understand the concepts of CAM Software, CNC technology, to convert a CNC-lathe into a CNC-Milling machine and vice-versa

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Apply the concepts of machining for selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.
CO2	Create and validate NC part program data using manual data input (MDI) for manufacturing of required component using CNC milling or turning applications Through CAM Software's like Fanuc, Siemen's, Unimat etc.
CO3	Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.
CO4	Apply the concepts of CNC technology to convert a CNC-lathe into a CNC-Milling machine and vice-versa and also to carry out machining using programmed part programs.
CO5	Develop prototype models by interpreting 3D part model/ part drawings

SYLLABUS

List of experiments

Experiment No. 1

Write a manual part program for step turning operation for a given drawing. Write the program and simulate in FANUC/SIEMENS CNC lathe simulator.

Experiment No. 2

Write a manual part program for radius cutting and taper turning operation for a given drawing. Write the program and simulate in FANUC/SIEMENS CNC lathe simulator.

Experiment No. 3

Write a manual part program for grooving operation for a given drawing. Write the program and simulate in FANUC/SIEMENS CNC lathe simulator.

Experiment No. 4

Write a manual part program for thread cutting operation for a given drawing. Write the program and simulate in FANUC/SIEMENS CNC lathe simulator.

Experiment No. 5

Convert a modular CNC-mill Unimat machine into CNC-Lathe Unimat machine and write a manual part program for step turning operation for a given drawing in Unimat CNC Lathe.

Experiment No. 6

Write a manual part program for taper turning operation for a given drawing in Unimat CNC Lathe.

Experiment No. 7

Write a manual part program for profile milling operation using linear and circular interpolation cutting for a given drawing. Write a program and simulate in FANUC/SIEMENS CNC milling simulator.

Experiment No. 8

Write a manual part program for Profile cutting with sub-program and right compensation for given drawing. Write a program and simulate in FANUC/SIEMENS CNC milling simulator.

Experiment No. 9

Write a manual part program for circular and rectangular pocketing for a given drawing. Write a program and simulate in FANUC/SIEMENS CNC milling simulator.

Experiment No. 10

Write a manual part program for drilling operation for a given drawing. Write a program and simulate in FANUC/SIEMENS CNC milling simulator.

Experiment No. 11

Convert a modular CNC-lathe Unimat machine into CNC-mill Unimate machine and write a manual part program for contouring operation for a given drawing in Unimat CNC Milling.

Experiment No. 12

Write a manual part program for contouring operation with tool compensation right for a given drawing.

Experiment No. 13

To study and learn how to operate CNC milling (VMC 300) machine-Siemens controller.

Experiment No. 14

To machine a mill part for a given drawing on a CNC milling machine (VMC 300).

Books recommended:**TEXT BOOK**

1. Mikell P. Grover “Automation, Production Systems and Computer-Integrated Manufacturing” Pearson Education, New Delhi. ISBN: 0132393212.(T1)
2. Rao, P.N. “CAD/CAM: Principles and Applications”, McGraw Hill Publication, 2nd Edition, 2004. (T2)
3. Mikell P. Grover, E. Zimmer, “Computer Aided Design and Manufacturing (CAD/CAM)”, Pearson Publication, 2nd Edition, 2006. (T3)

REFERENCE BOOK

1. David Bedworth, “Computer Integrated Design and Manufacturing” Tata McGraw Hill, New Delhi, 1998. (R1)
2. Radhakrishan P., Subramaniyam S., “CAD CAM and CIM”, New Age International, 2002 (R2)

Course Evaluation:

Progressive evaluation, end semester performance and viva-voce

Gaps in the syllabus (to meet Industry/Profession requirements) :

Design of real-time industrial projects.

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	2	1	3	2	2
CO3	2	3	3	2	3	2
CO4	3	2	2	3	2	3
CO5	3	3	3	3	3	3

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD3
CO2	CD1, CD3, CD7
CO3	CD1, CD3, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1,CD2,CD3,CD6, CD7

COURSE INFORMATION SHEET

Course code: PE 503

Course title: PLANNING & CONTROL OF PRODUCTION SYSTEM

Pre-requisite(s): None

Co- requisite(s): None

Credits: 03 L:3 T:0 P:0

Class schedule per week: 3

Class: M. Tech.

Semester / Level: I/05

Branch: Production Engineering

Name of Teacher:

Course Objectives

This course enables the students:

1.	To introduce to various inherent concepts of production systems, planning and control systems of Manufacturing Industry.
2.	To introduce of forecasting models, plant layout.
3.	To make routine process, scheduling process and identify different strategies employed in manufacturing industries to production planning.
4.	To give basic concept of inventory control and its technique.
5.	To give concept of Production monitoring & control

Course Outcomes

After the completion of this course, students will be:

CO1	Identify Various types of production systems
CO2	Understand the fundamentals of facility locations, demand forecasting.
CO3	Obtain knowledge about production planning, capacity planning.
CO4	Able to solve inventory problems and to be able to apply selected techniques for its control and management under dependent and independent circumstances.
CO5	Know production monitoring and control techniques.

SYLLABUS

Module 1 [8 L]
Generalized model of a production system, decisions in the life cycle of a production system, risk analysis using decision trees, different kinds of production systems.

Module 2 [8 L]
Mathematical models for facility location and layout, Importance of forecasting – Types of forecasting, their uses – General principles of forecasting – Forecasting techniques– qualitative methods and quantitative methods.

Module 3 [8 L]
Routing, Scheduling, Loading, dispatching, Production Planning Models, Hierarchical Production Planning, Aggregate planning, Desegregation of Aggregate Plan.

Module 4 [8 L]
Inventory planning and control, Material Requirements Planning and Lot Sizing, manufacturing resource planning & ERP.

Module 5 [8 L]
Production monitoring & control, Production Control principles and techniques, performance criteria & evaluation, resource balancing, PPC in Process Industries, Planning and Control of JIT Systems.

Books recommended:

TEXT BOOKS

1. Jay H Heizer, Barry Render, Production and operations management, Prentice Hall Publication.(**T1**)
2. Elsayed E.A. and Boucher T. O. Analysis and Control of Production systems, Prentice Hall.(**T2**)
3. King J. R., Production Planning and Control, Pergamon Press, Oxford.(**T3**)

REFERENCE BOOKS:

1. Production and operations management, S. N. Chary (**R1**)
2. Production and Operations Management Manufacturing and Services, Nicholas J. Aquilano and Richard B. Chase (**R2**)
3. Quantitative Production Management, Bestwick, P.F. and Lockyer, K (**R3**)
4. O. R. in Production Planning, Scheduling and Inventory Control Johnson, L. A. and Montgomery, D. C (**R4**)
5. Production and Inventory Management, Hax, A. C. and Candea, D.,(**R5**)

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

Gaps in the syllabus (to meet Industry/Profession requirements)

NIL

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	-	-	-
CO2	2	1	2	3	-	3
CO3	1	-	1	1	-	-
CO4	2	-	1	3	-	2
CO5	1	-	-	3	2	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD4
CO2	CD1, CD2, CD4
CO3	CD1, CD2, CD3, CD4
CO4	CD1, CD2, CD3, CD4
CO5	CD1, CD2, CD3, CD4

