Curriculum
for
Master of Technology
in
Production Engineering
(PRD)

Department of Mechanical Engineering

Delhi Technological University

Shahbad-Daulatpur, Delhi-110042

M.Tech. (Production Engineering)

M.Tech. (Production Engineering) course is meant for those candidates, who are aspiring of higher education in the area of Production Engineering. The basic purpose of the course is to serve the society and the nation through teaching, research and development in the area of Production Engineering. Our aim is to build a center of excellence to give the exposure of Production processes to improve the organizational efficiency and effectiveness.

The overall purpose of the proposed M.Tech. Programme is to establish a cohesive and expanding base of research Production Engineering. It will help in the sustainable growth of the industry, excellence in integrated research and education, and increase in national and international stature and economic competitiveness of Indian industries.

Nowadays, Production Engineering has attracted the attention of the researchers and practitioners to solve the industrial problems considering the sustainability and inclusive growth. Demand for the goods and services have been increasing day by day, but the availability of the resources is limited. Thus, It becomes important to improve the way of operations and design of the systems so that the resources can be conserved for future generation. It is important for the industry, society and nation to fulfil the need of the people without harming the ecological systems. The professional must be given a proper exposure of the sustainable growth of the economy. Considering these points, the curriculum of Production Engineering has been designed including the recent development in the technology, industrial constraints, and need of the society.

University Vision

"To be a world class university through education, innovation and research for the service of humanity "

University Mission

1. To establish centres of excellence in emerging areas of science, engineering, technology, management and allied areas.
2. To foster an ecosystem for incubation, product development, transfer of technology and entrepreneurship.
3. To create environment of collaboration, experimentation, imagination and creativity.
4. To develop human potential with analytical abilities, ethics and integrity.
5. To provide environment friendly, reasonable and sustainable solutions for local & global needs.

Program Educational Objectives PEOs

The objectives of the M.Tech. Programme in Production Engineering are:

PEO 1: To develop the scientific and engineering manpower of high quality to cater the need of the industries and institutes.

PEO 2: To provide a broad concept of Production Engineering.

PEO 3: To provide a deeper understanding of the area of specialization to solve the production problems.

PEO 4: To create some innovations for sustainable manufacturing systems.

PEO 5: To provide a capacity to learn continually and interact with interdisciplinary groups.

PEO 6: To develop the students with a capability to cater the requirements and aspirations of the society.

Program Outcomes (PO)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering

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Programme Specific Outcomes (PSOs)

PSO 1: Apply software skills in the field of decision making, optimization, simulation and modeling, statistics for optimal utilization of the different resources and improving the efficiency and affectiveness of the various processes in the industry.

PSO 2: Recognize the need for lifelong learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PSO 3: The student will be employable, able to develop entrepreneurship and be equipped in applying knowledge of Production Engineering in solving various real time problems and also pursue higher studies.

With these objectives in mind, the M.Tech. Programme has been designed to include courses of study, practicals/seminars and project/thesis through which a student may develop his/her concepts and intellectual skills. The procedures and requirements stated in this proposal embody the philosophy and regulations of the M.Tech. education and ensure a high standard of performance at the University and industries.

This will certainly expand the demonstrated capability of the University in the area of Production Engineering applications and to explore research activities that broaden and expand research expertise in this field. It will definitely find appropriate opportunities for educational outreach activities and training courses for other institutes and universities near Delhi to create awareness and to stimulate interest in Production Engineering.

Eligibility Criteria: Students with Bachelor degree (4-years degree Programs; B.Tech./B.E/B.Sc.Engg., and equivalent degree) in Industrial / Manufacturing / Welding /Automation & Robotics /Automobile /Aeronautical/Aerospace/Energy/CADM/CIM/ foundry /Marine /Mechatronics/Metallurgy/ Mining/Tool and Die/Agriculture or equivalent of Engineering will be eligible to take admission in this program. For scholarship a valid GATE Score is mandatory.

Total Intake: 25

DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)

SCHEME OF FULL TIME M. TECH as per NEP-2020

MASTER OF TECHNOLOGY IN INDUSTRIAL ENGINEERING AND MANAGEMNET(IEM)

Semester-I

Code	Type	Cr	L-T-P	Total Credits	Level
PRD 501	Theory of Metal Cutting	**4**	3-0-2	24	500-599
PRD 503	Advanced Casting Processes	**4**	3-0-2		
PRD 505	Plasticity & Metal Forming	**4**	3-0-2		
PRD 507	Metrology	**4**	3-0-2		
	Department Elective -1	**4**			
PRD 511	Computer Aided Design / Computer Aided Manufacturing		3-0-2		
PRD 513	Computer Integrated Manufacturing Systems		3-0-2		
PRD 515	Mechatronics		3-0-2		
PRD 517	Principles of Machine Tools		3-1-0		
PRD 519	Automation in Manufacturing		3-0-2		
	Self-Study				
PRD 551	Seminar	**2**	-		
PRD 553	MOOC				
	Skill Enhancement Course 1				
PRD 541	IT in manufacturing Enterprise	**2**	0-0-4		
PRD 543	Professional Software		0-0-4		
	Audit Course	**0**			
UEC 501	English for Research Paper writing		2-0-0		
UEC 503	Disaster Management		2-0-0		
UEC 505	Sanskrit for technical knowledge		2-0-0		
UEC 507	Value Education		2-0-0		
UEC 509	Constitution of India		2-0-0		
UEC 511	Pedagogy Studies		2-0-0		
UEC 513	Stress Management by Yoga		2-0-0		

DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)

SCHEME OF FULL TIME M. TECH as per NEP-2020

MASTER OF TECHNOLOGY IN COMPUTER AIDED ANALYSIS & DESIGN

Semester-II

Code	Type	Cr	L-T-P	Total Credits	Level
PRD 502	Welding Processes & Metallurgy	**4**	3-0-2	24	500-599
PRD 504	Automation & Robotics	**4**	3-0-2		
	Department Elective -2				
PRD 520	Materials Management	**4**	3-1-0		
PRD 522	Precision Engineering		3-0-2		
PRD 524	Operation Research		3-1-/0		
PRD 526	Methods Engineering and Ergonomics		3-0-2		
PRD 528	Composite Materials and Processing		3-0-2		
	Department Elective -3				
PRD 530	Maintenance Management	**4**	3-1-0		
PRD 532	Managerial Concept & Organizational Behaviour		3-1-0		
PRD 534	Industrial Quality Control		3-1-0		
PRD 536	Supply Chain Management		3-0-2		
PRD 538	Production & Operation Management		3-0-2		
UEC 502	Research Methodology & IPR	**4**	3-1-0		
	Skill Enhancement Course 2				
PRD 540	Industrial Training	**4**	0-0-8		
PRD 542	Professional Software		0-0-8		
	NHEQF Level				**6.5**

Semester-III					
Code	**Type**	**Cr**	**L-T-P**	**Total Credits**	**Level**
PRD 601	Advanced Machining Processes	**4**	3-0-2	16	**600-699***
	Open Elective				
OME 601	Optimization Techniques	4	3-1-0		
PRD 603	Minor Project/Research Thesis/Patent	8	-		
Semester-IV					
Code	**Type**	**Cr**	**L-T-P**	**Total Credits**	**Level**
PRD 604	Major Project/Research Thesis/Patent	16	-	16	**-**
	NHEQF Level				**7.0**

ANNEXURE–IV

SEMESTER- I

Course code: Course Title	Course Structure			Pre-Requisite
	L	T	P	
PRD 501: Theory of Metal Cutting	3	0	2	**NIL**

Course Objective: To familiarize the students with tool nomenclature and cutting forces, about heat distribution and thermal aspects of machining, knowledge on tool materials, tool life and tool wear. To impart knowledge on tool design and selection of machine tools. To comprehend the design of a variety of tools used in practical applications.

S. No.	Course Outcomes (CO)
CO1	To understand the basics of single point and multipoint cutting tools.
CO2	To understand the concepts & theories in metal cutting. Study of recent advancement in cutting tool materials.
CO3	To identify the problem and applying the fundamental concepts in solving the problem arising in metal cutting.
CO4	To select the tool and work-piece temperature and their effect on quality. To develop the skills of effective utilization of the cutting fluids.
C05	To apply the concepts in practical aspects of tool wear mechanisms, tool life, Machinability, their economic aspects and technological aspects.

