VIMAL JYOTHI
ENGINEERING COLLEGE (AUTONOMOUS)
CHEMPERI – KANNUR I WWW.VJEC.AC.IN

VJEC B. Tech. Syllabus 2024

Minor Degree
in
Manufacturing
Offered By: (Mechanical Engineering)

MINOR DEGREE STRUCTURE

Offered by Department of Mechanical Engineering

Minor is an additional credential a student may earn if he/she does 15 credits worth of additional learning in a discipline other than her/his major discipline of B. Tech degree. The objective is to permit a student to customize their engineering degree to suit their specific interests. Upon completion of an engineering minor, a student will be better equipped to perform interdisciplinary research and will be better employable. Engineering minors allow a student to gain interdisciplinary experience and exposure to concepts and perspectives that may not be a part of their major degree programs. The academic units offering minors in their discipline will prescribe the set of courses and/or other activities like projects necessary for earning a minor in that discipline.

Mechanical Engineering (ME) plays a crucial role in transforming day-to-day life through a multitude of innovative technologies and products. The Mechanical Engineering minor degree in "Manufacturing "at Vimal Jyothi Engineering College is designed to provide students from other disciplines to undergo an opportunity to explore the vast domain of manufacturing field and equip themselves with essential knowledge and skills in this field.

- **An academic major** is the academic discipline to which an undergraduate student formally commits. A student who successfully completes all courses required for the major qualifies for an undergraduate degree.
- **Academic minor** is an academic discipline outside of the student's academic major in which he or she takes a small number of classes.

Curriculum – Minor in Manufacturing

Semester	Course Code	Course Title	L	T	P	R	C	CIA	ESE
S3	MNMET309	MATERIAL SCIENCE & TECHNOLOGY	3	1	0	0	4	40	60
S4	MNMET409	MANUFACTURING TECHNOLOGY	3	1	0	0	4	40	60
S5	MNMET509	MACHINE TOOLS ENGINEERING/ MOOC	3	1	0	0	4	40	60
S6	MNMET609	INDUSTRIAL ENGINEERING/ MOOC	3	0	0	0	3	40	60
Total Credit							**15**		

SEMESTER S3

MATERIAL SCIENCE AND TECHNOLOGY

Course Code	MNMET309	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	ESE Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To recognize the importance of the microstructures and physical properties of the materials to enable the material selection process.
2. To develop an understanding of the crystal imperfections and basics of crystallography.
3. To recognize the importance of alloying and its effect on mechanical properties.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Earlier and present development of atomic structure (Self-Study)- primary bonds: - secondary bonds - Properties based on atomic bonding. classification of engineering materials. Crystallography: - SC, BCC, FCC structures.	7
2	Crystal imperfections: Point defects, Line defects, Surface defects, Volume defects. Basics of crystallography, Polishing and etching, Metallographic characterizations of metallic materials. SEM, TEM. Mechanism of crystallization: homogeneous and heterogeneous nuclei formation Hall - Petch theory.	7
3	Mechanical properties: Tensile properties, Hardness and hardness measurement, Fatigue, S-N curve, Creep, DBTT. Limitations of pure metals and need of alloying (Self-Study) - classification of alloys, solid solutions, Hume Rothery`s rule Types of steels- low, medium and high carbon steels, stainless steels, alloy steels and their applications. Heat treatment methods and enhancement of mechanical properties.	7
4	Composites: -types and properties - polymer matrix composites - metal matrix composites. Ceramics: - types and applications Semiconductor materials - dielectric materials- conductors - resistor materials Smart materials- bio materials (Self-Study)- super alloys.	7

Course Assessment Method

(CIA: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Internal Examination- 3 (Written)	Total
5	15	5	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, Each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs) and Assessment Tool