COURSE INFORMATION SHEET

Course code: PE 504

Course title: MODELING AND SIMULATION

Pre-requisite(s): None

Co- requisite(s): PE 505

Credits: 03 L:3 T:0 P:0

Class schedule per week: 3

Class: M. Tech

Semester / Level: I/05

Branch: Production Engineering

Name of Teacher:

Course Objectives

This course enables the students:

1.	To learn the concepts of modelling and simulation
2.	To understand the various types of simulation models and their practical use
3.	To know about software for modelling and simulation in various application areas
4.	Understand the statistical aspect of simulation
5.	To comprehend the verification and validation approaches for simulation models

Course Outcomes

After the completion of this course, students will be:

CO1	Develop model frameworks for discrete-event simulation
CO2	Apply pseudo-random number based manual simulation to discrete-events
CO3	Construct software models for manufacturing, logistic and material handling problems
CO4	Generate random distributions of various probability distributions for queuing systems
CO5	Analyse the simulation output for validation

SYLLABUS

Module 1 [8 L]

Introduction to modeling and simulation concepts, System analysis and components, Simulation terminology, Model of a system and types of models, Discrete *verses* continuous systems, Static and Dynamic System simulation, Pros and cons of simulation

Module 2 [8 L]

Event *verses* activity, General principles of event-driven simulation, Use of Pseudo-Random numbers in simulation of queuing systems, Simulation of manufacturing systems and other examples

Module 3 [8 L]

Simulation of manufacturing and material handling systems, Modeling downtime and failures, Case studies, Introduction to simulation software and languages for manufacturing and material handling

Module 4 [8 L]

Statistical models in simulation, Terminology and concepts, Useful statistical models: Discrete and continuous distribution, Poisson, Uniform, Exponential and Normal distribution, Empirical distribution

Module 5 [8 L]

Verification and validation of simulation models, Input-output validation using historical data, stochastic nature of output, Analysis of simulation results, Steady-State behavior, Output analysis and Replication method for steady-state simulation

Books recommended:

TEXT BOOKS:

1. Discrete-Event System Simulation by Jerry Banks, Carson and Nelson, Prentice Hall of India Pvt. Ltd.

REFERENCE BOOKS:

1. Simulation Modelling and Analysis by Law and Kelton, McGraw Hill, New York.
2. Introduction to simulation and SLAM II by Pritsker, John Wiley, New York.

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

Gaps in the syllabus (to meet Industry/Profession requirements)

NIL

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets

MAPPING OF COURSE OUTCOMES ONTO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	-	-	-
CO2	2	1	2	3	-	3
CO3	1	-	1	1	-	-
CO4	2	-	1	3	-	2
CO5	1	-	-	3	2	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD4
CO2	CD1, CD2, CD4
CO3	CD1, CD2, CD3, CD4
CO4	CD1, CD2, CD3, CD4
CO5	CD1, CD2, CD3, CD4

COURSE INFORMATION SHEET

Course code: PE 505

Course title: MANUFACTURING SIMULATION LAB

Pre-requisite(s): None

Co- requisite(s): PE 504

Credits: 03 L:0 T:0 P:4

Class schedule per week: 4

Class: M. Tech.

Semester / Level: I/05

Branch: Production Engineering (AMS)

Name of Teacher:

Course Objectives

This course enables the students:

A.	To apply the concepts of modeling and simulation to real problems
B.	To develop various types of simulation models
C.	To use some software for modelling and simulation
D.	To understand the statistical aspect of simulation
E.	To apply the verification and validation approaches for simulation models

Course Outcomes

After the completion of this course, students will be:

CO1	Able to develop models for discrete-event simulation
CO2	Apply pseudo-random number based manual simulation to discrete-events
CO3	Develop software models for manufacturing, logistic and material handling problems
CO4	Apply various probability distributions for queuing systems
CO5	Analyse the simulation output for validation

SYLLABUS

List of experiments

1. Modelling & Simulation Concepts and Simulation software

Aim: To understand and make a list of the basic terms, concepts and software related to modelling and simulation

2. Discrete Event Simulation (Using Random Numbers) of a Bank

Aim: Consider the operation of a one-teller bank where customers arrive for service in 1 ± 10 minutes. The customers are served in time 1 ± 6 minutes. Simulate the bank operation until twenty customers are served assuming customer 1 arrives at time 0, and compute measures of performance such as the percentage of idle time and the average waiting time per customer.

3. Simulation of a Robotic work cell

Aim: Simulate a robotic work cell to find the cycle time of job and production rate. Assuming a 90% efficient and 8 hours shift, find the per day production. Also give your suggestion for improving the system productivity.

4. Simulation of a Drill press operation

Aim: Parts are machined on a drill press. They arrive at a rate of one every 5 ± 3 minute and it takes 3 ± 2 minute to machine them. Every 60 ± 60 minutes, a rush job arrives which takes 12 ± 3 minute to complete. The rush job interrupts the present job. When the regular job returns to the machine, it stays only for its remaining process time. Simulate the mean system response time for each type of part. Response time is the total time that a part spends in the system.

5. Simulation of a Grocery shop

Aim: A small grocery has only one checkout counter. Customers arrive at this checkout counter at random in the interval of [1, 8] minutes. The service time vary from 1 to 6 minutes with the probabilities shown. Simulate the problem/system for arrival and service of 20 customers.

6. Discrete Event Simulation (Using aGPSS[®] software) of a Food Store

Aim: Use aGPSS[®] software to construct the model for simulation

7. Simulation of a Self-Service Cafeteria Using aGPSS[®] software

Aim: Use aGPSS[®] software to construct the model for simulation

8. Simulation of Ambulance Dispatch

Aim: Use aGPSS[®] software to construct the model for simulation

9. Simulation of Factory Maintenance

Aim: Use aGPSS[®] software to construct the model for simulation

10. Simulation of Ships (Un)Loading Cargo at a Harbor

Aim: Use aGPSS[®] software to construct the model for simulation

11. Simulation of Hospital's Emergency Room

- Aim: Use aGPSS[®] software to construct the model for simulation
12. Monte Carlo Simulation (Using MINITAB[®])

Aim: Use MINITAB[®] to conduct a Monte Carlo simulation for finding the distribution of machining time in a lathe when the probability distribution for length of job, feed rate and rotational rpm are known

Books recommended:

TEXT BOOKS:

1. Discrete-Event System Simulation by Jerry Banks, Carson and Nelson, Prentice Hall of India Pvt. Ltd. (T1)

REFERENCE BOOKS:

1. Simulation Modelling and Analysis by Law and Kelton, McGraw Hill, New York. (R1)

Course Evaluation:

1. Progressive evaluation, end semester performance and viva-voce

Gaps in the syllabus (to meet Industry/Profession requirements):

1. Design of real-time industrial projects.
2. POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

1. POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery methods

CD1	Lecture by use of boards/LCD projectors
CD2	Hands on training on computers
CD3	Self- learning advice

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	1	-	2	-
CO2	-	1	1	-	3	-
CO3	1	2	1	2	1	1
CO4	-	1	-	-	2	-
CO5	-	-	1	-	2	-

< 34% = 1, 34-66% = 2, > 66% = 3

COURSE INFORMATION SHEET

Course code: PE 506

Course title: MANUFACTURING TECHNOLOGY

Pre-requisite(s): None

Co- requisite(s): None

Credits: 03 L:3 T:0 P:0

Class schedule per week: 3

Class: M. Tech

Semester / Level: I/05

Branch: Production Engineering

Name of Teacher:

Course Objectives

This course enables the students to:

1.	learn the concepts of casting
2.	understand the various types of forming methods
3.	know about tool life, MRR, Cutting forces and surface finish in different machining process
4.	understand the concept of joining processes
5.	realize the importance of NTM in present manufacturing scenario.