CO-PO Articulation Matrix

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems
PO2: An ability to write and present a substantial technical report/document
PO3: An ability to demonstrate expertise over the area as per the specialization of the program.
PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.
PO-5: To be able to apply the research knowledge for solution to industry specific problems.
PO6: To demonstrate a master degree over the area as per Production Engineering.
The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.
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S. No.	Content (PRD 501: Theory of Metal Cutting)	Contact Hours
Unit 1	Mechanics of single point and multipoint cutting and abrasive metal removal processes, cutting forces	8
Unit 2	Analysis of work tool system as influenced by tool and work materials, tool geometry and environmental and process variables,	8
Unit 3	Heat transfer and temperature distribution, cutting fluids, Mechanics of tool wear, Tool life, Economics of metal removal, surface finish and dimensional accuracy.	9
Unit 4	Tool Design, Tool design consideration, Selection of tool materials, Tooling economics and safety as related to tool design. Design of Single point cutting tools,	8
Unit 5	Design of Carbide and Ceramic tipped tools, Design of Chip breakers, Design of Multi point cutting tools, Design of Broaches, Twist drill, Reamers and Milling cutters.	9
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Metal cutting principles by M C Shaw, Oxford University press	2004
2	Metal cutting Theory and practice by A Bhattacharya, New Central Book Agency	2017
3	Fundamentals of Metal Cutting and Machine Tools by B.L. Juneja, Nitin Seth, G.S. Sekhon, New Age Publishers	2017

**: Latest edition of the title of author may please be listed.*

Course code: Course Title	Course Structure			Pre-Requisite
PRD503: Advanced Casting Processes	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To familiarize the students with the major concepts associated with metal casting. To impart a knowledge on design of gating & riser system, grain growth, solidification of metal and alloys, casting defects and inspection. To have a basic understanding of foundry practices and processes.

S. No.	Course Outcomes (CO)
CO1	To understand the uses of various types of casting methods sand, materials, moulding materials and additives. Bonding mechanism of the clay and types.
CO2	To identify the mathematical and science principles to understand the basic concepts for designing the riser, gating and various design aspects and complex models.
CO3	To formulate the various reasons for casting defects and their remedies. Study of various inspection methods in order to make the products without defects.
CO4	To select and study different metallurgical reactions of the various casting steels, alloys, composite materials.
CO5	To apply the concepts in real-life applications with simulations, in cutting edge & newer technology, enhancement of yielding in casting.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content (PRD503: Advanced Casting Processes)	Contact Hours
Unit 1	Casting Processes, Classification, Characteristics of sand-casting processes, metal mould casting processes and casting processes using other mould/core materials, Characteristics and selection of molding sand; Bonding Theory	8
Unit 2	Solidification of castings, casting design considerations, gating system design, riser design, nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Rate of solidification, macrostructure and microstructure. Solidification contraction; Mould-metal interface reactions.	9
Unit 3	Cast metals and alloys, Specific considerations to Grey CI, steel and non ferrous foundry practices. Inoculation and gas removal methods.	8
Unit 4	Casting defects; their causes and their removal, inspection of castings. Quality control in foundries Metal matrix composites and their properties and suitability as casting materials	9
Unit 5	Special casting processes. Foundry mechanization pollution control in foundries, recent developments.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Foundry Engineering by Taylor H.F., M.C.Flemings and J.Wulff., John Wiley	1959
2	Foundry Technology by Beely P.R. Butterworths, London	1972
3	Principles of metal castings by Heine R.W., C.R. Loper and P.C Rosenthal, Mc Graw-Hill	2001

Course code: Course Title	Course Structure			Pre-Requisite
PRD 505: Plasticity & Metal Forming	L	T	P	NIL
	3	0	2	

Course Objective: To familiarize the students with the various aspects of metal forming which is an efficient method for manufacturing components. To evaluate the suitability of various forming processes for various practical applications. To understand the latest advancements in forming technology & their practical Importance

S. No.	Course Outcomes (CO)
CO1	To explain, interpret and use the concepts of stress at a point, stress and strain tensors, Mohr's circle, invariants of stress, Principle of super position and reciprocal theorem and be able to apply in theoretical and practical formulation of elastic problems.
CO2	To understand the fundamental of Airy's stress function, Analysis of stress and strain in 3-d, ellipsoid, variational methods, Castigliano's theorems. Anisotropic elasticity, finite deformation elasticity and be able to analyze the bending of beams and curved beams.
CO3	To understand the assumptions underlying several continuum plasticity theories, deviatoric stress tensor, deformation theory, yield surface, normality rule, flow rule theory, Hill's anisotropic yield, Prandtl Reuss, Levy mises equations etc. and to apply the concepts of various yielding principles in formulation of plasticity problems and solutions.
CO4	To analyze the plasticity based problems using upper and lower bound theorems
CO5	To analyze and apply the slab methods. slip line field theory and extremum principles in solving various plasticity problems.

CO-PO Articulation Matrix						
COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	2
CO2	2	2	2	2	2	2
CO3	2	2	2	2	2	2
CO4	2	3	3	3	3	3
CO5	3	3	3	3	3	3

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content:- PRD 505: Plasticity & Metal Forming	Contact Hours
Unit 1	Elasticity, Review of two dimensional stress and strain, state of stress in three dimensions, Stress tensor, Invariants, Mohr's circle for 3-dimensional state of Stress, strain at a point, Mohr's circle for strain, Hydrostatic & Deviatory components of stress, Elastic stress strain relations. Plane stress and plane strain Conditions.	9
Unit 2	Nature of plastic deformation, Flow curves, true stress & true strain, Yield criteria for ductile metals, von Misses & Tresca yield criteria, combined stress state tests. The yield locus, Anisotropy in yielding, Yield surface, Levy-Misses, Prandtl-Reuss equations, Octahedral shear stress and strain components, stress-strain relations in elastic and plastic problems, work hardening, formulation of elastic plastic problems.	8
Unit 3	Classification of forming processes, process and design variables in metal forming and their optimization, Hot working, Cold working, Strain rate effect, Friction and lubrication, Deformation zone geometry, Workability, Residual stress. Analytical method based on homogeneous compression slip line field theory, Upper bounds and lower bounds, Slab method of analysis. Flow stress determination,	8
Unit 4	Analysis of metal forming processes: Forging: die design and lubrication, Classification and selection of forging machines, Die failure and economics of forging, Analysis of forging operation, Load calculation in plane strain forging, Rolling: Forces & geometrical relationship in rolling, Rolling load and torque in rolling operation, Extrusion: Analysis of direct and indirect extrusion process, Extrusion pressure, Wire and tube Drawing.	8
Unit 5	Sheet metal forming operations, Sheet metal cutting operations like blanking, shearing and laser cutting etc., Analysis of deep drawing, load, strip drawing and its force analysis, bending and spring back, Die design for deep drawing and bending. Drawability, Anisotropy and texture evaluation of sheet metal, Erischen cupping tests, Determination of Forming Limit Diagrams and their applications, Limiting dome height and Limiting draw ratio. Advances in metal forming operations	9
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Fundamentals of Metal forming process by Juneja B.L., New age international Publishers	2010
2	Principal of Industrial Metal working Processes by Rowe G.W, CBS publishers & Distributers	2005
3	Manufacturing Science by Ghosh Amitabha & Mallik Kumar Asok, East-West Prem Pvt Ltd	2002

**: Latest edition of the title of author may please be listed.*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 507: Metrology	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To familiarize the students with the basic theoretical, technical and legislative aspects of metrology, testing and quality management. To acquire knowledge of exact measurements of selected physical quantity and the evaluation of metrological measurements

S. No.	Course Outcomes (CO)
CO1	To understand the basics of Metrology.
CO2	To identify various difficulties in Metrology.
CO3	To formulate various difficulties in Metrology.
CO4	To select appropriate process/tool/techniques in Metrology.
CO5	To apply knowledge in relevance to professional practice and To understand the emerging trends of latest technology.