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)	Assessment Tool
CO1	Explain the evolution of atomic structure, bonding mechanisms, and crystal structures, and classify engineering materials based on their bonding and crystallography.	**K2**	Written exam & Assignments
CO2	Identify different types of crystal imperfections, describe metallographic techniques, and analyze crystallization mechanisms and their influence on material strength.	**K2**	
CO3	Evaluate mechanical properties of materials, explain the role of alloying and classification of steels, and understand heat treatment methods to enhance performance.	**K3**	
CO4	Classify and describe the properties and applications of composites, ceramics, electronic materials, smart materials, biomaterials, and superalloys.	**K3**	

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create*

CO-PO Mapping Table

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	-
CO2	3	3	2	3	2	-	-	-	-	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Material Science and Engineering, 2014	Callister William.D	John Wiley	2014

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The science and engineering of materials	Donald R Askeland	Thomson	
2	Introduction to Physical Metallurgy	Avner H Sidney	Tata McGraw Hill	2009
3	Material Science and Engineering	Raghavan V	Prentice hall	2004

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/113/105/113105103/

SEMESTER S4

MANUFACTURING TECHNOLOGY

Course Code	MNMET409	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To gain theoretical and practical knowledge in manufacturing processes and to develop an understanding of the dependent and independent variables that control production processes.
2. Provide a detailed discussion on the welding process and the physics of welding. Introduce students to different welding processes, weld testing, and advanced processes to be able to appreciate the practical applications of welding.
3. Generate solutions to problems that may arise in manufacturing engineering

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	General Classification of Manufacturing Processes (Self-Study) Casting-Characteristics of sand (Self-Study), design of patterns, cores, chaplets, solidification of metals, elements of gating system, risers, chills, numerical problems, defects in castings. Special casting process- Shell moulding, precision investment, die casting, centrifugal casting, continuous casting and squeeze casting.	9
2	Welding: Classification, Fusion and Solid-state welding processes (Self-Study) Gas Welding - Oxyacetylene welding-chemistry, types of flame and its applications Arc welding- applications, process parameters, consumable and non-consumable arc welding, SMAW; GTAW; GMAW; PAW, ultrasonic welding, electron beam welding, laser beam welding Resistance welding applications, process parameters, numerical problems weldability of ferrous and non-ferrous metals, residual stresses and distortion, defects in welding and Brazing - soldering - adhesive bonding (Self-Study)	9

3	Metal Forming: Plastic deformation and yield criteria − hot and cold working processes Rolling- Flat-rolling process, rolling force and power, numerical problems, types of rolling mills, rolling defects, miscellaneous rolling processes. Sheet metal operations- Press tool operations- Shearing, Tension, Compression, Tension and compression operations, applications (Self-Study) Types of Progressive dies, Compound dies, and Combination dies.	**9**
4	Forging-Forging load, numerical problems, Various methods, applications, defects in forging – Wire, Rod, and tube drawing - mechanics of rod and wire drawing, drawing defects – Deep drawing. Extrusion- Metal flow, mechanics of extrusion, numerical problems, miscellaneous processes, defects in extrusion, applications (Self-Study)	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Internal Examination- 3 (Written)	Total
5	**15**	**5**	**10**	**5**	**40**

List of sample micro-projects

1. Sand moulding of a spur gear
   Abstract:
   This project involves designing a simple pattern, preparing a sand mold, and casting an aluminum or mild steel component. The effect of different molding sand properties on casting quality is analyzed.

2. Design and Fabrication of a Gating System
   Abstract:
   A well-designed gating system improves casting quality by controlling metal flow. This project optimizes sprue, runner, and riser design.

3. Powder Metallurgy – Compacting and Sintering of Metal Powders
   Abstract:
   Powder metallurgy is used to make precision metal parts. This project produces simple sintered parts using metal powders, compacting dies, and heat treatment.

4. Effect of Welding Current on Weld Bead Characteristics
   Abstract:
   This project analyzes how varying welding current affects weld bead width, penetration, and strength in SMAW welding.