Course Outcomes

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

CO1	Classify the different types of casting process
CO2	Explain principles and process of Forging, Rolling, Extrusion, drawing and designing of die
CO3	Analyse the tool life, MRR, Cutting forces and surface finish
CO4	Categorize welding processes according to welding principle and material
CO5	Select a proper NTM method for given component

SYLLABUS

Module 1: Introduction to manufacturing and Foundry [8 L]

Classification of different manufacturing processes, application areas and limitations, basic engineering materials.

Sand casting process- Patterns, Core; Molding Processes, Solidification Process, Melting Furnaces,

Special casting methods - centrifugal casting and continuous casting; Permanent mold casting; Hot chamber and cold chamber die casting; Investment casting; Shell mold casting; Plaster mold casting.

Basic design considerations in casting, Casting defects and remedies.

Module 2: Metal forming [8 L]

Hot and cold working. Forming operation--Forging, rolling, extrusion, drawing processes, sheet metal operations.

Powder metallurgy processing: Production of metal powders, compaction and sintering processes.

Module 3: Metal Removal Processes [8 L]

Classification of machining processes and machine tools. Tool's materials, different types of cutting tools, tool geometry and nomenclature of single point cutting tool, Concept of cutting speed, feed and depth of cut single and multipoint cutting operation. Turning, Drilling, shaper, grinding, milling operations.

Module 4: Joining processes [8 L]

Classification of welding processes, electric arc, special welding methods: MMAW, GTAW, GMAW, GMAW-CO₂ welding, submerged arc welding, electro-slag welding, electron beam welding, laser beam welding, ultrasonic welding, resistance welding, welding defects, and arc blow heat affected zone, testing of welded joints, brazing and soldering.

Module 5: Non conventional manufacturing [8 L]

Theory and application of machining by Abrasive Jet, Water Jet, Abrasive Flow, Ultrasonic. Electrochemical Machining and grinding. Thermal energy methods of material processing by Electro-discharge, High Energy Rate Forming.

Books recommended:

TEXT BOOKS:

1. Kalpakjian, S. and Schmid, S. R, "Manufacturing Engineering and Technology", Pearson Education, 2000.
2. Groover, M. P., "Fundamentals of Modern Manufacturing", John Wiley and Sons Inc., 2002.
3. Rao, P. N., "Manufacturing Technology (Vol. 1&2)", Tata McGraw Hill 2009.
4. Choudhry, S.K.H., Choudhry, A.K.H., and Roy N., "Elements of Work Shop Technology", Vol I & II, Media Promoters & Publishers, 1994.

REFERENCE BOOKS:

1. Ghosh A., Malik A. K., “Manufacturing Science” East West Press, 2010.
2. DeGarmo, E. P, Black, J. T., Kohser, R. A. “Materials and Processes in Manufacturing”, Prentice Hall of India Pvt. Limited, 1997.
3. Lindberg, R. A., “Processes and Materials of Manufacture”, Prentice Hall India Limited, 1990.
4. Khanna, O.P., and Lal, M., A Text Book of Production Technology, Vol I & II, Dhanpat Rai & Sons, 1992.
5. Jain R K ., “Production Technology: Manufacturing Processes, Technology and Automation” Khanna Publication 2004.

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

Gaps in the syllabus (to meet Industry/Profession requirements):

Design of real-time industrial projects.

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets

Mapping between Objectives and Outcomes**Mapping of Course Outcomes onto Program Outcomes**

Course Outcome #	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	1	-
CO2	1	1	1	2	1	-
CO3	1	1	2	3	1	1
CO4	1	1	1	3	1	-
CO5	1	1	2	3	2	1

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Mapping between CO and CD		
CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5

COURSE INFORMATION SHEET

Course code: PE 507

Course title: ADDITIVE MANUFACTURING

Pre-requisite(s): None

Co- requisite(s): None

Credits: 03 L: 03 T:00 P:00

Class schedule per week: 3

Class: M. Tech

Semester / Level: I/05

Branch: Production Engineering

Name of Teacher:

Course Objectives

This course enables the students:

1.	To exploit technology used in additive manufacturing.
2.	To understand importance of additive manufacturing in advance manufacturing process.
3.	To acquire knowledge, techniques and skills to select relevant additive manufacturing process.
4.	To explore the potential of additive manufacturing in different industrial sectors.
5.	To apply 3D printing technology for additive manufacturing.

Course Outcomes

After the completion of this course, students will be:

CO1	Able to define the various process used in Additive Manufacturing
CO2	Able to analyse and select suitable process and materials used in Additive Manufacturing.
CO3	Able to identify, analyse and solve problems related to Additive Manufacturing.
CO4	Able to apply knowledge of additive manufacturing for various real-life applications
CO5	Able to apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.

COURSE INFORMATION SHEET

Course code: PE 507

Course title: ADDITIVE MANUFACTURING

Pre-requisite(s): None

Co- requisite(s): None

Credits: 03 L: 03 T:00 P:00

Class schedule per week: 3

Class: M. Tech

Semester / Level: I/05

Branch: Production Engineering

Name of Teacher:

Course Objectives

This course enables the students:

1.	To exploit technology used in additive manufacturing.
2.	To understand importance of additive manufacturing in advance manufacturing process.
3.	To acquire knowledge, techniques and skills to select relevant additive manufacturing process.
4.	To explore the potential of additive manufacturing in different industrial sectors.
5.	To apply 3D printing technology for additive manufacturing.

Course Outcomes

After the completion of this course, students will be:

CO1	Able to define the various process used in Additive Manufacturing
CO2	Able to analyse and select suitable process and materials used in Additive Manufacturing.
CO3	Able to identify, analyse and solve problems related to Additive Manufacturing.
CO4	Able to apply knowledge of additive manufacturing for various real-life applications
CO5	Able to apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.

SYLLABUS

Module 1 [8 L]

Introduction

Overview, Basic principle need and advantages of additive manufacturing, Procedure of product development in additive manufacturing, Classification of additive manufacturing processes, Materials used in additive manufacturing, Challenges in Additive Manufacturing.

Module 2 [8 L]

Additive Manufacturing Processes

Z-Corporation 3D-printing, Stereolithography apparatus (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM), Selective deposition lamination (SDL), Ultrasonic consolidation, Selective laser sintering (SLS), Laser engineered net shaping (LENS), Electron beam free form fabrication (EBFFF), Electron beam melting (EBM), Plasma transferred arc additive manufacturing (PTAAM), Tungsten inert gas additive manufacturing (TIGAM), Metal inert gas additive manufacturing (MIGAM).