CO-PO Articulation Matrix

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**2**
CO4	**2**	**2**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content (PRD 507: Metrology)	Contact Hours
Unit 1	Introduction to dimensional metrology, limits, fits and tolerances, application of tolerances,	8
Unit 2	limit gauging, design of gauges, measuring instruments, comparators and their design considerations.	8
Unit 3	Angular measurements, auto collimators and interferometers. applications of dimensional inspection.	8
Unit 4	Measurement of screw threads, thread gauges for internal and external threads, gear inspection, inspection of surface quality, parameters for assessing surface finish and experimental methods of surface finish measurements, feature inspection, straightness, flatness, parallelism, squareness, circularity and roundness	9
Unit 5	Automated dimensional measurements, automatic gauging, automatic measuring machines for inspecting multiple work-piece dimensions, measurement with coordinate measuring machines.	9
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Fundamentals of Mechanical Inspection by R. Jenkins, McGraw Hill	1944
2	Fundamentals of Dimensional Metrology by C. Dotson, Cengage Learning	2018
3	Engineering Metrology by I.C. Gupta, Dhanpat Rai Publications,	2016

**: Latest edition of the title of author may please be listed.*

SEMESTER - II

Course code: Course Title	Course Structure			Pre-Requisite
PRD 502: Welding Process & Metallurgy	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To familiarize the students with basics of processes for joining various materials, in-depth understanding for the selection of right welding process for a particular application. This will further help in understanding the effect of welding parameters, selection of power sources and welding consumables, welding defects and inspection methods.

S. No.	Course Outcomes (CO)
CO1	To develop in-depth understanding for the selection of right material and right process to weld those materials.
CO2	To understand the effect of process parameters, selection of power sources and welding consumables.
CO3	To formulate and understand the specialized joining techniques and their real-life applications.
CO4	To select appropriate method to obtain crack free welds and achieve mechanical properties.
CO5	To apply knowledge in relevance to professional practice and to understand the emerging trends of latest technology in industrial applications.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**2**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

**: Latest edition of the title of author may please be listed.*

S. No.	Content (PRD 502: Welding Process & Metallurgy)	Contact Hours
Unit 1	Arc, gas and resistance welding processes oxy-acetelyne and arc cutting of metals. Review of modern welding and cutting methods.	9
Unit 2	Welding metallurgy, Heat and temperature during fusion welding, filler metal and metal transfer.	8
Unit 3	Weldability of plain carbon, low alloy, austenitic and other nikel crome steels, Problems and procedure for welding non-ferrous alloys: electrode selection.	9
Unit 4	Design of welded joints, Distortion, residual stresses and stress relieving.	8
Unit 5	Weld defects, Non destructive testing.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Principles of Welding Technology by L.M. Gourd ELBS/ Edward Arnold	1980
2	Welding processes & technology by Dr. R.S.Parmar, Khanna Publishers	2022

Course code: Course Title	Course Structure			Pre-Requisite
PRD-504: Automation & Robotics	L	T	P	NIL
	3	0	2	

Course Objective: To be familiar with the automation and brief history of robot and applications. To give the student familiarities with the kinematics of robots. To impart the knowledge about robot end effectors and their design. To learn about Robot Programming methods & Languages of robot.

S. No.	Course Outcomes (CO)
CO1	To develop in-depth understanding of automation, different level of automation, part programming.
CO2	To understand the basics of robot, end effectors, kinematics of robot, method of robot programming.
CO3	To formulate and understand the controlling the robot system, and different drives and feedback control system.
CO4	To select suitable mechanism about robot safety in hazards situation.
CO5	To apply knowledge in relevance to professional practice and to understand the emerging trends of latest technology in industrial applications.

CO-PO Articulation Matrix						
COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	2
CO2	2	2	2	2	2	2
CO3	2	2	2	2	2	3
CO4	2	3	3	3	3	3
CO5	3	3	3	3	3	3

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

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PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

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Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content (PRD-504: Automation & Robotics)	Contact Hours
Unit 1	**Automation:** Introduction, Need and implications of automation in Manufacturing, Modern developments in automation in manufacturing and its effect on global competitiveness, Actuators and sensors, Additive Manufacturing, different types of production systems and automation, hard/fixed automation, Open and closed loop	**9**
Unit 2	Introduction to Robotics, Classification of Robots, Characteristics of Robots, performance, advantages and disadvantages of a Robot, Human robot interaction, Industrial applications of a robot	9
Unit 3	Fundamentals of a Robot: Various system, structure and definition, terms relating to industrial Robots, basic terms related to Robot performance and Characteristics, Control volume of a Robot, Robot languages and programming. Industrial robotics & IOT	9
Unit 4	Controlling the Robot systems: Introduction to drives, Mechanical, Hydraulic, Pneumatic, electric drives, feedback control	8
Unit 5	Robot safety: Introduction, potential safety hazards, safety planning check lists, safety guidelines, latest development in safety measurement	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Automation, Production systems and Computer Integrated Manufacturing by Mikell P Groover, Printice Hall	2008
2	Industrial Robotics: Technology, Programming and applications, by Mikell P Groover, McGraw-Hill	1986
3		

**: Latest edition of the title of author may please be listed.*

SEMESTER - III

Course code: Course Title	Course Structure			Pre-Requisite
PRD-601: Advanced Machining Processes	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To familiarize the students with basics of advanced machining processes,
To impart knowledge about the basic principles of operation for each process and their applications. State various process parameters influencing the machining process.

S. No.	Course Outcomes (CO)
CO1	To enrich students with overview and classification of advanced machining process
CO2	To comprehend working mechanism of advanced machining processes based on different energy.
CO3	To study the mathematical formulations of advanced machining processes and analyses the influence of various process parameters in each process on metal removal, heat affect zone and surface finish.
CO4	To learn hybrid advanced machining process to enhance overall performance of the machining process and its applications.
CO5	To apply latest technological developments and research trends in the field of advanced machining processes and to learn the need of industries' current necessity and environment related issue in advanced machining process with respect to new materials.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**2**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems
PO2: An ability to write and present a substantial technical report/document
PO3: An ability to demonstrate expertise over the area as per the specialization of the program.
PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.
PO-5: To be able to apply the research knowledge for solution to industry specific problems.
PO6: To demonstrate a master degree over the area as per Production Engineering.
The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD-601: Advanced Machining Processes)	Contact Hours
Unit 1	Introduction to advanced machining processes – need for such processes and application areas Mechanical Energy utilized advanced machining processes like ultrasonic machining, abrasive flow machining, magnetic abrasive finishing, magneto-rheological finishing, abrasive water jet machining - mechanics of cutting, process parametric analysis, process capabilities, applications.	9
Unit 2	Thermoelectric based advanced machining processes like electro discharge machining, wire EDM, Plasma Arc Machining, Laser Beam Machining, Focused Ion Beam Machining – working principles, material removal mechanisms, process capabilities and applications;	9
Unit 3	Electrochemical and Chemical Advanced Machining – ECG; Electro stream Drilling	8
Unit 4	Chemical Machining – process characteristics, numerical modelling of the processes, applications and limitations.	8
Unit 5	Plasma arc machining: Working principle, Plasma arc cutting system, applications.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Advanced machining process by Dr. V. K. Jain, Allied Publisers Pvt Ltd	2009
2	Modern manufacturing process by Pandey & shan, Tata McGraw-Hill	2017
3		

**: Latest edition of the title of author may please be listed.*

Department Elective 1

Course code: Course Title	Course Structure			Pre-Requisite
PRD 511: Computer Aided Design / Computer Aided Manufacturing	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To understand CNC classification, its need, construction details and part programming, adaptive control, inspection and rapid prototyping. To impart knowledge about computer aided process planning, computer aided assembly planning, computer aided inspection & reverse engineering.