5. Gas Welding – Flame Characteristics and Weld Strength Analysis

Abstract:
This project studies the effect of different oxyacetylene flames (neutral, carburizing, oxidizing) on weld quality.

6. Comparative Study of MIG, TIG, and Arc Welding
   Abstract:
   This project compares the strength, heat input, and distortion of welds produced by MIG, TIG, and SMAW welding.

7. Spot Welding Experiment on Thin Metal Sheets
   Abstract:
   Spot welding is widely used in the automobile and sheet metal industries. This project measures the strength of spot-welded joints.

8. Analysis of Heat-Affected Zone (HAZ) in Welding
   Abstract:
   The heat-affected zone (HAZ) influences weld properties. This project studies HAZ using a microscope and hardness tester.

9. Design and Fabrication of a Simple Hand-Operated Sheet Metal Bender
   Abstract:
   This project involves making a manual sheet metal bending tool for small-scale operations. The tool is designed to bend thin metal sheets at various angles.

10. Experimental Study of Extrusion Process.
    Abstract:
    Extrusion is a metal forming process where a billet is forced through a die to achieve a desired cross-section. This experiment investigates the direct extrusion of aluminum to analyze surface finish, defects, and material flow.

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	**2**
2	Contribution in Progress Presentations and Question Answer Sessions	**2**
3	Involvement in the project work and Team Work	**2**
4	Execution and Implementation	**2**
5	Final Presentations	**2**
Total		**10**

Project Assessment and Evaluation criteria (10Marks)

1. Project Planning and Proposal (2 Marks)
- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (2 Marks)
- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (2 Marks)
- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (2 Marks)
- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (2 Marks)
- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	60

Course Outcomes (COs) and Assessment Tool

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)	Assessment Tool
CO1	Classify different techniques of casting	**K2**	Written exam & microproject
CO2	Summarize powder metallurgy processes	**K2**	
CO3	Categorize welding processes according to welding principles and materials.	**K2**	
CO4	Determine forming load associated with rolling, forging, drawing, extrusion, and sheet metal forming	**K3**	
CO5	Develop products, processes or technologies for socially relevant applications	**K3, K4, K5**	

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	-	-	-	-	-	2	-
CO2	3	3	-	-	-	-	-	-	-	2	-
CO3	3	3	2	-	-	-	-	-	-	2	-
CO4	2	3	2	-	-	-	-	-	-	2	-
CO5	3	3	3	-	3	3	-	2	-	2	-

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Manufacturing Science	Amitabha Ghosh Asok Kumar Mallik	Affiliated East-West Private Limited	2nd Edition 2010
2	Manufacturing Engineering and Technology	SeropeKalpakjian Steven R. Schmid	Pearson	
3	Manufacturing Technology Volume -1	P N Rao	Tata McGraw Hill	
4	Fundamentals of Modern Manufacturing	Mikell P. Groover	JOHN WILEY & SONS, INC.	4th Edition 2010
5	Introduction to Manufacturing Processes	John A. Schey	Boston : McGraw-Hill	3 rd Edition 2010
6	Materials and Processes in Manufacturing	E. Paul DeGarmo, J. T. Black & Ronald A. Kohser	JOHN WILEY & SONS, INC	9th Edition 2012
7	Manufacturing Processes	H.N. GuptaR.& C. Gupta	New Age International (P) Ltd., Publishers	2nd Edition 2009
8	Metal Forming: Mechanics and Metallurgy	William F. Hosford and Robert M. Caddell	Cambridge University Press	Fourth Edition (2011)