Module 3 [8 L]

Additive Manufacturing Machines and Systems

Axes, Linear motion guide ways, Ball screws, Motors, Bearings, Encoders/ Glass scales, Process Chamber, Safety interlocks, Sensors. Introduction to NC/CNC/DNC machine tools, CNC programming and introduction, Hardware Interpolators, Software Interpolators, Recent developments of CNC systems for additive manufacturing.

Module 4 [8 L]

Pre-Processing in Additive Manufacturing

Preparation of 3D-CAD model, Reverse engineering, Reconstruction of 3D-CAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and Generation of codes for tool path, Surface preparation of materials.

Module 5 [8 L]

Post-Processing in Additive Manufacturing

Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques, Brief information on characterization techniques used in additive manufacturing, Applications of additive manufacturing in rapid prototyping, rapid manufacturing, rapid tooling, repairing and coating.

Future scope in Additive Manufacturing

Modelling and Simulation: Thermal model to predict size of deposition such as width and height of deposition, Finite element simulation of additive process.

Books recommended:

TEXT BOOKS:

1. Gibson, I, Rosen, D W., and Stucker,B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010
2. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third Edition, World Scientific Publishers, 2010
3. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping, World Scientific Publishers, 2014
4. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003

Reference books:

1. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2007
2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006
3. Mahamood R.M., Laser Metal Deposition Process of Metals, Alloys, and Composite Materials, Engineering Materials and Processes, Springer International Publishing AG 2018
4. Ehsan Toyserkani, Amir Khajepour, Stephen F. Corbin, “Laser Cladding”, CRC Press, 2004

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	-	3	1	-
CO2	2	1	1	-	3	1
CO3	1	3	2	3	-	2
CO4	-	-	1	3	2	3
CO5	-	-	3	2	3	3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Mapping between CO and CD		
CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5

COURSE INFORMATION SHEET

Course code: PE 508

Course title: OPERATIONS AND SUPPLY CHAIN MANAGEMENT

Pre-requisite(s): None

Co- requisite(s): None

Credits: 03 L:3 T:0 P:0

Class schedule per week: 3

Class: M. Tech

Semester / Level: I/05

Branch: Production Engineering

Name of Teacher:

Course Objectives

This course enables the students:

1.	To provide the student the knowledge of strategic importance of supply chain design and planning of an organisation
2.	The role of inventory management and forecasting in a supply chain
3.	Knowledge of facility planning and scheduling models
4.	Knowledge of various distribution and transportation networks and their applications
5.	The role of sourcing, information technology, pricing and revenue management, and coordination in a supply chain.

Course Outcomes

After the completion of this course, students will be:

CO1	Define the goal of a supply chain and analysis the impact of supply chain decisions on the success of a firm
CO2	Analyse demand forecasts and supply for both an enterprise and a supply chain
CO3	Apply operations planning, MRP, and aggregate planning concepts
CO4	Design a supply chain network for a firm or organisation
CO5	Judge and select the best supplier for a firm or organisation

SYLLABUS

Module 1 [8 L]

Introduction to Supply Chain Management: Understanding the supply chain, Supply Chain Performance- Achieving strategic fit and scope, complexity, key issues, Supply Chain Drivers and Metrics, Centralized vs. decentralized systems

Module 2 [8 L]

Planning Demand and Supply in a Supply Chain: Forecasting- Need for forecasting, Quantitative methods. Inventory Management- Various costs in inventory management and need, Deterministic models and discounts, Probabilistic inventory management. Aggregate Planning- The Role of Aggregate Planning, Aggregate Planning Strategies.

Module 3 [8 L]

Facility Planning and Scheduling models: Facility layout and location- Qualitative aspects, Quantitative models for layout decisions, Product, process fixed position, group layout, Location decisions-quantitative models. Scheduling models- Scheduling in MRP system, Sequencing rules and applications, Batch production sequencing and Scheduling.

Module 4 [8 L]

Designing the Supply chain network: Distribution Networks– Design options for a distribution network, e-Business and the distribution network, Network design in an uncertain environment. Transportation Networks- Design options for a transportation network, Trade-offs in transportation design, Supply Chain Optimization.

Module 5 [8 L]

Managing Cross-Functional Drivers in a Supply Chain: Sourcing Decisions- Make or buy decisions, Third- and fourth-party logistics providers, Sourcing Processes. Pricing and Revenue Management in a Supply Chain, Information Technology in a Supply Chain, Coordination in a Supply Chain.

Books recommended:

TEXT BOOKS:

1. Chopra, S., and Meindl, P. “Supply Chain Management, strategy, planning, and operation” 6/e – PHI, second edition, 2014.
2. Operations Management by Evans and Collier.
3. R. Panneerselvan, Production and operations Management, Prentice Hall of India, Delhi (2000).

REFERENCE BOOKS:

1. Christopher, “Logistics and Supply Chain Management”, Pearson Education Asia, New Delhi.
2. Taylor and Brunt, “Manufacturing Operations and Supply Chain Management (The Lean Approach)”, Business Press Thomson Learning, NY.
3. Arjan J. Van Weele, “Purchasing and Supply Chain Management (Analysis Planning and Practice)”, Engineering, Business Press, Thomson Learning NY.
4. Shah, J. “Supply Chain Management, text and cases”, Pearson Education South Asia,2009.
5. Donald B., “Logistic Management - The Integrated Supply Chain process”, McGraw Hill.
6. Operations Management by Heizer and Render.

Gaps in the syllabus (to meet Industry/Profession requirements)- NIL

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	3	-	-
CO2	2	1	2	3	-	-
CO3	2	1	2	3	-	-
CO4	2	1	2	3	1	-
CO5	2	1	2	3	-	-

< 34% = 1, 34-66% = 2, > 66% = 3

Mapping between CO and CD		
CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO4, CO5

COURSE INFORMATION SHEET

Course code: PE 510
Course title: ROBOTICS & ROBOT APPLICATIONS
Pre-requisite(s): PE 501
Co- requisite(s): None
Credits: 03 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech
Semester / Level: II/5
Branch: Production Engineering (A.M.S)
Name of Teacher:

Course Objectives

This course enables the students:

A.	To understand robot structures and their workspace
B.	To perform spatial transformations associated with rigid body motions
C.	To perform forward and inverse kinematics analysis of robot manipulator
D.	To carry out robot dynamic analysis and trajectory planning
E.	To perform programming of robots.

Course Outcomes

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

CO1	Describe and explain the various robot classification and their characteristics.
CO2	Analyse gravity force of simple robot manipulators.
CO3	Solve forward and inverse kinematics of simple robot manipulators
CO4	Plan and generate joint trajectory for robot motion.
CO5	Code fundamental programs for robot applications.

SYLLABUS

Module 1 [8L]

Introduction: Brief history of robot technology, Basic terminologies, Robot Anatomy, Degree of Freedom, classification and characteristics, Robot selection, structure of industrial robot, Robots in Automation.