S. No.	Course Outcomes (CO)
CO1	To identify and understand the evolution of CAD and CAM
CO2	To understand concepts of CNC, DNC, CAPP, FMS, CIM IN detail.
CO3	To formulate and apply acquired knowledge in programming using G codes and M codes
CO4	To apply the acquired knowledge in programming using APT language
CO5	To apply the acquired knowledge in preparing feasibility report to adopt CIM technology for the first time in the industry and to be capable of dealing with CAD, CAM, FMS, CAPP, CIM in industries.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content (PRD 511 Computer Aided Design / Computer Aided Manufacturing)	Contact Hours
Unit 1	Introduction to CAD/CAM, representation of curves, surfaces and solids for CAD/CAM applications	8
Unit 2	Computational geometry for manufacturing, product design for manufacture and assembly	8
Unit 3	Computer aided process planning, computer aided assembly planning, computer aided inspection & reverse engineering	9
Unit 4	Flexible manufacturing system (FMS)- Introduction, type of flexibility, different FMS systems	9
Unit 5	Computer integrated manufacturing (CIM)	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	CAD/CAM by Grover/Zhimmer, PHI	2003
2	Computer Aided Manufacturing by Kundra, Rao, Tiwari , Tata McGraw HILL.	2017
3	CAD/CAM by A J Medland and Piers Buounett, Springer	1986

**: Latest edition of the title of author may please be listed.*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 513 Computer Integrated Manufacturing Systems	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To understand CNC classification, its need, construction details and part programming, Evolution Towards CIM system, Automation strategies. To impart knowledge about group technology, Flexible manufacturing system and AI in CIM.

S. No.	Course Outcomes (CO)
CO1	To understand the basics about role of computer and automation in manufacturing
CO2	To understand the automation, types of automation and automation strategies.
CO3	To identify various mechanism for computer based integration between various functions - manufacturing, sales, design, and materials
CO4	To select and understand the application of computer in CAPP, Production Management and ERP
CO5	To apply the concept of group technology, FMS, concurrent engineering, Simulation and AI in CIM systems and to be capable of dealing with CAD, CAM, FMS, CAPP, CIM in industries

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content- PRD 513: Computer Integrated Manufacturing Systems	Contact Hours
Unit 1	Evolving manufacturing environment, New competitive challenges, Evolving Role Information Technology, CIM Systems: Flexibility, Integration and Automation Opportunities,	9
Unit 2	Automation of information and manufacturing systems, Automation strategies, Towards Flexible Automation, Islands of automation, Evolution Towards CIM systems	9
Unit 3	Computer based integration between various functions - manufacturing, sales, design, materials, Flexible Manufacturing Systems (FMS) as mini CIM	8
Unit 4	Computer Integrated Production Management, ERP, Group technology	8
Unit 5	Concurrent Engineering, Simulation and AI in CIM systems, CIM and Beyond.	8
Total		42

REFERENCES		
S. No.	**Name of Books/Authors/Publishers**	**Year of Publication / Reprint***
1	CAD/CAM by Grover, Zhimmer, PHI	2014
2	Computer Aided Manufacturing by Kundra, Rao, Tiwari, Tata McGraw HILL.	2017
3	CAD/CAM by A J Medland and Piers Buounett, Springer	1986

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Course code: Course Title	Course Structure			Pre-Requisite
PRD 515: Mechatronics	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To familiarize the students with basics of science and focus in mechanical, electronics, control, software, and computer engineering, and a solid command of the newest technologies. To impart knowledge about sensors, transducers, actuators, modeling and simulation, feedback system.

S. No.	Course Outcomes (CO)
CO1	To identification of key elements of mechatronics system and its representation in terms of block diagram
CO2	To understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O
CO3	To interface of Sensors, Actuators using appropriate DAQ micro-controller
CO4	To analyze time and frequency domain of system model (for control application)
CO5	To implement PID control on real time systems and To develop of PLC ladder programming and implementation of real-life system

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertize over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content (PRD 515: Mechatronics)	Contact Hours
Unit 1	Introduction to Mechatronic systems and components; Sensors and transducers;	8
Unit 2	Actuators- electrical, electromechanical, electromagnetic, hydraulic, pneumatic, smart material actuators, micro actuators, nano actuators. Active actuators- piezoelectric, shape memory alloys (SMA), electro active polymers (EAP), magneto restrictive, magneto rheological fluid (MR); Stepper and servo motors, Encoders and resolvers	9
Unit 3	Modeling, analysis and simulation of dynamic systems; use of MATLAB; Bode, Nyquist and root-locus plot	8
Unit 4	Feedback systems: Open and closed loop control systems; Stability and sensitivity; PID, phase lag and phase lead compensation;	8
Unit 5	Sampled data systems and Digital controllers; DA/AD converters, microprocessors, interfacing with computers; Digital logic: Analysis and synthesis of Mechatronic systems with application to robotics, CNC systems and others	9
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Introduction to Mechatronics and Measurement systems by Alciatore David G., Tata-McGraw Hill India Ltd	2011
2	Mechatronics: Principles, Concepts and applications by Mahalik.N, Tata-McGraw Hill India Ltd	2017
3	Mechatronics: Principles and applications by Onwubolu, Elsevier India Pvt Ltd.	2005

**: Latest edition of the title of author may please be listed.*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 517: Principles of Machine Tools	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To familiarize the students with the features and types of machine tools used in industry and shop floor. To understand the capabilities of machine tools in meeting the product requirements. To understand the cutting parameters and machining with tools and equipment's.

S. No.	Course Outcomes (CO)
CO1	To understand the basics of Principles of Machine Tools
CO2	To identify various difficulties in Principles of Machine Tools
CO3	To formulate various difficulties in Principles of Machine Tools
CO4	To select appropriate process/tool/techniques in Principles of Machine Tools
CO5	To apply knowledge in relevance to professional practice and understand the emerging trends of latest technology

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 517: Principles of Machine Tools)	Contact Hours
Unit 1	Kinematics of machine tool drives, stepped and stepless speed regulation, design of speed gear box,	9
Unit 2	Design of beds, columns, slides etc., their strength and rigidity, design of spindles and bearing	8
Unit 3	Automatic and numerically controlled machine tools, Hydraulic drives testing of machine tools	9
Unit 4	Dynamics acceptance tests, Damping in machine tools	8
Unit 5	Modern trends in machine tool design, transfer machines.	8
Total		42

REFERENCES		
S. No.	**Name of Books/Authors/Publishers**	**Year of Publication / Reprint***
1	Principles of Machine Tools by G.C.Sen and A. Bhattacharya, Central Publication	2009
2	*Fundamentals of Machining and Machine Tools* by G *Boothroyd*, McGraw-Hill.	2005
3		

**: Latest edition of the title of author may please be listed.*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 519: Automation in Manufacturing	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To familiarize the students with basic understanding of NC, CNC, its classification, its Need and implications of automation in Manufacturing, Automation strategies. To impart knowledge about different types of production systems, drives and material handling system used in automation.

S. No.	Course Outcomes (CO)
CO1	To understand the basics about role of computer and automation in manufacturing
CO2	To understand the automation, types of automation and automation strategies.
CO3	To identify various mechanism for computer based integration between various functions – manufacturing.
CO4	To select and understand the application of CNC system in Automated Production system.
CO5	To apply the deep knowledge of Automation in different production systems as per current need in industrial applications.

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 519: Automation in Manufacturing)	Contact Hours
Unit 1	Modern developments in automation in manufacturing and its effect on global competitiveness, Need and implications of automation in Manufacturing,	9
Unit 2	Different types of production systems and automation, hard/fixed automation	8
Unit 3	Hydraulic and pneumatic actuators, their design and control devices, sequence operation of hydraulic/pneumatic actuators, designing of systems with hydraulic/pneumatic	9
Unit 4	Electro Pneumatic & Electro Hydraulic Systems design, Relay Logic circuits	8
Unit 5	Material handling systems, applications in manufacturing.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Hydraulic and Pneumatic Controls by Srinivasan R., Vijay Nicole imprints Pvt. Ltd., Chennai.	2019
2	Introduction to Hydraulic and Pneumatic by Ilango S and Soundararajan V., Prentice-Hall of India, Delhi	2011
3	Pneumatic Systems: Principles and Maintenance by Majumdar S.R., Tata McGraw-Hill, Delhi	1996

**: Latest edition of the title of author may please be listed.*

Department Elective 2

Course code: Course Title	Course Structure			Pre-Requisite
	L	T	P	
PRD 520: Materials Management	4	0	0	NIL

Course Objective: The key objective of this course is to acquaint the students with Decision making for effective and efficient purchase, storage and flow of materials in manufacturing and service organizations; cost reduction techniques in prepurchase

S. No.	Course Outcomes (CO)
CO1	To understand the basics of materials management
CO2	To Identify various difficulties in materials management
CO3	To Formulate various difficulties in materials management
CO4	To select appropriate process/tool/techniques in materials management
CO5	To apply knowledge in relevance to professional practice and understand the emerging trends of latest technology