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	American Society for Metals - ASM Metals Handbook, Vol. 14	Joseph R. Davis, S. L. Semiatin,	Forming and Forging ASM International	1989
2	Tool design	Donalson cyril, LeCain, Goold, Ghose:-	McGraw Hill	
3	Cold and Hot Forging Fundamentals and Applications	Taylan Altan, Gracious Ngaile, Gangshu Shen	ASM International	2004
4	Foundry Technology	Peter Beeley	Butterworth-Heinemann	
5	Manufacturing Processes and Systems.	Phillip F. Ostwald & Jairo Muñoz	JOHN WILEY & SONS, INC.	9th Edition January 1997
6	Manufacturing Science	Amitabha Ghosh and Asok Kumar Mallik	East-West Press Pvt. Ltd	2nd Edition 2010
7	Fundamentals of Metal Forming –	Robert H. Wagoner and Jean-Loup Chenot	Cambridge University Press	First Edition (2001)
8	Manufacturing Science	Amitabha Ghosh and A.K. Mallik	East-West Press	: Second Edition (2010)

SEMESTER S5

MACHINE TOOLS ENGINEERING

Course Code	MNMET509	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand machine tools and select appropriate tools for operations.
2. To develop supervisory and teamwork skills for solving shop floor problems.

SYLLABUS

Module No	Syllabus Description	Contact Hours
1	Definition of machining−brief history of machining−role of machining in society. Introduction to metal cutting: Elements of cutting process− orthogonal cutting− mechanism of chip formation−machining variables -types of chips−chip breaker− geometry of single point cutting tool− tool nomenclature- speed, feed, depth of cut – cutting fluids- effect of machining variables on surface roughness- Cutting tool materials−types−application. Machinability−tool life and wear.	10
2	General purpose machine tools – Lathe: Principle of operation, construction details, types of lathe and specification, main operations, machining time calculation. Drilling Machines: Principle of operation, construction details, types of drilling machines and specification, machining time calculation. Milling Machines: Principle of operation, types and specifications, principal parts, types of milling cutters, up milling, down milling, machining time calculation. Grinding Machines: Classification, operations, surface, cylindrical and centerless grinding, grinding wheels, specification, types of abrasives-dressing and truing of grinding wheels. (Self-Study)	12
3	Machine tools with Computer Numeric Control: Principle of operation of CNC system−basic components of CNC system− classification of CNC systems− open loop control and closed loop control− point to point and continuous path control− absolute positioning and incremental positioning−CNC lathe−construction and operation – CNC milling machine−construction and operation (elementary treatment only)	10
4	Non-conventional techniques in machining: Electric Discharge Machining (EDM): mechanisms of metal removal- elements of an EDM− spark generation− application of EDM (Self-Study) – Wire-cut EDM-features. UltraSonic Machining (USM): mechanism of metal removal- elements of USM applications. Water Jet Machining (WJM): mechanism of metal removal-elements of WJM- applications. (Self-Study)	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Internal Examination- 3 (Written)	Total
5	15	5	10	5	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	60

Course Outcomes (COs) and Assessment Tool

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)	Assessment Tool
CO 1	Explain the fundamental concepts of machining, including metal cutting mechanics, chip formation, tool geometry, machining variables, and tool materials.	K2	Written exam & Assignments
CO 2	Utilize appropriate machine tools and cutting parameters to perform operations such as turning, drilling, milling, and grinding, and compute machining time.	K3	
CO 3	Interpret the principles of CNC machining, including system components, classifications, control methods, and positioning systems.	K2	
CO 4	Apply non-conventional machining techniques such as EDM, USM, and WJM to achieve intricate profiles and close tolerances in complex jobs.	K3	

CO-PO Mapping Table

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	2
CO3	3	-	-	-	1	-	-	-	-	-	2
CO4	3	2	-	-	-	-	-	-	-	-	2