Module 2 [8L]

Robot End Effectors and Sensors: Types of End Effectors, Mechanical Grippers, Gripper Force Analysis, Other Types of Grippers, Special-Purpose Grippers, Gripper Selection and Design. Robot Sensors, Different types of Robot Sensors.

Module 3 **[8L]**

Robot Kinematics: Transformations and Kinematics, Vector operations - Properties of Transformation matrices and their arithmetic link and joint description -Homogeneous transformations and Manipulator – Forward solution -Inverse solution, Denavit-Hartenberg parameters, frame assignment to links, Jacobian Transformation in Robotic Manipulation

Module 4 **[8L]**

Robot Dynamics: Dynamics of Robotic Manipulators, Euler Equations, The Lagrangian Equations of motion. Application of Lagrange–Euler (LE), Dynamic Modeling of Robotic Manipulators. Trajectory Planning and generations, Join-Interpolated Trajectories, Cartesian Path Trajectories.

Module 5 **[8L]**

Robot Programming and Applications: Robot Programming, Programming Methods, Programming Languages. Robot application in Manufacturing- Material handling, Processing operations, Assembly and Inspection Operations.

Text books:

1. M. P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, Industrial Robotics Technology, Programming and Applications, McGraw Hill, Int. 2008.
2. Keramas, J., G., Robot Technology Fundamentals, DELMAR, Cengage learning.
3. Mittal, R., K., Robotics and Control, McGraw Hill publication, 2015.
4. K.S. Fu, R. C. Gonzalez and C.S.G. Lee, Robotics Control, Sensing, Vision and Intelligence, McGraw Hill, 2008.

Reference books:

1. Introduction to Robotics Analysis, Systems, Applications by Saeed B Niku PHI.
2. Fundamentals of Robotics Analysis and Control, Robert J Schilling, PHI.
3. J. J. Craig, Introduction to Robotics: Mechanics and Control, 3/e, Pearson Education, 2009
4. S. K. Saha, Introduction to Robotics, Tata McGraw Hill Education Private Limited, 2008.
5. D. Richard, Klafter, and A. Thomas, Chmielewski, Michael Negin, Robotics Engineering- An Integrated Approach, Prentice-Hall of India Pvt. Ltd., 2009.

6. A. Ghosal, Robotics Fundamental Concepts and Analysis, Oxford University Press India, 2006.
7. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw -Hill, 2009.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution				
3 Quizzes	30 % (3 × 10%)				
Assignment (s)	10				
Seminar before a committee	10				
Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous internal assessment					
Semester End examination					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping between Course Outcomes and Program Outcomes

Course Outcome	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6

CO1	1		1	1	2	
CO2			2	2	2	
CO3	1		2	3	3	
CO4	1		2	3	3	1
CO5	2	1	2	3	3	

<34% =1, 34-66% = 2, >66% = 3

Mapping between Course Outcomes and Course delivery method		
CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO2, CO5

COURSE INFORMATION SHEET

Course code: PE 511

Course title: COMPUTER INTEGRATED MANUFACTURING

Pre-requisite(s): PE 503

Co-requisite(s): None

Credits: 03 L: 03 T:0 P:0

Class schedule per week: 03

Class: M.Tech

Semester / Level: II/5

Branch: Production Engineering (A.M.S)

Name of Teacher:

Course Objectives

This course enables the students:

A.	To acquire knowledge in recent advances in the CIM.
B.	Design and develop CIM systems using the knowledge of mathematics, science, engineering and IT tools
C.	Apply modern computational, analytical, tools and techniques to face the challenges in CIM.
D.	Communicate ideas effectively with diversified groups to become lead professionals in academia and industry in advanced areas of manufacturing.
E.	To inculcate students with professional and ethical attitude, and an ability to relate CIM issues to broader engineering and social context.

Course Outcomes:

After the completion of this course, students will be:

1.	Understand the effect of manufacturing automation strategies and know the basics of Computer Integrated Manufacturing (CIM)
2.	Analyse automated flow lines and assembly systems and balance the line.
3.	Design automated material handling and storage systems for a FMS
4.	Design manufacturing cells and apply automatic inspection methods in CIM environment.
5.	Analyze the role of OSI model in the design of communication protocols and comprehend the importance of data communications in CIM environment.

MODULE-I

Manufacturing Automation: Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation and Process Improvement, CIM, Computer based integration between various functions - manufacturing, sales, design, materials, shop floor & computer process monitoring.

MODULE-II

Manual Assembly Lines: Assembly Workstations and Work Transport Systems

Automated Flow lines: System Configurations, Work part Transfer Mechanisms, Storage Buffers, Control of Production Line, Analysis of Transfer Lines-Transfer Lines with No Internal Parts Storage, Transfer Lines with Internal Storage Buffers. The Line Balancing Problem.

MODULE-III

Flexible Manufacturing Systems: Flexibility, Types of FMS and its Components. FMS Applications and Benefits, Machine loading problems in FMS, Production scheduling, scheduling rules, Routing and sequencing decisions.

Automatic Material Handling and Storage systems: Design Considerations in Material Handling, Material Transport Equipment- Automated Guided Vehicles, Design of Automated Storage/Retrieval Systems.

MODULE-IV

Cellular Manufacturing Systems: Part Families, Parts Classification and Coding, Features of Parts Classification and Coding Systems, Opitz of Parts Classification and Coding Systems, Production Flow Analysis, Machine Cell Design, Applications of GT Quantitative analysis of Cellular Manufacturing, Grouping of parts and Machines by Rank Order Clustering, Arranging Machines in a GT Cell.

Automated Inspection systems: Overview of Automated Identification Methods, Bar Code Technology, Radio Frequency Identification,

MODULE-V

Computer Networks for Manufacturing

Introduction to Data Communications: Data Communications, CIM data Files and report formats for data management.

Networks, The Internet – History, Protocols and Standards. Network Models: Layered Tasks, The OSI model, Layers in the OSI model,

Network Layer: logical addressing and Internet Protocol. MAP/TOP,

Physical Layer and Media: Bandwidth Utilization, Multiplexing, Spread Spectrum, Transmission media

Data Link Layer: Error Detection and Correction, Data Link Control, Multiple Access, Wired LANs: Ethernet, Wireless LANs.

Transport and Application Layer: Process-to-Process Delivery: UDP, TCP and SCTP. Domain Name System, File Transfer.

Books:

Text books:

1. Groover, M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Third Edition, Prentice-Hall, 2007
2. P.N.Rao, "CAD/CAM Principle and Applications", Tata McGraw Hill Publishing Company Limited.
3. Viswanadham N. and Narahari Y., Performance Modelling of Automated Manufacturing Systems, Prentice Hall India, 1994.
4. Kumar Surender, U.Chandra, and S.C.Srivastava, "Computer Integrated Manufacturing", Satya Prakshan Pvt. Ltd., New Delhi

Reference books:

1. Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), "Planning, design and analysis of cellular manufacturing systems", Elsevier, 1995.
2. Burbidge, J.L., "Group Technology in Engineering Industry", Mechanical Engineering pub.London, 1979.
3. Rani, S.A., " Hand Book of Cellular Manufacturing Systems", John Wiley & Sons, 1999.
4. Askin R. G. and Standridge C. R., Modelling and Analysis of Manufacturing Systems, John Wiley and Sons, 1994.
5. Ranky P. G., Flexible Manufacturing Cells and Systems in CIM, CIM Ware Ltd., Guildford, Surrey, England, 1990.
6. B. Scholz and Reiter, C.I.M.Interfaces, Chapman Hall, 1992.
7. D. Bedworth et al., Computer Integrated Design and Manufacturing, McGraw Hill, 1991.