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	2
CO2	2	2	2	2	2	2
CO3	2	2	2	2	2	3
CO4	2	3	3	3	3	3
CO5	3	3	3	3	3	3

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 520: Materials Management)	Contact Hours
Unit 1	Scope of materials management, integrated materials management, Reasons of materials management, relation with other functional areas of organisation, Organizing for materials management, integrated materials management, conventional and modern approaches to organizing materials management.	8
Unit 2	Classification, codification, Specification, standardization, simplification and variety reduction of materials, scope of materials management,	8
Unit 3	Inventory problems, inventory policies, classification of inventory models, Static inventory models, Multi-item Budget Constraint model, Optimal Policy Curve	8
Unit 4	Selective inventory management: ABC, VED, FSN analysis, Inventory models: EOQ-ROP Model, Finite Replenishment Rate Model, Lot Size Model with Planned Backlogging, Sensitivity analysis of Lot Size System, Quantity discount model	10
Unit 5	Vendor development, Make-Buy decision, Store management, Future trends	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Purchasing & Supply Management by Dobler & Burt, McGraw-Hill	1995
2	Purchasing & Supply Chain Management by Monczka, Trent & Handfield, Cengage	2020
3	Materials Management by A K Chitle & R C Gupta, PHI	2014

**: Latest edition of the title of author may please be listed.*

Course code: Course Title	Course Structure			Pre-Requisite
	L	T	P	
PRD 522: Precision Engineering	3	0	2	NIL

Course Objective: The aim of this course is to enable the students to exploit the capabilities of Precision Manufacturing processes in order to design Precision Engineering products with outstanding performance.

S. No.	Course Outcomes (CO)
CO1	To understand the concept and importance of precision engineering in manufacturing sector
CO2	To apply the mathematical and basic science principles to understand the basic concepts for developing the research plan and apply innovative ideas on various small problems.
CO3	To study the various processes under Mechanical, Thermal and Chemical action. They are able to apply these concepts to develop experimental setup.
CO4	To perform the experiments for variety of case studies. They are able to develop the theme for experimental and computation work.
CO5	To develop and implement the plan to train the quality professionals at shop floor level and to develop the quality professionals to work on shop floor independently for variety of applications

CO-PO Articulation Matrix						
COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	2
CO2	2	2	2	2	2	2
CO3	2	2	2	2	2	3
CO4	2	3	3	3	3	3
CO5	3	3	3	3	3	3

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 522: Precision Engineering)	Contact Hours
Unit 1	Introduction – Precision, Accuracy & Smoothness – Need – Development of overall machining precision-Classes of achievable machining Accuracy-Precision machining-High precision Machining-Ultra precision Machining-application of precision machining	8
Unit 2	Materials for tools and machine elements – carbides – ceramic, CBN & diamond-Tool and work material compatibility; Precision machine element- Introduction – Guide ways – Drive systems – Spindle drive – preferred numbers - Rolling 83 elements – hydrodynamic & hydrostatic bearings –Hybrid fluid bearings	8
Unit 3	- Aero static and aero dynamic bearings-Hybrid gas bearings-materials for bearings; Error control- Error – Sources – Static stiffness – Variation of the cutting force – total compliance – Different machining methods – Thermal effects – heat source – heat dissipation – Stabilization – decreasing thermal effects – forced vibration on accuracy – clamping & setting errors – Control – errors due to locations – principle of constant location surfaces	9
Unit 4	Precision manufacturing-Micro machining processes-diamond machining - micro engraving - Micro replication techniques-forming-casting-injection moulding - micro embossing	8
Unit 5	Energy assisted processes - LBM, EBM, FIB, Micro electro discharge machining-photolithography-LIGA process- Silicon micro machining-Wet and dry etching-thin film deposition; MEMS Introduction – MEMS –characteristics- principle – Design – Application: automobile, defence, health care, Industrial, aerospace etc	9
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Precision Engineering by Venkatesh V.C. and Izman S., Tata McGraw Hill	2008
2	Precision Engineering by Murthy R. L., New Age International	2005
3	Principles of Precision Engineering by Nakazawa H., Oxford University Press	1994

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
	L	T	P	
PRD 524: Operation Research	3	0	2	NIL

Course Objective: To allow students to develop the technical, analytic, and managerial skills necessary to perform the tasks successfully

S. No.	Course Outcomes (CO)
CO1	To identify and develop operational research models from the verbal description of the real system.
CO2	To understand the mathematical tools that are needed to solve optimization problems.
CO3	To use mathematical software to solve the proposed models
CO4	To understand the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools
CO5	To design new simple models to improve decision –making and develop critical thinking and objective analysis of decision problems and develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision making processes.

CO-PO Articulation Matrix						
COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	2
CO2	2	2	2	2	2	2
CO3	2	2	2	2	2	3
CO4	2	3	3	3	3	3
CO5	3	3	3	3	3	3

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content (PRD 524: Operation Research)	Contact Hours
Unit 1	Historical development, Nature of O.R. projects, Model Building Linear deterministic optimization models-linear Programming	9
Unit 2	Simplex Algorithm, Duality, Degeneracy, transportation and Trans-shipment models, assignments, post optimality analysis. Integer LP	9
Unit 3	Queuing theory, elementary concepts of Dynamics Programming, Goal Programming	8
Unit 4	Inventory control, Game Theory and Markov Chains. Application of OR software's.	8
Unit 5	Non-Linear programming: Fundamentals of non-linear programming problems- Canonical form, Graphical solution, constrained and unconstrained non linear programming -Lagrangian method	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Operation Research by J. K. Sharma;	2001
2	Operations Research by Hamdi A. Taha, Pearson	2006
3	Operations Research: Concepts and cases by F S Hiller and G J Liebermaan, TMH	2010

**: Latest edition of the title of author may please be listed.*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 526: Methods Engineering and Ergonomics	**L**	**T**	**P**	**NIL**
	4	**0**	**0**	

Course Objective: To aware and provide knowledge about ergonomics and different disorders.

S. No.	Course Outcomes (CO)
CO1	To understand work measurement and work improvement techniques like stop watch time study, work sampling, method study, etc.
CO2	To understand ergonomics with human comfort point of view
CO3	To identify harmful work conditions on the basis of theory and methods
CO4	To carry out a design for assembly study
CO5	To select and apply a proper method to study and quantify human physical workload in an observed situation and design an appropriate material presentation at a workplace

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content (PRD 526: Methods Engineering and Ergonomics)	Contact Hours
Unit 1	Definition, origin, scope and goals of ergonomics as a field of study. Examples of applications of ergonomics in design. Types of data from human at physical, physiological, cognitive and affective levels	9
Unit 2	Data gathering and analysis techniques. Use of descriptive and inferential statistics in ergonomic data. Applications of mean, median, mode and percentile in anthropometry	8
Unit 3	Use of anthropometry in workstation design. Human physiological potentials and limitations in terms of load carrying capacity. Concept of comfort, fatigue and stress.	9
Unit 4	Design for the cognitive user. Concept of mental workload.	8
Unit 5	Cognitive perspective in control panel design and graphical user interface design.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Motion and time study by Ralph M. Barnes, Wiley	1980
2	Motion and time study by **Benjamin W. Niebe**l, Richard D. Irwin, Inc	2012
3	Operations Research, by D.S. Hira, P. K. Gupta, S. Chand	1995

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 528: Composite Materials and Processing	**L**	**T**	**P**	**NIL**
	4	**0**	**0**	

Course Objective: The objective of this course is to develop ability to identify the properties of fiber and matrix materials used in commercial composites and some common manufacturing techniques, also to predict the elastic properties of both long and short fiber composites based on the constituent properties.