Note: *1.' Slight (Low), 2.- Moderate (Medium), 3. Substantial (High), - No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Production Technology	R.K.Jain	Khanna publishers	17th ed., 2013.
2	Elements of Workshop Technology Vol. II	Hajra Choudhary	Media Promoters & Publishers Pvt. Ltd.	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Manufacturing Engineering and Technology	Serope Kalpakjian, Steven R. Schmid	Mc Graw Hill	8th ed. Pearson.
2	Workshop Technology	Chapman W.A.J.	Viva books (P) Ltd	1998
3	Precision Machining Technology	Peter J. Hoffman, Eric S. Hopewell et al.	Engg. Press, Texas	Cengage Learning 2014
4	Grinding Technology: Theory and application of Machining with Abrasives	Malkin Stephen	Industrial press.	2008

SEMESTER-S6

INDUSTRIAL ENGINEERING

Course Code	MNMET609	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce core concepts and tools of Industrial Engineering.
2. To apply work study and planning techniques in industry.

SYLLABUS

Module No	Syllabus Description	Contact Hours
1	Core functions and responsibilities of Industrial Engineers, Productivity concepts, measurement, Techniques for productivity improvement (Lean, Kaizen, etc.),Basic production cost concepts, Make-or-Buy analysis, Cost-Volume-Profit (CVP) analysis – simplified problems, Introduction to Break-even analysis, Basics of Ergonomics and Human Factors, Man-Machine systems, Workplace and workstation design using anthropometry, Introduction to Value Engineering (Self-Study)	9
2	Work study-procedure, Method Study-steps-recording techniques-operation process chart-flow process chart-two hand process chart-multiple activity chart. Micro-motion study-SIMO chart- critical examination. Principle of motion economy. Work measurement- modern work measurement techniques (Work Sampling, MOST, MTM)- Time Study-Steps in time study, Plant location, plant layout and material handling	9
3	Principles of material handling - Unit load concept- Automated Material Handling Systems- AGVs. Depreciation -Method of providing for depreciation- straight line method- Declining balance method- Sinking fund methods (Problems), Production Planning and control. Demand forecasting-Aggregate planning- methods, Material Requirement Planning -Gantt charts	9
4	Inventory Control, Inventory models – Basic model -price discounts -problems – determination of safety stock - Selective inventory control techniques, Quality control (Self-Study)- Statistical quality control - control charts for X and R (problems) Reliability-causes of failures- Bath tub curve -System reliability. Introduction to concepts of, TQM, ISO, Six Sigma and Quality circles (Self-Study). Project management- Critical Path Method, PERT.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Internal Examination- 3 (Written)	Total
5	15	5	10	5	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out Of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	60

Course Outcomes (COs) and Assessment Tool

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)	Assessment Tool
CO 1	Apply the core concepts of Industrial Engineering including productivity improvement techniques, cost analysis, ergonomics, and value engineering for efficient system design and decision-making.	K3	Written exam & Assignments
CO 2	Apply work study, method study, and work measurement techniques to analyze and improve industrial operations and layout planning.	K3	
CO 3	Apply the principles of material handling, depreciation methods, and production planning techniques for effective forecasting, scheduling, and resource management in manufacturing systems.	K3	
CO 4	Apply techniques of inventory control, quality management, reliability analysis, project management, and replacement analysis to improve decision-making in industrial systems.	K3	

CO-PO Mapping Table

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	2	-	-	3	3	-	-	-	2
CO2	-	3	2	-	-	2	-	-	-	-	-
CO3	-	2	2	3	2	-	-	-	-	-	3
CO4	-	3	3	3	3	3	3	-	-	-	2

Note: *1.' Slight (Low), 2.- Moderate (Medium), 3. Substantial (High), - No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Industrial Engineering & Production Management	Martand Telsang	S. Chand	Third revised edition 2018
2	Industrial Engineering	B. Kumar	Khanna Publishers	Tenth Edition 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Production management	E. S. Buffa	John Wiley	1983
2	Statistical Quality Control	Grant and Ieven Worth,	McGraw Hill	2000
3	Motion and Time Study	Ralph M Barnes	Wiley	1980
4	Facility Layout and Location: An Analytical Approach	Richard L. Francis	McGinnis Jr., John A. White	2nd Edition,1991