Gaps in the syllabus (to meet Industry/Profession requirements)

NIL

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	3		
CO2	3		1	3	2	3
CO3	3	1	2	3		2
CO4	3	2		3	3	2
CO5	3	3		3		1

<34% =1, 34-66% = 2, >66% = 3

Mapping between CO and CD	

CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4, CO5
CD3	Seminars	CO3, CO4, CO5
CD4	Self- learning advice using internets	CO2, CO3, CO4, CO5
CD5	Industrial visit	CO1, CO4, CO5

COURSE INFORMATION SHEET

Course code: PE 512

Course title: SOFT COMPUTING IN MANUFACTURING AUTOMATION

Pre-requisite(s): PE 501

Co- requisite(s): None

Credits: 03 L:3 T: P:

Class schedule per week: 03

Class: M.Tech

Semester / Level: II/5

Branch: Production Engineering (AMS)

Name of Teacher:

Course Objectives

This course enables the students:

A.	To differentiate soft computing tools from hard computation
B.	To learn ANN, Fuzzy Logic and GA and their capabilities to solve complex problems
C.	To apply Artificial Neural Network and its various learning/training algorithms
D.	To learn fuzzy sets, their operations and apply fuzzy rule base to complex problems
E.	To understand various hybrid soft computing applications

Course Outcomes

After the completion of this course, students can

CO1	Distinguish controllers based hard and soft computing tools
CO2	Apply ANN tools for optimization, prediction and search applications
CO3	Apply fuzzy logic tools to inference systems
CO4	Apply genetic algorithm for optimization and search
CO5	Develop hybrid soft computing tools using ANN, fuzzy and GA

Syllabus Module 1

[8L]

Introduction to soft computing and comparison with hard computation, capabilities of soft computing tools, practical applications of soft computing.

Module 2 [8L]

Basic concepts of Artificial Neural Networks (ANN), Single layer and Multi-layer perceptron, Learning Processes, Fundamentals of back propagation neural networks (BPNN), Learning and tuning parameters. Applications of ANN in manufacturing and automation.

Module 3 [8L]

Basic concepts Fuzzy Logic (FL), Fuzzy sets and their operations. Fuzzy memberships and relations, Fuzzification and defuzzification methods, Fuzzy rule generation, Applications of FL in manufacturing and automation.

Module 4 [8L]

Genetic Algorithms: An Overview, Introduction to fundamentals of techniques and applications of genetic algorithms, Selection, fitness function, Cross over, Mutation, Reproduction. GA in problem solving, Implementation of GA. Application of GA in optimization and search

Module 5 [8L]

Hybridization of soft computing tools, Types of hybridization, Fundamentals of hybrid systems like Neuro-Fuzzy, Neuro-Genetic and Fuzzy Genetic hybrids

Text books:

1. Neural Network, Fuzzy logic and Genetic Algorithm: Synthesis and Applications – S.Rajasekaran, G.A and Vijayalakshmi Pai.

Reference books:

1. Fuzzy Logic- Intelligence control and information – Jhon Yen and Reza Langar, Pearson Education
2. Neural Network A Comprehensive Foundation- Simon Haykin, Person Education
3. Genetic Algorithms in Search, Optimization and Machine Learning- D.E. Goldberg, Addison-Wesley, 1989.
4. Fuzzy logic with engineering applications - Ross, T. J, 1997, McGraw-Hill, New York.

Gaps in the syllabus (to meet Industry/Profession requirements)

NIL

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

**COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION
PROCEDURE**

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

Mapping between Objectives and Outcomes

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	1	2		2	2
CO2	1		3		2
CO3	1	2	3	2	
CO4	2				2
CO5	1	2	3		2

< 34% = 1, 34-66% = 2, > 66% = 3

**MAPPING BETWEEN COURSE OUTCOMES AND COURSE
DELIVERY METHOD**

Course Outcomes	Course Delivery Method
CO1	CD1,CD2,CD3, CD4
CO2	CD1,CD2
CO3	CD1, CD2,CD3
CO4	CD1,CD2
CO5	CD1,CD2,CD3, CD4

COURSE INFORMATION SHEET

Course code: PE 513

Course title: MANUFACTURING SYSTEM DESIGN

Pre-requisite(s): None

Co- requisite(s): None

Credits: 3 L:03 T: 00 P: 00

Class schedule per week: 3

Class: M. Tech

Semester / Level: II/5

Branch: Production Engineering (AMS)

Name of Teacher:

Course Objectives

This course enables the students:

A.	To learn the concepts of manufacturing systems
B.	To know the fundamentals of design system, components and processes
C.	To estimate optimizing parameters of product
D.	To redesign the manufacturing systems
E.	To understand the optimization techniques in Manufacturing

Course Outcomes

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

CO1	Evaluate the manufacturing systems and its components
CO2	Design the manufacturing system according to need.
CO3	Analyze the optimization parameter for particular product
CO4	Redesign manufacturing system
CO5	Solve problems on optimization and designing of manufacturing system.

Syllabus

Module 1 [8L]

Introduction of manufacturing systems; Elements of manufacturing systems and their interaction; Recent Manufacturing strategies; Dynamics of manufacturing systems; Performance evaluation of manufacturing systems.

Module 2 [8L]

Design requirements of manufacturing system, Architecture and methodologies of manufacturing system, Framework of Manufacturing Systems, performance measurement and tools of Manufacturing Systems.

Module 3 [8L]

Design of Information system for manufacturing, Parts oriented production information system Development of Knowledge Based manufacturing system. Production control strategies, the importance of Optimization in manufacturing.

Module [8L] **4**

Redesign Methodology, case study of system redesign; Miltenburg's manufacturing system worksheet. System element used for system redesign. Sensitivity analysis of stochastic parameters.

Module 5 [8L]

Concept of artificial intelligence and its application for optimization. Human centered manufacturing system; Role of Manufacturing systems in Industry; Social system for manufacturing system

Text books:

1. Robert E Stein, "Re-Engineering the Manufacturing System" Marcel, Dekker
2. Product Design & Development - Karl. T. Ulrich and Steven D. Eppinger – TMH, Delhi
3. Ulrich Rembold, Christan Blume, Ruediger Dillmann, "Computer Integrated Manufacturing Technology and Systems", Marcel, Dekker.
4. Introduction of work study - ILO, Geneva - Universal Publishing Corporation, Bombay.
5. Motion and Time Study - Ralph M. Bannes - John Wiley & Sons
6. Work Study and Ergonomics - H.S. Shan – Dhanpat Rai & Sons

Reference books:

1. David O' Sullivan, "Manufacturing System Redesign- Creating the Integrated Manufacturing Environment", PTR Prentice Hall
2. Gideon Malevi, "Restructuring the Manufacturing Process Applying the Matrix Method", APICS.