S. No.	Course Outcomes (CO)
CO1	To understand classification and types of matrices material and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Particulate composites, Prepegs, and sandwich construction. To understand application of composite materials for Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational
CO2	To understand Hooke's law for different types of materials, number of elastic constants, derivation of nine independent constants for orthotropic material, two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two dimensional angle lamina, engineering constants - Numerical problems. Invariant properties. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.
CO3	To understand evaluation of the four elastic moduli, Rule of mixture, Numerical problems. Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems
CO4	To understand Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) Engineering constants, Special cases of laminates, Numerical problems.
CO5	To understand Layup and curing - open and closed mould processing, Hand lay, Up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Quality assurance, Introduction, material qualification, Types of defects, NDT methods.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**2**	**2**	**2**	**3**	**3**
CO2	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**2**	**2**	**3**	**3**
CO4	**3**	**3**	**2**	**2**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Computer Aided Analysis and Design.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

S. No.	Content: PRD 528: Composite Materials and Processing	Contact Hours
Unit 1	**Introduction to Composite Materials:** Definition, Classification, Types of matrices material and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Particulate composites, Prepegs, and sandwich construction. **Metal Matrix Composites:** Manufacturing of MMC, Reinforcement materials, Types, Characteristics and selection, Base metals, Selection, Applications.	9
Unit 2	**Macro Mechanics of a Lamina:** Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Invariant properties. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.	8
Unit 3	**Micro Mechanical Analysis of a Lamina:** Introduction, Evaluation of the four elastic moduli, Rule of mixture, Numerical problems. **Biaxial Strength Theories:** Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.	8
Unit 4	**Macro Mechanical Analysis of Laminate:** Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) Engineering constants, Special cases of laminates, Numerical problems.	8
Unit 5	**Manufacturing:** Lay up and curing - open and closed mould processing, Hand lay, Up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Quality assurance, Introduction, material qualification, Types of defects, NDT methods. **Application Developments:** Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment-future potential of composites.	9
Total		42
REFERENCES		

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	**Mechanics of composite materials,** Autar K. Kaw CRC Press New York.	2006
2	**Mechanics of Composite Materials,** Rober M. JonessMc-Graw Hill Kogakusha Ltd.	1998
3	**Composite Material Science and Engineering,** Krishan K. Chawla Springer.	2015

**: Latest edition of the title of author may please be listed.*

PRD 508 Department Elective 3

Course code: Course Title	Course Structure	Pre-Requisite

PRD 530: Maintenance Management	L	T	P	NIL
	4	0	0	

Course Objective: The ability to apply principles and techniques in the design, planning and control of the production systems to optimize or make best use of resources in achieving their objectives.

S. No.	Course Outcomes (CO)
CO1	To use of contemporary maintenance management practices.
CO2	To manage and develop the maintenance activities in a modern enterprise
CO3	To perform maintenance activities in a cost-effective manner
CO4	To determine the optimal overhaul/repair/replacement maintenance policy for an equipment subject to breakdown.
CO5	To determine the optimal inspection frequency for maximization of profit and minimization of down time and explain different maintenance systems and the steps involved in establishing a maintenance plan and designing a technically sound preventive maintenance and lubrication program.

CO-PO Articulation Matrix						
COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	2
CO2	2	2	2	2	2	2
CO3	2	2	2	2	2	3
CO4	2	3	3	3	3	3
CO5	3	3	3	3	3	3

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 530 : Maintenance Management)	Contact Hours
Unit 1	Introduction to maintenance management, Reliability basics,Asset criticality Analysis, Reliability centered maintenance, Basic maintenance models for age and time based replacement, block and group replacement, inspection and shock based replacement	9
Unit 2	imperfect maintenance models, Maintainability models, Availability models, Life cycle cost models	9
Unit 3	Simulation based approach for maintenance planning, Queuing models for maintenance planning	8
Unit 4	Models for condition monitoring, Models for Maintenance scheduling,	8
Unit 5	Maintenance performance measurement, Asset management practices, Case studies.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Engineering Maintainbility by Dhillon,B.S., Prentice Hall of India, New Delhi	1999
2	Logistics Engineering and Management by Blanchard, Benjamin, S., Pearson	1998
3		

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 532: Managerial Concept & Organizational Behaviour	**L**	**T**	**P**	**NIL**
	4	**0**	**0**	

Course Objective: To familiarize the students with basics of managerial concept & organizational behavior. To impart knowledge about to process and climate effects in Organization Behavior and understand the organizational system, including organizational structures, culture, human resources, and change.

S. No.	Course Outcomes (CO)
CO1	To understand the Importance & Role of Management in the Organizations
CO2	To evaluate the different aspects related to Decision Making and Controlling Process
CO3	To understand individual behavior in organizations, including diversity, attitudes, job satisfaction, emotions, moods, personality, values, perception, decision making, and motivational theories.
CO4	To understand group behavior in organizations, including communication, leadership, power and politics, conflict, and negotiations.
CO5	To evaluate the process and climate effects in Organization Behavior and understand the organizational system, including organizational structures, culture, human resources, and change

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 532: Managerial Concept & Organizational Behaviour)	Contact Hours
Unit 1	The over-all concepts of the nature of management, emergence of management: new challenges; the dimensions of management, the functions of Manager, overview of the functional approach to management-planning, organizing, directing coordinating and controlling. Planning, policies, procedure and methods, decision-making	9
Unit 2	Organizing: Organization structure, principles and theories in organization, departmentalization, vertical and horizontal growth in organization, span of management.	8
Unit 3	centralization and decentralization line and staff function, organization as a social system-formal and informal organization. Directing: Administrative communication, motivation and leadership.	8
Unit 4	Delegation. Coordinating: Internal and external coordination, committee in management. Controlling: The process of control, techniques of control Philosophical considerations: Social responsibilities of management.	8
Unit 5	Indian management: the power and influence of Indian management, the role of management associations. Influence of Social and Cultural factors in human behavior. Socio-metry, attitudes, values and norms and factors influencing manager's behavior.	9
Total		42

REFERENCES		
S. No.	**Name of Books/Authors/Publishers**	**Year of Publication / Reprint***
1	Management & organizational behaviour by R B Rudani, **Tata McGraHill Education**.	2011
2	Organizational behaviour by Robbins S P, Judge T A and Sanghi S, Pearson	2018
3	Organizational behaviour by Robbins S P, Pearson	2013

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 534: Industrial Quality Control	**L**	**T**	**P**	**NIL**
	4	**0**	**0**	

Course Objective: To make students aware of industrial engineering concepts of work study and measurement, quality control and reliability etc.

S. No.	Course Outcomes (CO)
CO1	To understand the concepts and importance of quality management in manufacturing and service sector
CO2	To develop a plan to implement various types of control charts and Acceptance sampling plans
CO3	To conduct research in areas like Quality Function Deployment, Six sigma, Deming Cycle, QC tools.
CO4	To analyze and improve the existing quality management systems in industry.
CO5	To develop and implement a plan to train the quality professionals at management level as well as shop floor level and assess the reliability and maintainability of products and processes at industry level.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 534: Industrial Quality Control)	Contact Hours
Unit 1	Introduction: Quality basics and history, Quality Philosophy (Deming, Juran, Crosby), Dimensions of quality, Quality Costs: Quality Cost Measurement, Utilizing Quality Costs for Decision-Making. Seven QC Tools: Histogram, Pareto Diagrams, Check Sheet, Cause-Effect Diagrams, Scatter Diagrams, Control Charts and Stratification. Statistical Process Control	9
Unit 2	Control Charts for Variables; Definitions, Variation: Common vs. Special Causes, Control Chart Techniques, X-bar and R chart, X-bar and S charts, Control Chart Interpretation and Analysis, Process Capability, Other Variable Control Charts; Individuals and Moving Range Charts, Moving Average and Moving Range Charts; Control Charts for Attributes: Definitions, Control Charts for Non-conforming Units, Control Charts for Counts of Non-conforming Units	9
Unit 3	Sampling Techniques: Single, Double, Multiple, Sequential Sampling Techniques, LTPD, AQL, AOQL; Quality Systems: ISO 9000, ISO 14000, ISO 18000, Six Sigma, Certification Requirements, Evolving Standards; Reliability: System concepts in reliability, availability and maintainability (RAM) Engineering	8
Unit 4	Fundamentals of reliability, Failure distributions, System reliability assessment. Reliability of repairable by Markov approach. Point, mission and steady state availability. Availability assessment. Maintainability and its assessment;	8
Unit 5	Advanced Topics: Quality Function Deployment, Design of Experiments, Benchmarking and Auditing.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	The Management and Control of Quality by J R Evans and W M , Lindsay, Cengage learning, India	2020
2	Total Quality Management by Besterfield, Pearson Education	2011
3	Statistical Quality Control by Douglas C. Montgomery, Wiley India Pvt Ltd	2012

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 536: Supply Chain Management	**L**	**T**	**P**	**NIL**
	4	**0**	**0**	

Course Objective: To understand the key considerations at the various stages involved in the supply of product in order to maintain the smooth flow from source to the point of consumption so that overall organizational performance may improve.

S. No.	Course Outcomes (CO)
CO1	To understand fundamental supply chain management concepts.
CO2	To evaluate and manage an effective supply chain
CO3	To understand the foundational role of logistics as it relates to transportation and warehousing.
CO4	To align the management of a supply chain with corporate goals and strategies
CO5	To analyze and improve supply chain processes and measure the performance of a supply chain.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 536: Supply Chain Management)	Contact Hours
Unit 1	Supply Chain Management: Concepts, theoretical background and managerial issues, Inventory Management and Risk Pooling, Demand Forecasting	8
Unit 2	Aggregate Planning and MRP, Network Planning, Distribution Strategies, Smart Pricing, Supply Chain Integration, Vendor Development, Procurement	9
Unit 3	Outsourcing Strategies, Strategic Alliances, Value of Information and IT in SCM	8
Unit 4	Coordinated Product and supply chain Design, Global Supply Chain, Customer Value and Performance Measurement of Supply Chain.	8
Unit 5	International Issues in Supply Chain Management: Concepts in Globalization, Globalization forces, Risks and Advantages of International supply chains, Issues in International supply chain management, regional differences in logistics.	9
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies by David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi and Ravi Shankar, Tata McGraw-Hill	2008
2	Supply Chain Management: Strategy, Planning, and Operation by Sunil Chopra and Peter Meindel, Prentice Hall of India.	2010
3	Principles of SCM: A Balanced Approach by Wisner, JD, Leong GK and Tan, KC, Cengage Learning	2019

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 538: Production & Operation Management	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To allow students to develop the technical, analytic, and managerial skills necessary to perform the tasks successfully

S. No.	Course Outcomes (CO)
CO1	To demonstrate an understanding of production as a process of converting or transforming resources into products
CO2	To understand the basic concepts and theories of the production management
CO3	To comprehend the operations management situations with greater confidence.
CO4	To anticipate issues in production and operations processes they may face during their careers
CO5	To expand individual knowledge of operations management principles and practices and apply operations management concepts and their influence on business decisions

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 538: Production & Operation Management)	Contact Hours
Unit 1	Introduction to Production & Operation Management, Management functions of an organization, job design and work measurement: job design decisions, approaches to job design, work measurement standards, learning curves, and its application.	9
Unit 2	Work flow systems; pull & push systems, MRP-I MRP-II, cellular manufacturing and FMS, CIMS, JIT manufacturing, automated production lines, line balancing, facility layout, bottleneck and balance matching,	9
Unit 3	capacity management, Management of professional services. Aggregate planning: aggregate units of production cost in aggregate planning,	8
Unit 4	leave of production strategy, mixed strategy, mathematical model, linear decision rule	8
Unit 5	master production scheduling shop scheduling, shop floor control, manpower scheduling DRP & demand management.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Production & operation Management by Chase, Aquilano, Jacobs –TMH	2009
2	Production & operation Management by James Dilworth, Pearson International	1993
3	Production & operation Management by Jay Heizer, Barry Render, Prentice Hall	2009

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
UEC-502: Research Methodology & IPR (Online)	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To familiarize the students with the basic techniques and tools for conducting systematic researchand and develop an understanding of the relevant tools and techniques applicable in proposed area of research. To familiarize them with basic skills in design, implementation and evaluation of research methods to conduct the research.

S. No.	Course Outcomes (CO)
CO1	To introduce research methods and processes.
CO2	To formulate research problem statement and prepare the plan for investigations
CO3	To apply various quantitative techniques for data analysis.
CO4	To communicate and present research findings.
CO5	To understand IPR and related aspects.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**2**	**1**	**1**	**2**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Industrial Engineering and Management. The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content (UEC-502: Research Methodology & IPR (Online))	Contact Hours
Unit 1	Introduction, Concepts of research, Meaning and objectives of research, Research process, Types of research, Research problem identification, Research proposal-contents, Funding agencies, Ethical aspects and Plagiarism detection tools.	8
Unit 2	Research design process, Need and types of research design, Literature survey, Use of internet and advanced search techniques, Various reputed publishers and their databases, identification of research gaps, Measurement and scaling techniques, Data collection-types and methods, Processing and analysis of data, Design and analysis of experiment.	9
Unit 3	Quantitative techniques, sampling fundamentals, Type of hypothesis, Introduction and applications of Binomial, normal and Poisson distributions, Statistical tests: Chi-squared test, t-test, f-test etc., Multivariate analysis, Introduction to various statistical analysis software.	9
Unit 4	Computer applications in research, Pre-writing considerations, Principles of thesis and report writing, Formats for thesis, report and research papers, Documentation and presentation tools- introduction to LATEX and MS Office.	8
Unit 5	Nature of Intellectual Property: Patents, Designs, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, development, new developments in IPR: National and international scenarios.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Dr. C.R. Kothari, "Research Methodology: Methods and Techniques", New Age International Publisher.	2019
2	Stuart Melville and Wayne Goddard, "Research Methodology: An Introduction for Science &| Engineering Students", Juta and Company Ltd.	2004
3	Wadehra B.L., "Law Relating to Patents, Trademarks, Copyright Designs and Geographical Indicators", Universal Law Publishing	2004

**: Latest edition of the title of author may please be listed.*

Open Elective 1

Course code: Course Title	Course Structure			Pre-Requisite
OME601: Optimization Techniques	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective: To allow students to develop the technical, analytic, and managerial skills necessary to perform the tasks successfully

S. No.	Course Outcomes (CO)
CO1	Apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.
CO2	Explain the applications of optimization techniques and solve practical problems on linear programming, sensitivity analysis and transportation model.
CO3	Formulate and solve non-linear programming problems and constrained optimization.
CO4	Demonstrate the applications of multi-objective optimization methods.
CO5	Formulate and solve the stochastic programming and solve the problems using heuristic modelling techniques.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department.

S. No.	Content (OME601: Optimization Techniques)	Contact Hours
Unit 1	Introduction to Optimization; Introduction, Engineering Applications, Statement of an Optimization Problem, Classification; Linear Programming: Simplex Algorithm; Two Phase Method, Big 'M' Method, Revised Simplex Method, Duality in Linear Programming; Prime-Dual Relations, Duality Theorem, Dual simplex method, Sensitivity and Post Optimality Analysis	9
Unit 2	Transportation and Assignment Problem; Integer Programming – Branch and bound Method, Cutting Plane Method	8
Unit 3	Dynamic Programming: Elementary Concepts of Dynamics Programming, Multi stage Decision Process, Calculus Method and Tabular Method; Classical Optimization techniques – Unconstrained Optimization: Optimizing Single-Variable Functions, Optimizing Multi-Variable Functions.	8
Unit 4	Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Lagrange Multipliers Method. Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions; Non-Linear Programming-Unconstrained Optimization Techniques: Direct search methods, Descent Methods.	9
Unit 5	Constrained Optimizations: Direct and Indirect methods; Introduction to Advanced Optimization Techniques –Genetic Algorithms (GA), Simulated Annealing, Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO) etc.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Optimization of Engineering Design by Deb, K., PHI	2021
2	Operations Research by Hamdi A. Taha, Pearson	2006
3	Operations Research by D.S. Hira, P. K. Gupta, S. Chand	1995

**: Latest edition of the title of author may please be listed.*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 6022: Surface Engineering	**L**	**T**	**P**	**NIL**
	4	**0**	**0**	

Course Objective: To enable the students to exploit the capabilities of Surface Engineering methods/ processes in order to design quality products with outstanding performance

S. No.	Course Outcomes (CO)
CO1	To understand the engineering and scientific reasons behind identifying the right surface engineering method among number of processes
CO2	To understand and appreciate the practical difficulties in surface engineering methods
CO3	To understand the metallurgical changes occurring during a coating or a surface modification technique to improve a technique and hence finally appreciate the life of coatings
CO4	To understand and use fundamental concepts of surfaces, interfaces and coatings to create engineering solutions to related industrial needs
CO5	To analyze and critically assess surface engineering problems and appreciate cutting-edge research in the area of surface engineering and coatings