3. Peter Bernus, Laszlo Nemes & Theodore J. Williams, “Architectures for Enterprise Integration”, Chapman & Hall.

Gaps in the syllabus (to meet Industry/Profession requirements) :

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution				
3 Quizzes	30 % (3 × 10%)				
Assignment (s)	10				
Seminar before a committee	10				
Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1		2	1	
CO2	2	1			2	2
CO3	3	2	2	2	1	
CO4	3	2	3	3	1	3
CO5	1	2			3	

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Mapping between CO and CD		
CD	Course Delivery methods	Course Outcomes
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4, CO5
CD2	Tutorials/Assignments	CO2, CO3, CO4
CD3	Seminars	CO4, CO5
CD4	Self- learning advice using internets	CO1, CO2, CO3, CO4, CO5
CD5	Industrial visit	CO3, CO5

COURSE INFORMATION SHEET

Course code: PE 514

Course title: MECHATRONICS SYSTEMS

Pre-requisite(s): None

Co- requisite(s): None

Credits: 03 L: 3 T: 0 P: 0

Class schedule per week: 3

Class: M.Tech

Semester / Level: II/5

Branch: Production Engineering (A.M.S)

Name of Teacher:

Course Objectives:

This course enables the students to:

A.	Understand the concepts of Mechatronics systems and its Applications
B.	Study various types of Sensors, Actuators & Transducers
C.	Gain knowledge on Hydraulic and Pneumatic systems
D.	Gain Knowledge on Data Acquisition systems
E.	Understand the types of Modelling & Simulation Techniques

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Comprehend mechatronic systems, measurement system and control systems
CO2	Select appropriate sensors and transducers for mechatronic applications
CO3	Design hydraulic and pneumatic systems for machine tool automation
CO4	Develop Signal Conditioning and Data Acquisition systems
CO5	Model and Simulate Different types of Mechanical, Electrical & Electronics Systems

SYLLABUS

Module 1: Introduction to Mechatronics [8L]

Introduction to mechatronic systems, measurement system, control systems; Microprocessors and their applications, PLC system, examples of mechatronic system.

Module 2: Sensors and Transducers [8L]

Performance parameters of transducers, photoelectric transducers, flow transducers, optical transducers; Sensors specifications, Different types of sensors, application of sensors, Actuators and its types.

Module 3: Hydraulic and Pneumatic systems [8L]

Hydraulic system, pressure-flow-direction control valves, servo, logic valves. Hydraulic circuit of machine tools; Pneumatic system, Pressure-flow-direction control valves, Pneumatic component symbols, Pneumatic circuit of machine tools

Module 4: Signal Conditioning [8L]

Signal conditioning, Filtering digital signals, Multiplexers, Data acquisition, Signal processing, Pulse modulation, Data presentation systems

Module 5: Modelling and Simulation of systems [8L]

Mechanical, Electrical, Hydraulic and Thermal systems, Dynamic response of system, Mathematical models, Transfer function and frequency response, Closed loop controllers, Simulation and techniques of simulation

Books recommended:

Text Books:

1. Mechatronics 3/e,W, Bolton (Addison Wesley, ISBN 981-235-874-9.
2. Mechatronics (G. K. Vijayaraghavan, K. P. Ramachandran, M. S. Balasundaram),
Wiley Publication
3. Mechatronics System Design 2nd Edition (Devdas Shetty), Cengage Learning

Reference Books

1. Introduction to Mechatronics and Measurement Systems, David G. Alciatore, McGraw Hill Publications
2. Mechatronics: A Foundation Course 1st Edition, Clarence W. de Silva, CRC Press.

Gaps in the syllabus (to meet Industry/Profession requirements) :

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

**COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION
PROCEDURE**

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Self- learning advice using internets
CD5	Industrial visit

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3		
CO2	2		1	2		3
CO3	3	3	3	3		2
CO4	2	2	2	2	2	3

CO5	3	3	3	3	3	2
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< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD2, CD3
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD3,CD6,
CO4	CD1, CD2, CD3,CD6
CO5	CD1,CD2,CD3,CD6

COURSE INFORMATION SHEET

Course code: PE 515

Course title: SMART MANUFACTURING

Pre-requisite(s): None

Co- requisite(s): None

Credits: 03 L:3 T:0 P:0

Class schedule per week: 3

Class: M. Tech

Semester / Level: II/5

Branch: Production Engineering (AMS)

Name of Teacher:

Course Objectives

This course enables the students:

A.	To learn the concepts of CAD/CAM, CIMS and smart manufacturing
B.	To understand the various types of robots and their applications
C.	To gain knowledge about different types material handling systems
D.	To comprehend the concepts of agile and E- manufacturing system
E.	To realise the importance of Industry 4.0 through industrial case studies

Course Outcomes

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

CO1	Classify automated Manufacturing Systems, CAD/CAM and CIMS and smart manufacturing.
CO2	Identify and select different types of robots based on their applications
CO3	Develop basic design criteria for AGVs and AS/RS systems
CO4	Define the concepts of E-manufacturing, IT based supply chain, Cloud based

COURSE INFORMATION SHEET

Course code: PE 516

Course title: AUTONOMOUS SYSTEMS LAB

Pre-requisite(s): None

Co- requisite(s): None

Credits: 02 L: 0 T: 0 P: 4

Class schedule per week: 4

Class: M.Tech.

Semester / Level: II/5

Branch: Production Engineering (AMS)

Name of Teachers:

Course Objectives:

This course enables the students to:

1	Comprehend a real-time concepts of Manufacturing Autonomous systems
2	Be acquainted with standard Autonomous systems and create application programs for different applications
3	Give a hands-on experience of industrial applications and integrate with PLC
4	Identify real scenario for the kinematic parameters and troubleshoot a given autonomous system
5	Develop simple robot simulations using MATLAB for controlling the robot positions

Course Outcomes:

At the end of the course, students should be able to:

CO1	Develop a basic manufacturing autonomous systems
CO2	Create programs for different autonomous applications (Robots and AS/RS)
CO3	Design and create pneumatic and electro-pneumatic circuits using PLC
CO4	Analyze the kinematic and dynamic parameters of a standard robot

CO5	Simulate a given autonomous system using virtual tools like MATLAB and interpret the results
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List of experiments

Experiment No. 1

Basic components and applications of Autonomous systems

Experiment No. 2

Simulation and study the functional details of the various components of the ARISTO robots

Experiment No. 3

Simulation and Writing a program for PTP operation in ARISTO robot software

Experiment No. 4

Robot Workspace Calibration

Experiment No. 5

Simulation and Writing a program for repeatability through ARISTO robot software

Experiment No. 6

Simulation and Writing a program for circle and spline command through ARISTO robot Software

Experiment No. 7

Simulation and study the functional details of the various components of the Automated storage & Retrieval System (AS/RS)

Experiment No. 8

Simulation and Writing a program for rack to conveyor and conveyor to rack through AS/RS software