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 6021: Precision Engineering)	Contact Hours
Unit 1	Introduction to surface engineering – importance and scope of surface engineering, conventional surface engineering practices like pickling, grinding, buffing etc.,	8
Unit 2	surface engineering by material addition like electroplating, surface modification of ferrous and non-ferrous materials like nitriding, cyaniding, aluminizing etc. Advanced surface engineering practices like laser assisted surface modification	9
Unit 3	electron beam assisted modification, spraying techniques like fame and plasma spraying, high velocity oxy-fuel, cold spray techniques. Sputter deposition processes, PVD and CVD methods of surface coatings	9
Unit 4	surface modification by ion implantation and ion beam mixing Characterization of the engineered surface and coatings like thickness	8
Unit 5	porosity and adhesion of coatings, surface microscopy and spectroscopic analysis of the modified surfaces. Functional coatings and their applications.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Introduction to surface engineering and functionally engineered materials by Peter Martin, John Wiley and Sons	2011
2	Tribology and Surface Engineering by J. Paulo Davum, Nova Science Publishing	2012
3		

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
	L	T	P	
PRD 6023: Design for Manufacturing and Assembly	4	0	0	**NIL**

Course Objective: To allow students to develop the technical, analytical, and managerial skills necessary to perform the tasks successfully

S. No.	Course Outcomes (CO)
CO1	To understand the complex interrelationships between design and manufacturing
CO2	To explore and understand basic manufacturing processes and the design for manufacturing (DFM) implications of design choices for specific manufacturing processes
CO3	To use assembly considerations and assembly costs in evaluations
CO4	To Understand the role of software applications in evaluating designs for manufacturing and assembly costs; understand approaches and practices related to CAD model building and model checking for specific manufacturing processes such as models for sheet metal and models for casts and molds
CO5	To Understand the quality aspects of design for manufacture and assembly and apply the concept of DFM for casting, welding, forming and assembly

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 6023: Design for Manufacturing and Assembly)	Contact Hours
Unit 1	Product design for life-cycle, concurrent engineering, design for manufacture, rule-based and plan based DFM	9
Unit 2	Automated manufacturability assessment, Automated manufacturability assessment,	8
Unit 3	Commonly used tools for design for manufacture and assembly tools including, QFD, POKA YOKE, FMEA,	9
Unit 4	Design for manual assembly and automated assembly, design for environment	8
Unit 5	Industrial and real-life case studies of design for manufacture and assembly.	8
Total		42

REFERENCES		
S. No.	**Name of Books/Authors/Publishers**	**Year of Publication / Reprint***
1	Designing for Manufacturing by Harry Peck, Pitman Publications	1973
2	Engineering Metrology by R.K. Jain, Khanna Publication	2022
3		

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 6024: Reliability Engineering	L	T	P	NIL
	3	0	2	

Course Objective: To develop the ability in formulating suitable maintenance strategies to achieve reliable a manufacturing system. To equip with essential system diagnosis techniques so that students can identify and take appropriate actions on error symptoms and causes of failures.

S. No.	Course Outcomes (CO)
CO1	To understand major concepts of reliability prediction
CO2	To analyze statistical experiments leading to reliability modeling (DFM) implications of design choices for specific manufacturing processes
CO3	To identify reliability testing components
CO4	To apply reliability theory to assessment of reliability in engineering design
CO5	To estimate reliability functions and parameters of product/component systems using reliability block diagram, fault tree and event tree and evaluate maintainability and availability of product/component systems, and different maintenance strategies.

CO-PO Articulation Matrix						
COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	2
CO2	2	2	2	2	2	2
CO3	2	2	2	2	2	3
CO4	2	3	3	3	3	3
CO5	3	3	3	3	3	3

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate expertise over the area as per the specialization of the program.

PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.

PO-5: To be able to apply the research knowledge for solution to industry specific problems.

PO6: To demonstrate a master degree over the area as per Production Engineering.

The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 6024: Reliability Engineering)	Contact Hours
Unit 1	Introduction: System concepts in reliability, availability and maintainability (RAM) Engineering, Practical applications of RAM Engineering to systems, products and processes; Concepts, terms and definitions	8
Unit 2	Failure rate function, Probability density function, Cumulative distribution function, reliability function, Mean time to failure (MTTF), MTBF, MTTR; Fundamentals of reliability: Failure distributions; Exponential, Weibull, Normal and Lognormal; Constant failure rate model and time dependent failure models	8
Unit 3	System reliability assessment: Series, Parallel, Combined series-parallel configurations; Cut sets and path sets approach, fault tree analysis (FTA); State dependent systems; Markov analysis, load sharing system, standby system, degraded system, Monte Carlo simulation; Design for Reliability and reliability improvement: Reliability specifications and system measurements	9
Unit 4	reliability allocation; exponential case, optimal allocations, arnica method, AGREE method, Various types of redundancies; active and passive redundancy, k-out-of-n-redundancy, standby redundancy, optimization, reliability-cost trade off; Availability and maintainability: Point, mission and steady state availability;	8
Unit 5	Availability assessment, Maintainability and its assessment; Maintenance policies: individual policy, Planned, preventive and condition based maintenance; Opportunistic maintenance policy; Design for maintainability: Maintenance requirements, measurements and specifications, fault diagnosis, failure mode and effect analysis (FMEA), Parts standardization and interchangeability, modularization, accessibility, repair versus replacement, proactive maintenance, maintainability prediction and demonstration.	9
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Reliability Engineering by Srinath, L. S., East –West Press Ltd., New Delhi	2005
2	Engineering Maintainbility by Dhillon, B. S., Prentice Hall of India, New Delhi	1999

**: Latest edition of the title of author may please be listed*

Course code: Course Title	Course Structure			Pre-Requisite
PRD 6025: IT in manufacturing Enterprise	**L**	**T**	**P**	**NIL**
	4	**0**	**0**	

Course Objective: To familiarize the students with basics of advanced manufacturing systems.
To impart knowledge about the basic principles of IT in manufacturing., and flexible manufacturing systems and evaluate the performance of IT enabled supply chains.

S. No.	Course Outcomes (CO)
CO1	To understand major applications of It in manufacturing enterprises.
CO2	To analyze the major challenges in application of IT tools in manufacturing
CO3	To identify area of applications of IT in manufacturing.
CO4	To apply technology management and technology transfer
CO5	To understand the applications of flexible manufacturing systems and evaluate the performance of IT enabled supply chains.

CO-PO Articulation Matrix						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Three values 1/2/3 (1 indicates low, 2 indicates medium, and 3 indicates high) can be filled for CO-PO articulation matrix. As per NBA, there are three standard POs that are given below.

Program Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems
PO2: An ability to write and present a substantial technical report/document
PO3: An ability to demonstrate expertise over the area as per the specialization of the program.
PO-4: To integrate basic and advance research knowledge for identification and formulation of problem statement to focus on alternate approaches for their solution.
PO-5: To be able to apply the research knowledge for solution to industry specific problems.
PO6: To demonstrate a master degree over the area as per Production Engineering.
The mastery should be at a level higher than the requirements in the appropriate bachelor program

Note: Program may add up to three additional POs approved by BOS of the department

S. No.	Content (PRD 6025: IT in manufacturing Enterprise)	Contact Hours
Unit 1	Production Systems, Manufacturing Enterprises as Systems, Appreciate the evolving manufacturing environment and multi-attributed competition: IT role Challenges and Opportunities, Evolving Role of Information Technology in Enterprises.	9
Unit 2	P&I Implications, Technology Management Challenges, Technical Fundamentals: MIS in Manufacturing Enterprises, FMS (Flexible Manufacturing Systems), CIM Systems, Intelligent Manufacturing Systems.	9
Unit 3	Concurrent Engineering and Extended Enterprises, ERP (Enterprise Resource Planning).	8
Unit 4	E-Business and Supply Chain Management, Discrete Event Simulation	8
Unit 5	AI Applications in manufacturing enterprises, Implementation Issues, Future Trends, Careers.	8
Total		42

REFERENCES

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint*
1	Information Technology Project Management by **Kathy Schwalbe**, Cengage	2019
2	Analysis of Manufacturing Enterprises by N Viswanadham, Springer	2012
3	Information Technology for Manufacturing by Kevin Ake, John Clemons, Mark Cubin, Bruce Lilly, CRC press	2003

**: Latest edition of the title of author may please be listed*