Experiment No. 9

Introduction to PLC and Ladder Logic Programming

Experiment No. 10

Programming PLC for Pick and Place Tasks

Experiment No. 11

Programming using MATLAB to perform Autonomous Simulations

Experiment No. 12

Simulate a Robot in MATLAB and control its position

Books recommended:

TEXT BOOK

4. Mikell P. Grover, E. Zimmer, "Computer Aided Design and Manufacturing (CAD/CAM)", Pearson Publication, 2nd Edition, 2006. (T1)
5. Rao, P.N. "CAD/CAM: Principles and Applications", McGraw Hill Publication, 2nd Edition, 2004. (T2)

REFERENCE BOOK

3. Radhakrishnan P., Subramaniam S., "CAD CAM and CIM", New Age International, 2002 (R1)
4. David Bedworth, "Computer Integrated Design and Manufacturing" Tata McGraw Hill, New Delhi, 1998 (R2)

Course Evaluation:

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution				
Day to day performance & Lab files	30				
Quiz (es)	10				
Viva-voce	20				
Semester End Examination	% Distribution				
Examination: Experiment Performance	30				
Quiz	10				
Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous internal assessment					
Semester End examination					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Gaps in the syllabus (to meet Industry/Profession requirements) :

Design of real-time Industrial projects.
POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

Design optimization for industrial projects, Fractional order controller
POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1		2	1	2	2	
CO2	1	2	1	2	3	
CO3	2	1	3	2	3	2
CO4		2	2	3	3	
CO5	1	1	1	3	1	1

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD3
CO2	CD1, CD3, CD7
CO3	CD1, CD3, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD6, CD7

COURSE INFORMATION SHEET

Course code: PE 517

Course title: COMPUTER AIDED DESIGN AND DRAFTING LAB

Pre-requisite(s): None

Co- requisite(s): None

Credits: 02 L: 0 T: 0 P: 4

Class schedule per week: 4

Class: M.Tech.

Semester / Level: II/5

Branch: Production Engineering (AMS)

Name of Teacher:

Course Objectives:

This course enables the students to:

1	Learn the concepts and principles of Computer aided Design & Drafting (CADD)
2	Understand the various types of CAD Software's like CATIA V5, Unigraphics NX etc.
3	Understand concepts of designing and drafting of various manufacturing components.
4	Understand the concepts of parametric 3D part modelling/Assembly
5	Understand the concepts of CAD Software, Design & Assemble various parts of Manufacturing with focus on Industrial Applications

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Apply the concepts of concepts of designing using 3D modeling software
CO2	Create Designs of various real-world Industrial components by using mechanical design Software's like CATIA, Unigraphics, etc.
CO3	Produce models of an industrial component by interpreting 3D part drawings using

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1		2	1	2	2	
CO2	1	2	1	2	3	
CO3	2	1	3	2	3	2
CO4		2	2	3	3	
CO5	1	1	1	3	1	1

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD3
CO2	CD1, CD3, CD7
CO3	CD1, CD3, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD6, CD7

COURSE INFORMATION SHEET

Course code: PE 517

Course title: COMPUTER AIDED DESIGN AND DRAFTING LAB

Pre-requisite(s): None

Co- requisite(s): None

Credits: 02 L: 0 T: 0 P: 4

Class schedule per week: 4

Class: M.Tech.

Semester / Level: II/5

Branch: Production Engineering (AMS)

Name of Teacher:

Course Objectives:

This course enables the students to:

1	Learn the concepts and principles of Computer aided Design & Drafting (CADD)
2	Understand the various types of CAD Software's like CATIA V5, Unigraphics NX etc.
3	Understand concepts of designing and drafting of various manufacturing components.
4	Understand the concepts of parametric 3D part modelling/Assembly
5	Understand the concepts of CAD Software, Design & Assemble various parts of Manufacturing with focus on Industrial Applications

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Apply the concepts of concepts of designing using 3D modeling software
CO2	Create Designs of various real-world Industrial components by using mechanical design Software's like CATIA, Unigraphics, etc.
CO3	Produce models of an industrial component by interpreting 3D part drawings using

	Computer Aided Design, Drafting software.
CO4	Apply the concepts of CAD Drawings and Assemble various components of Manufacturing with focus on Industrial Applications
CO5	Will be able to generate part/assembly drawings.

List of experiments

Experiment No. 1

Introduction to Basics of Computer Aided Design. Sketcher, Drafting & 3D Modeling.

Experiment No. 2

Exercise on Padding, Pocketing & Revolving.

Experiment No. 3

Exercise on Nut, Bolt & Threads

Experiment No. 4

Exercise on Chamfer, Fillets, Mirror & Offset

Experiment No. 5

Exercise on Hole & Patterns

Experiment No. 6

Exercise on Ribs & Shell

Experiment No. 7

Exercise on Sweep

Experiment No. 8

Exercise on Blend

Experiment No. 9

Exercise on Datum plane & Axis

Experiment No. 10

Exercise on Assembly-I: Foot-step Bearing

Experiment No. 11

Exercise on Assembly-II: Plumber-Block

Experiment No. 12

Exercise on Assembly-III: Bench-Vice assembly

Books recommended:

TEXT BOOK

1. Rao, P.N. "CAD/CAM: Principles and Applications", McGraw Hill Publication, 2nd Edition, 2004. (T1)
2. Mikell P. Grover, E. Zimmer, "Computer Aided Design and Manufacturing (CAD/CAM)", Pearson Publication, 2nd Edition, 2006. (T2)

REFERENCE BOOK

1. David Bedworth, "Computer Integrated Design and Manufacturing" Tata McGraw Hill, New Delhi, 1998. (R1)

2. Radhakrishnan P., Subramaniam S., “CAD CAM and CIM”, New Age International, 2002
(R2)

Course Evaluation:

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution				
Day to day performance & Lab files	30				
Quiz (es)	10				
Viva-voce	20				
Semester End Examination	% Distribution				
Examination: Experiment Performance	30				
Quiz	10				
Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous internal assessment					
Semester End examination					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Gaps in the syllabus (to meet Industry/Profession requirements) :

Design of real-time Industrial projects.

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

Design optimization for industrial projects, Fractional order controller

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3	3	
CO2	1	2	1	3	2	1
CO3	2	1	3	2	3	2
CO4	2	2	2	3	2	1
CO5	1	2	3	3	3	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD3
CO2	CD1, CD3, CD7
CO3	CD1, CD3, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD6

COURSE INFORMATION SHEET

Course code: PE 601

Course title: Data Analytics

Pre-requisite(s): NA

Co- requisite(s): PE 605

Credits: 03 L: 03 T: 00 P: 00

Class schedule per week: 3

Class: M. Tech

Semester / Level: III/6

Branch: Production Engineering (A.M.S)

Name of Teacher:

Course Objectives

This course enables the students:

A.	To learn the concepts of Descriptive Statistics
B.	To know the fundamentals of Analysis of variance and Hypothesis test
C.	To understand the various types of statistical approach for identifying clustering of data
D.	To know about supervise learning and support vector machines algorithms
E.	To understand basics of Neural network method

Course Outcomes

After the completion of this course, students will be: