

Jharkhand University of Technology

Ranchi

Master of Technology

Specialization – Production Technology & Management

Course Structure & Syllabus



**Department of Production & Industrial
Engineering
December 2021**

(With effect from Academic Year 2021-22)

M. Tech in – Production & Industrial Engineering
I SEMESTER

S. No.	Course Code	Course	Subject	Credits
1.	PTM1101	Core-I	Advanced Manufacturing Processes-I	3
2.	PTM1102	Core-II	Operations Management	3
3.	PTM1103	Programme Elective-I	Decision Modelling	3
	PTM1104		Quality Management	
	PTM1105		Manufacturing Resources Management	
	PTM1106		Design for Manufacture And Assembly	
4.	PTM1107	Programme Elective-II	Machine Tool Design & Numerical Control	3
	PTM1108		Industrial Automation	
	PTM1109		Flexible Manufacturing Systems	
	PTM1110		Modeling and Simulation of Manufacturing Systems	
5.	PTM1111	Programme Elective-III	Information System & Data Management	3
	PTM1112		Product Design & Development	
	PTM1113		Rapid Prototyping	
	PTM1114		Product Lifecycle Management	
6.	PTM1201	Lab-I	Advanced Manufacturing Lab-I	2
9.	PTM1202	Lab-II	Computational Laboratory	2
8.	RMC 1101	Compulsory Paper	Research Methodology & IPR	2
9.	A10001	Audit-I	English for research paper writing	-
	A10002		Professional ethics	
	A10003		Constitution of India	
	A10004		Stress management by yoga	
TOTALCREDITS				21

M. Tech in – Production & Industrial Engineering
II SEMESTER

S. No.	Course Code	Course	Subject	Credits
1.	PTM2101	Core-III	Advanced Operations Research	3
2.	PTM2102	Core-IV	Advanced Manufacturing Processes II	3
3.	PTM2103	Programme Elective-IV	Robotics and Control	3
	PTM2104		Processing of Non-Metals	
	PTM2105		Computer Aided Process Planning	
	PTM2106		Condition Monitoring	
4.	PTM2107	Programme Elective-V	Supply Chain Management	3
	PTM2108		Project Management	
	PTM2109		Maintenance Management	
	PTM2110		Six Sigma	
5.	PTM2111	Open Elective-I	Industrial Safety	3
	PTM2112		Composite Materials	
	PTM2113		Mechatronics (NPTEL/SWAYAM)	
	PTM2114		Smart Materials, Structures and Devices	
	PTM2115		Industrial IoT and Industry 4.O	
6.	PTM2201	Lab III	Advanced Manufacturing Lab II	2
7.	PTM2202	Lab IV	Strategic Management Lab	2
8.	PTM2203	Mini Project	Mini Project	2
9.	A20001	Audit-II	Disaster management	-
	A20002		Value education	
	A20003		Soft skills	
	A20004		Personality development through life enlightenment skills	
TOTAL CREDITS				21

SEMESTER- III			
S. No	Course Code	Course/ Subject	Credits
01.	PTM3201	DISSERTATION Phase- I	10
Total Credits			10

SEMESTER- IV			
S. No	Course Code	Course/ Subject	Credits
01.	PTM4201	DISSERTATION Phase- II	16
Total Credits			16

Core I

1. Course Title: **Advanced Manufacturing Processes I (PTM1101)**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Basics of Welding: Physics of Welding Arc, Mechanism and types of metal transfer in various arc welding processes, factors controlling melting rate in various welding processes.	08
2.	Welding Processes: Critical review of MMA; TIG. MIG and CO ₂ welding processes, plasma arc, submerged arc welding, electro- gas and electro-slag welding; resistance welding. Theory and mechanism of solid state welding; technique and scope of friction welding, diffusion welding; cold pressure welding and ultrasonic welding, scope and application of electron beam and laser welding processes	12
3.	Metal Casting: Introduction to solidification, Nucleation and grain growth, Solidification of pure metals and alloy.	05
4.	Advanced casting processes: Centrifugal and continuous casting processes, squeeze casting, vacuum mould casting, evaporative pattern casting, Semi solid metal working processes, ceramic shell casting	05
5.	Metal Forming: Introduction: stress/strain, strain-rate characteristics of materials, y criteria of metals, classification of metal working processes, various methods analyzing the metal working processes (slip-line field theory; stab methods), Effective strain rate and temperature in metal forming	06
6.	Advanced metal forming processes: Details of high energy rate forming (HERF) process: electro-magnetic forming, explosive forming, electro-hydraulic forming; stretch forming, contour roll forming, Microforming.	06
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books /Publisher	Year of Publication/ Reprint
1.	Larry J. and Jeffus L., "Welding Principles and Application", 5 th Ed., Delmer Publication.	2002
2.	Messler R. W., "Principles of Welding (Processes, Physics, Chemistry and Metallurgy)", John Wiley & Sons.	1999
3.	Baldev, R., "Welding Technology for Engineers", ASM International	2006
4.	Ghosh A. and Mallik A. K., "Manufacturing Science", Affiliated East-West Press Pvt. Ltd. New Delhi.	1985
5.	Heine and Roshenthal, "Principles of Metal Casting", Tata McGraw-Hill Publishing Company Ltd, New Delhi.	1983
6.	Chakrabarti, A. K., "Casting Technology and Cast Alloys" Prentice-Hall of India, New Delhi	2005

Core II

1. Course Title: **Operations Management (PTM1102)**

Semester - I

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Basic concepts of operations and production management, types of manufacturing systems and their characteristics.	04
2.	Product and Process Design: System planning and design, long-range planning, product and process design and technological considerations.	04
3.	Demand Forecasting: Role of demand forecasting in operations decisions; various demand patterns, qualitative and quantitative techniques of demand forecasting.	06
4.	Production Planning and Scheduling: Aggregate production planning, operation scheduling, various scheduling criteria, lot sizing, job shop control; Mutli-stage manufacturing systems, their scheduling and management, capacity planning.	16
5.	Materials Planning: Details of material requirement planning (MRP) and manufacturing resource planning (MRP-II) and their various techniques.	06
6.	Facilities Planning: Plant design, types and considerations in the plant location, plant layout types, design, evaluation, principles and types of material flow, optimum plant layout.	06
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books /Publisher	Year of Publication/ Reprint
1.	Buffa, E. S. and Sarin, R. K., "Modern Production/Operations Management", 8 th Ed., John Wiley & Sons.	2003
2.	Adam, E., Jr. and Ebert, R. E., "Production Operations Management", 5 th Ed., Pearson Education.	1992
3.	Brown, S., Blackmon, K., Cousins, P. and Maylor H., "Operations Management: Policy, Practice, and Performance Improvement", Butterworth-Heinemann.	2001
4.	Dervitsiotis, K. N., "Operations Management", 2 nd Ed., McGraw Hill.	1987
5.	Starr M. K., "Production and Operations Management", Thomson Business Information.	2009
6.	Karjewski, L. J, Ritzman, L. P. and Malhotra, M. K., "Operations Management: Processes & Supply Chains, 9 th Ed., Pearson Education.	2009

Program Elective I**1. Course Title: Decision Modelling****(PTM1103)****Semester - I****2. Details of Course:**

S. No.	Contents	Contact Hours
1	Linear programming: Formulation of LP models, Graphical procedure of solution and Simplex method	01
2	Duality Concept and its applications, Dual Simplex Methods Linear Algebra, Revised Simplex Method, Sensitivity Analysis	02
3	Transportation and Assignment problems, Network flow	07
4	Linear programming approach to goal programming and gaming situations Integer Programming, Cutting plane algorithm and Branch and bound algorithm	08
5	Probability and statistical methods: probability and conditional probability, random variables, density and distribution functions	08
6	Important statistical distributions and their properties, sampling and sampling distributions, point and interval estimation, tests of hypothesis, regression and correlation analysis, and analysis of variance	08
7	Models and Modelling: model verification and validation, decision modelling for deterministic, uncertainty, risk and competitive situations	08
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books / Publisher	Year
1	Ravindran, A., Philips, D.T., and Solberg, J.J., Operations research, John Wiley and Sons.	1987
2	Taha H.A., Operation Research- An Introduction, PHI	2007
3	Hillier F.S. and Lieberman G.J., Introduction to Operation Research, McGraw Hill.	2001
4	Hadley G., Linear Programming, Addison-Wesley	1977

Program Elective I

1. Course Title: **Quality Management (PTM1104)**

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Fundamentals of Quality Management: Quality of products, services and total quality control and its impact on the organization; Buyer, producer and market place demand for quality, quality cost and quality system economics; Quality management factors and jobs, system approach for quality management, commitment, leadership and team work.	09
2.	Techniques of Quality Engineering: Quality policy, product reliability and life cycle, safety, product quality and process capability, evaluation of methods, processes and materials, quality cost optimization; Quality planning, implementation and inspection, quality information feedback, corrective actions, Taguchi's philosophy and robust product and process design.	04
3.	Process Control Engineering: Machine and process capability analysis, multivary chart, vendor performance and their ratings, mechanization of process for quality.	04
4.	Statistical Quality Control: Review on variables, attributes quantities and their measurements etc; Theory of control charts, brief review on X, R, P, C, charts; Different adaptation of control charts, viz, group control chart, control charts with variable subgroup sizes, moving average and moving range charts, acceptance control charts, charts for trended universe average, CUSUM charts, different control charts.	04
5.	Acceptance Sampling: Acceptance sampling tables, acceptance sampling plans for attributes and variables.	05
6.	Quality Improvement Techniques: Variance concept in manufacturing cycle; Fish bone diagrams; Pareto charts; Just in Time (JIT) - philosophy, evaluation and concept.	06
7.	System Approach and Quality System Establishment: ISO-9000 pre-requisites, different quality systems and their structure, quality policies and objectives, management responsibility, documentation and methodology of implementation, quality audits and assessment.	05
8.	Achieving Total Commitment to Quality: Participative approach and team work, training and motivation; quality circles, their characteristics, objectives and organization structure; Quality circle implementation structures and techniques; Communicating quality commitment to vendors and customers.	05
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books /Publisher	Year of
1.	Jackson, P. and Ashton, D., "Implementing Quality Through ISO-9000", Viva Book Pvt Ltd.	1993
2.	Grant, E. and Lavenworth, R., "Statistical Quality Control", 11 th Ed., McGraw Hill.	1997
3.	Ross, P. J., "Taguchi Techniques For Quality Engineering", 2 nd Ed., McGraw Hill.	1995
4.	Gryna, F., Chua, R. and Defeo, J., "Juran's Quality Planning and Analysis for Enterprise Quality", 5 th Ed., McGraw Hill.	2005

Program Elective I

1. Course Title: **Manufacturing Resources Management (PTM1105) Semester - I**

2. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Production as input output system; Resources of production; Forecasting and resources planning.	5
2	Material Management: Definition and scope; Functions; Types of materials; Analytical structure of inventory models; Material requirement planning (MRP); Inventory control systems; Purchase management; Storekeeping and issue of materials; Material handling; Just in Time (JIT) and Kanban systems.	7
3	Human Resources Management: Objective; function; organizational planning and development; staffing policies and process; training and executive development; wage and salary policies and administration; motivation; employee services; employee record; labor relations; collective bargaining; personnel research.	10
4	Production Management: Direct and indirect; Machines and equipment planning; jigs and tools planning, material handling equipment planning; Planning of land, roads, building, warehouses etc.; General vs special purpose equipment; Economic analysis; Equipment replacement; Capital resources planning; Method of allocation of resources.	10
5	Production Information Management: Management of production technology; information systems; Management Information Systems (MIS); Strategic Information System (SIS); Information networking; Parts oriented production information systems.	10
Total		42

3. Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year
1	Hitomi K., "Manufacturing System Engineering", 2nd Edition, Viva Books.	1996
2	Hitomi K, "Manufacturing Systems Engineering: A Unified Approach to Manufacturing Technology, Production Management and Industrial Economics", 2nd Edition, CRC Press.	1996
3	Groover, M. P., "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", 4th Edition, Wiley	2010
4	Gary Dessler, "Personnel Management", 4th Edition, Reston Publishing.	1988
5	Rajneesh Prakash, "Management of Systems Nauhria R. N. and", Wheeler Publishing.	1995
6	Thomas Vollman E., William Berry L. and Clay Whybark D., "Manufacturing Planning and Control Systems", 5th Edition, Galgotia Publishing.	1997

Program Elective I

1. Course Title: **Design for Manufacture and Assembly (PTM1106)** Semester – I

2. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Objectives and Principles of DFMA, Geometric Tolerancing and Dimensioning: Process capability studies, Feature tolerances, Geometric tolerances and Dimensioning, Assembly limits, Datum features, Tolerance stacks, Criterion for Selection of Materials and Manufacturing process, Design requirements, Operational requirement, Materials choice for metal forming process and machining process, Operation Layout	8
2	Design for Casting: Design of castings based on parting line considerations, minimizing core requirements, Metal injection moulded parts: Process, suitable materials, Design recommendations for metal injection molded parts.	8
3	Design for Metal Extrusion: Design recommendation for metal extrusion, stamping, fine blanked parts, Rolled formed section. Design for Forging: Forging processes, Suitable materials for forging, Design recommendation,	8
4	Design for Machining: Economics of machining, Features to facilitate machining – surface finish, review of relationship between attainable tolerance grades and different machining processes, Design for Turning, drilling and milling etc.	8
5	Design for Assembly and Manufacture: Design for Assembly principles and process, Design for Welding, Brazing and Soldering and Design for Joining of Plastics, Design for economy, Identification of uneconomical design, Modifying the design, Computer Applications for DFMA.	10
Total		42

3. Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year
1	Boothroyd, G., Peter Dewhurst, Winston A. Knight, “Product Design for Manufacture and Assembly”, CRC Press, Taylor & Francis, USA	2013
2	Chitale A. K and Gupta R.C., “Product design and Manufacture”, Prentice Hall India Learning Private Limited.	2014
3	Karl T. Ulrich, Ateven D. Eppinger , “Product Design and Development”, Tata McGraw-Hill	2015
4	Michael Ashby., “Materials Selection in Mechanical Design”, Butterworth Heinemann, U.K	2016
5	O. Molloy, S. Tilley and E. A. Warman., “Design for Manufacturing and Assembly: Concepts, Architectures and Implementation”, Springer.	2012

Program Elective II

1. Course Title: **Machine Tool Design and Numerical Control (PTM1107)**

Details of Course:

S. No.	Contents	Contact Hours
1	Machine Tool Design: General requirements; Electrical and hydraulic drives of machine tools; Layout of gear boxes; Hydraulic, electric and mechanical stepless speed regulations; Design and analysis of guideways; Bed, column, spindle and power screw.	15
2	Numerical Control (NC): Introduction to numerical control; Components of NC systems; Open and close loop NC; Types of numerical control: Point-to-point, straight cut, and continuous path NC; Drives and controls; NC-tape coding standards; Coordinate and positioning systems – Cartesian and polar; Reference zero points; NC interpolations – linear, circular, helical, parabolic and cubic interpolation; Applications of NC systems.	06
3	NC Part Programming Methods: Structure of NC part program; NC word formats; Introduction to G and M codes; Manual programming methods; Computer-assisted programming methods; APT part programming.	10
4	Extensions of NC: Concepts of CNC, machining center, and DNC; Types of CNC systems; Introduction to post processors; Tooling for NC/CNC.	03
5	CNC Part Programming: Tool motion commands; Tool length offset; Cutter diameter compensation command; fixed cycle command; Scaling; rotation; Mirror image; Macros programming etc.	08
Total		42

3. Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year of Publication/ Reprint
1.	Mehta, N. K., “Machine Tool Design and Numerical Control”, 2 nd Ed., Tata McGraw Hill.	1996
2.	Koren, Y., “Computer Control of Manufacturing Systems”, McGraw Hill.	1983
3.	Rapello, R. G., “Essentials of Numerical Control”, Prentice Hall.	1986
4.	Chen, S, and Lin, J., “Computer Numerical Control: From Programming to Networking”, Thomson Delmer Learning.	1994
5.	Sava, M., and Pusztai, J., “Computer Numerical Control Programming”, Prentice Hall.	1990

Program Elective II

1. Course Title: **Industrial Automation (PTM1108)**

Semester - I

2. Details of Course:

S. No.	Contents	Contact Hours
1	Basic Concepts: Introduction of mechanization and automation, classification and strategies of automation, reasons for and arguments against automation, mechanical, electrical, hydraulic, and pneumatic devices and controls.	6
2	High Volume Manufacturing: Automated flow lines, types of automatic transfer mechanisms, design and fabrication considerations, analysis of automated flow lines.	6
3	Assembly Systems: Assembly systems and their types, manual assembly lines and line balancing.	4
4	Assembly Automation: automated assembly lines and their types, automatic assembly transfer systems, automatic feeding and orienting devices- vibratory and mechanical feeders and their types, orientation of parts, performance and economics of assembly systems, feasibility study for assembly automation.	12
5	Design for Assembly: Design for manual assembly, design for high speed automatic assembly, design for robot assembly.	4
6	Flexible Automation: Introduction of group technology (GT), steps in implementing Group Technology (GT), part families and machine cell formation, introduction of flexible manufacturing systems (FMS).	6
7	Programmable Automation: Brief introduction of numerical control (NC), computer numerical control (CNC), machining centers, programmable robots, direct numerical control (DNC) and adaptive control	4
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books / Publisher	Year
1	Groover, M. P., "Automation, Production systems and Computer Integrated Manufacturing", 2nd Ed., Prentice Hall.	2005
2	Boothroyd, G., "Assembly Automation and Product Design", 2nd Ed., Marcel Dekker.	1992
3	Boothroyd, G., Dewhurst, P. and Knight, W., "Product Design for Manufacture and Assembly", 2nd Ed., Taylor & Francis.	2002
4	Boothroyd, G., Poli, C. and Murch, L. E., "Automatic Assembly", Marcel Dekker.	1982
5	Tergan, V., Andreev, I. and Lieberman, B., "Fundamentals of Industrial Automation", Mir Publishers.	1986

Program Elective II

1. Course Title: **Flexible Manufacturing Systems (PTM1109)**

Semester - I

2. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Definition and classification of manufacturing systems, fundamentals of automated production cycle, need of flexibility, concept of flexibility, various types of flexibility, measures of flexibility.	07
2	Flexible Manufacturing System (FMS) Type: Introduction of FMS, definition of FMS, types of FMS, applications of FMS, FMS configuration, FMS host operator interface.	10
3	FMS Planning and Control: Functional requirements of FMS equipments, functions of FMS host computer, host system design, planning, scheduling of FMS, FMS simulation, Databases in FMS, GT in FMS, cell design and layout design, CAPP in FMS.	14
4	Material handling in FMS: Material handling principles in FMS, applications of robots in FMS.	06
5	Case Studies: Cases on FMS installation and implementation –acceptance testing and maintenance	05
Total		42

3. Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year of Publication/ Reprint
1.	Groover, M. P., “Automation, Production System and CIM”, 2nd Ed., Prentice Hall.	2000
2.	Rankey, P., “Design and Operations of FMS”, North-Holland Publishing.	1983
3.	Warnecke, H. J. (Ed.), “Flexible Manufacturing System”, Springer.	1986
4.	Bonetto, R., “FMS in Practice”, North Oxford Academic Publishers.	1988

Program Elective II

1. Course Title: **Modeling and Simulation of Manufacturing Systems (PTM1110)**

2. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction to System and simulation: Concept of system and elements of system, Discrete and continuous system, Models of system and Principles of modeling and simulation, Monte carlo simulation, Types of simulation, Steps in simulation model, Advantages, limitations and applications of simulation, Applications of simulation in manufacturing system.	09
2	Review of statistics and probability: Types of discrete and continuous probability distributions such as Geometric, Poisson, Uniform, Geometric distribution with examples, Normal, Exponential distribution with examples, Random numbers, Test for Random numbers, Chi square test or Kolmogorov Smirnov test, Auto correlation test Random Variate generation, Inverse transforms technique or Rejection method	09
3	Analysis of simulation data: Input data analysis, Verification and validation of simulation models, Output data analysis Simulation languages, Comparison and selection of simulation languages, evaluation of simulation languages	08
4	Design and evaluation of simulation experiments: Development and analysis of simulation models using simulation language with different manufacturing systems	06
5	Queuing models: An introduction, M/M/1 and M/M/m Models with examples, Open Queueing and Closed queueing network with examples Markov chain models and others: Discrete time markov chain with examples, Continues time markov chain with examples, stochastic process in manufacturing, Game theory	10
Total		42

3. Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year of Publication/ Reprint
1.	J.Banks, J.S. Carson, B. L. Nelson and D.M. Nicol, "Discrete Event System Simulation", PHI, New Delhi	2009
2.	A.M. Law and W.D.Kelton, "Simulation Modeling and Analysis", Tata McGraw Hill Ltd, New Delhi	2008
3.	N. Viswanadham and Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", PHI, New Delhi	2007
4.	Ronald G. Askin, Charles R. Standridge, "Modeling and Analysis of Manufacturing Systems", John Wiley & Sons.	1993

Program Elective III

1. Course Title: **Information Systems and Data Management (PTM1111)**

Semester - I

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Role of information system, the function of information system, determination of informational need	4
2.	Information Processing Concepts: Historical perspective, today's status, systems approach and analysis, concepts of data and information, data collection, data or information, data and information storage, data processing and information generation, transmission of data and information and the information economics of information	10
3.	Information System Analysis: Overview of system, management and formal information systems, hierarchical and system approach to information systems design and their applications, tailoring the information system to meet specific information requirements using filtering monitoring, interrogative and external methods.	14
4.	Data Base Management System: Introduction to data base concepts, difference between a file system and a data base systems, goals of DBMS including data independence consistency, data security and integrity; DBMS models hierarchical network and relation, data description and query language, physical database design case studies, system R, Ingress, IDMS etc.; Introduction to distributed database, concurrency control bases recovery etc.	14
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books / Publisher	Year
1.	Henry Luces C., "Information Systems Concepts for Management", McGraw Hill.	1978
2.	Burch, J. G. and Grudnitski, G., "Information Systems Theory and Practice", John Wiley & Sons.	1989
3.	Walker, D. W., "Computer Based Information System An Introduction", Pergamon Press.	1989
4.	Mark L. Gillenson, "Fundamentals of Database Management Systems", John Wiley & Sons.	2004

Program Elective III

1. Course Title: **Product Design and Development (PTM1112)** Semester - I
 2. Details of Course:

S. No.	Contents	Contact Hours
1	Product Design: Traditional and modern design processes; Organization objectives; Innovation, creation, and diffusion techniques; Evaluation of new product ideas – functional, technological, ecological, legal.	06
2	Product Modeling and Reverse Engineering: Wireframe modeling; Surface modeling – boundary representation; Solid modeling – CSG; Concept of reverse engineering.	08
3	Product Data Exchange: Neutral file formats for product data exchange – DXF, IGES, STEP.	06
4	Concurrent Engineering: Concept of concurrent engineering; Design for X; Design for manufacturability (DFM); Design for assemblability (DFA); Design for reliability (DFR); Design for quality (DFQ).	10
5	Rapid Prototyping (RP) Methods: Liquid based RP methods – stereolithography apparatus (SLA), solid ground curing (SGC), solid creation system (SCS), etc.; Solid based RP methods: Fused deposition modeling (FDM), laminated object manufacturing (LOM), etc.; Powder based RP methods– selective laser sintering (SLS), 3D printing (3DP), ballistic particle manufacturing (BPM), etc	12
Total		42

3. Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year of Publication/ Reprint
1.	Andrearsen, M. M., and Hein, L., “Integrated Product Development”, Springer.	1987
2.	Huang, G. Q., “Design for X: Concurrent Engineering Imperatives”, Chapman and Hall.	1996
3.	Chitale, A. K. and Gutpa, R. C., “Product Design and Manufacturing”, Prentice Hall.	1997
4.	Zeid I., “CAD/CAM: Theory and Practice”, Tata McGraw Hill.	1998
5	Mortenson, M. E., “Geometric Modeling”, 3rd Ed., Industrial Press.	2006
6	Boothroyd G., Dewhurst P., and Knight, “Product Design for Manufacture and Assembly”, 2nd Ed., Marcel Dekker.	2002
7	Chua, C. K and. Leong, K. F., “Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley & Sons.	1997

Program Elective III

1. Course Title: **Rapid Prototyping (PTM1113)**

Semester - I

2. Details of Course:

Sr. No.	Contents	Contact Hours
1	Introduction to Rapid Manufacturing, Customization and Mass Customization, Classification of Rapid Manufacturing Processes (Additive/Subtractive/Formative)	4
2	Process Chain for Additive and Other Rapid Manufacturing Processes. Data Formats for additive and Other Rapid Manufacturing Processes and associated details. Data Conversion for Layered/additive manufacturing and Associated Difficulties.	6
3	Data Validity Checks for Layered Manufacturing, Data repair procedures for Layered Manufacturing, Slicing Algorithms and related details, Part Deposition Orientation and its Importance, Direct Slicing and STEP related Details, Data Format (STEP) and its details related non layered manufacturing processes.	8
4	Classification of additive (layered) prototyping/tooling/manufacturing processes and some introduction, Fused Deposition Modelling of Polymers, Ceramics and Metals, Extruder deposition System, Laminated Object Manufacturing and Laminated Tooling Systems	7
5	Shaped Deposition Manufacturing and Modular configuration, Stereolithography and other liquid based systems, Laser Sintering based technologies and their related details	7
6	3D printing, Direct Metal Deposition/3D welding; Laser/Electron Beam melting based technologies, Silicon Rubber Moulding, Metal Arc Spray System and other R T processes	4
7	Rapid Manufacturing Processes: Subtractive	2
8	Rapid Manufacturing Processes: Formative	2
9	Process selection, Applications and Case studies	2
	Total	42

3. Suggested Books

S. No.	Name of Authors / Books /Publisher	Year of Publication/ Reprint
1.	Gibson, I, Rosen, D W., and Stucker,B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer	2010
2.	Hopkinson, N, Haque, R., and Dickens, P., Rapid Manufacturing:An Industrial Revolution for a DigitalAge:An Industrial Revolution for the DigitalAge, Wiley	2005
3.	Bartolo,P J (editor),Virtual and Rapid Manufacturing:Advanced Research in Virtual and Rapid Prototyping, Taylor and Francis	2007
4.	Chua, C K, Leong,KF., Lim CS, Rapid Prototyping, World Scientific	2003
5.	Pique,A., Chrisey, DB., Direct Write Technologies for RPAApplications: Sensors,Electronics and Integrated Power Sources,Academic Press,	2002
6.	Venuvinod,PK., Ma, W., Rapid Prototyping – Laser Based and Othr Technologies,Kluwer	2004

Program Elective III

1. Course Title: **Product Lifecycle Management (PTM1114)**

Semester - I

2. Details of Course:

S. No.	Contents	Contact Hours
1	Product Life Cycle Environment : Background, Overview, Need, Benefits, Concept of Product Life Cycle, Components / Elements of PLM, Significance of PLM, Product Data and Product Workflow, Company's PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy	08
2	Product Development Process : Integrated Product development process, Concept design, Specification, Detailed design, Validation and analysis (simulation), Tool design, Plan manufacturing , Build/Assemble , Test (quality check) , Sell and Deliver , Use , Maintain and Support, Dispose.	06
3	Product Development Approaches: Bottom-up design, Top-down design, Front-loading design workflow, Design in context, Modular design. Concurrent engineering, collaborative and Internet based design, Product and process systemization, problem, identification and solving methodologies, improving product development solutions	06
4	Product Modelling: Product Modelling , Definition of concepts, Fundamental issues, Role of Process chains and product models, Types of product models, model standardization efforts-types of process chains	10
5	Product Data Management (PDM) Technology: Introduction to Concepts, Benefits and Terminology, PDM functions, definition and architectures of PDM systems, product data interchange, portal integration, PDM acquisition and implementation. Information authoring tools (e.g., MCAD, ECAD, and technical publishing), Core functions (e.g., data vaults, document and content management, workflow and program management), Functional applications (e.g., configuration Management)	12
Total		42

3. Suggested Books:

S. No.	Name of Books / Authors / Publisher	Year of Publication/ Reprint
1.	Michael Grieves "Product Lifecycle Management", McGraw-Hill Education	2005
2.	Antti Saaksvuori, Anselmi Immonen, "Product Life Cycle Management", Springer	2010
3.	Stark, John , "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag	2016
4.	Riaz Ahmad, "Product Lifecycle Management", Lambert Academic Publishing.	2011

Lab I:

1. Course Title: **Advanced Manufacturing Lab I (PTM1201)**

Semester-I

Teaching Scheme

Practicals : 3 hrs/week

Examination Scheme

Term work : 100

Sl No.	Topic
1.	Hydraulic Bulge test and Erichsen test
2.	Uni-axial compression test to obtain true stress-strain data and to study the effects of lubrication
3.	Plane strain compression test for sheet type of specimen to obtain stress-strain behaviour
4.	Studies on Arc behaviour in shielded metal arc welding
5.	Temperature distribution in arc welding
6.	Weld quality tests (Destructive Test)
7.	Weld quality tests (Non-Destructive Test- 3 Practicals)
8.	Analysis of Extrusion Processes

Lab II

1. Course Title: **Computational Laboratory (PTM1202)**

Semester-I

Teaching Scheme

Practicals : 3 hrs/week

Examination Scheme

Term work : 100

Development of algorithms and computer programs using C, C++, MATLAB, LINDO, LINGO, EXCEL and ARENA for the modeling and analysis of decision problems in the areas of Production Planning and Control, Inventory and Supply Chain Management, Manufacturing System Design, Performance of Manufacturing Systems, Facilities Planning, Financial Management, Human Resource Management and Marketing Management

RMC 1101	Compulsory paper	Research Methodology & IPR	2
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Course Content

Unit-1: Research Problem and Scope for Solution: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit-2: Format: Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit-3: Process And Development: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

Unit-4: Patent Rights: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit-5: New Developments In IPR: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books:

1. Stuart Melville and Wayne Goddard, “*Research methodology: an introduction for science & engineering students*”
2. Wayne Goddard and Stuart Melville, “*Research Methodology: An Introduction*”
3. Ranjit Kumar, 2nd Edition, “*Research Methodology: A Stepby Step Guide for beginners*”

Reference Books:

1. Halbert, “*Resisting Intellectual Property*”, Taylor & Francis Ltd ,2007.
2. Mayall, “*Industrial Design*”, McGraw Hill, 1992.
3. Niebel, “*Product Design*”, McGraw Hill, 1974.
4. Asimov, “*Introduction to Design*”, Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ *Intellectual Property in New Technological Age*”, 2016.
6. T. Ramappa, “*Intellectual Property Rights Under WTO*”, S. Chand, 2008

Core III

1. Course Title: **Advanced Operations Research(PTM2101)**

Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Understanding supply chain, supply chain performance; supply chain drivers and obstacles.	04
2	Planning Demand and Supply in a Supply Chain: Demand forecasting in supply chain, aggregate planning in supply chain, planning supply and demand; managing predictable variability, Economic Order Quantity Models, Reorder Point Models, Multi-echelon Inventory Systems.	12
3	Planning and Managing inventories in a Supply Chain: Managing economies of supply chain, managing uncertainty in a supply chain, determining optimal levels of product availability.	06
4	Transportation, Network Design and Information Technology: Transportation aspects in a supply chain, facility Decision, Network design in a supply chain, Information technology and its use in supply chain.	10
5	Coordination in Supply Chain and effect of E- Business: Role of Coordination and E-business in a supply chain; financial evaluation in a supply chain.	10
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books / Publisher
1	Hopp W. J., Spearman M. L. and Irwin, "Factory Physics: Foundations of Manufacturing", McGraw-Hill Inc. New York.
2	Viswanadham N., "Analysis of Manufacturing Enterprises", Kluwer Academic Publishers, UK.
3	Sridhar Tayur, Ram Ganeshan and Michael Magazine (editors), "Quantitative Models for Supply Chain Management", Kluwer Academic Publishers, UK.
4	Handfield R.B. and Nichols E.L.Jr., "Introduction to Supply Chain Management", Prentice Hall Inc. Englewood- Cliff, New Jersey.
5	Viswanadham N. and Narahari Y., "Performance Modeling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi.
6	Chopra S. and Meindel P., "Supply Chain Management: Strategy, Planning, and Operation", Prentice Hall of India, New Delhi.
7	Shapiro J. F., Duxbury Thomson Learning, "Modeling the Supply Chain", Duxbury Thomson Learning Inc., Duxbury, Pacific Grove.

Core IV

1. Course Title: **Advanced Manufacturing Processes II (PTM2102) Semester - II**

2. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Types of advanced manufacturing processes; Evolution, need, and classification of advanced machining processes (AMPs).	02
2	Mechanical Type AMPs: USM, Rotary UltraSonic Machining (RUM), AJM, WJM, AWJM processes - Process principle and mechanism of material removal; Process Parameters; Process Capabilities; Applications; Operational characteristics; Limitations.	06
3	Advanced Fine Finishing Process: Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magneto Rheological Abrasive Finishing (MRAF) - Process principle; Process equipment; Process Parameters; Process Capabilities; Applications; Limitations.	05
4	Chemical Type AMPs: Process principle and details of Chemical Machining (CHM), Photo-Chemical Machining (PCM), and Bio-Chemical Machining (BCM) processes.	03
5	Electro Chemical Type AMPs: ECM - Process principle; Mechanism of material removal; Process Parameters; Process Capabilities; Applications	04
6	Thermal Type AMPs: EDM, Wire Electro Discharge Machining (WEDM), LBM, EBM, IBM, PAM processes – Process principle and mechanism of material removal; Process parameters and characteristics; Surface finish and accuracy, Process Capabilities; Applications; Limitations.	07
7	Derived and Hybrid AMPs: Electro Stream Drilling (ESD), Shaped Tube Electro Machining (STEM), Electro Chemical Honing (ECH), Electro Chemical Deburring (ECDE), Electro Chemical Discharge Machining (ECDM) - Process Parameters; Process Capabilities; Applications; Limitations, Introduction to form machining.	07
8.	Rapid prototyping (RP): process chain in RP, layering techniques, stereolithography, fused deposition modeling, laminated object manufacturing, repetitive masking and depositing.	08
Total		42

3. Suggested Books:

S. No.	Contents
1.	Pandey P. C., Shan H. S. "Modern Machining Processes", Tata McGraw-Hill Publishing Co. Ltd, New Delhi
2.	Ghosh A., Mallik A. K., "Manufacturing Science", Affiliated East-West Press Ltd, New Delhi
3.	Benedict G. F., "Nontraditional Manufacturing Processes", Marcel Dekker, Inc. New York
4.	McGeough J. A., "Advanced Method of Machining", Chapman and Hall, New York
5.	Mishra P. K., "Nonconventional Machining", Narosa Publishing House, New Delhi
6.	Jain V. K., "Advanced Machining Processes", Allied Publishers, New Delhi
7.	"Machining Data Handbook: Vol. 2", Machinability Data Center, (3 rd edition), Metcut Research Associates Inc., Ohio

Program Elective IV

1. Course Title: **Robotics and Control (PTM2103)**

Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Definition, Structure, Classification and Specifications of Robots, Industrial Robots.	02
2	Robot Elements and Control: Manipulators, Drives, Sensors, End Effectors, Configuration, Force/Torque Relationship, Trajectory Planning, Position Control, Feedback System, Digital Control	05
3	Modeling of Robots: Coordinate Frames, Mapping and Transformation; Direct Kinematic Model; Inverse Kinematics; Manipulator Differential Motion; Static Analysis; Jacobian	10
4	Manipulator Dynamics: Acceleration of a rigid body, mass distribution, Newtons equation, iterative Newton Euler dynamic formulation, Lagrangian formulation of manipulator dynamics, Bond graph modeling of manipulators, Trajectory Planning.	10
5	Linear and Non Linear Control of Manipulators: control law partitioning, trajectory following control, multi input multi output control systems, Cartesian based control scheme.	10
6	Force Control of manipulators: hybrid position/force control	03
7	Robot Programming: Robot Programming for Manufacturing and Other Applications, Robot Integration with CAD and CAM.	02
	Total	42

3. Suggested Books:

S. No.	Name of Authors / Books / Publisher
1	Craig John J., "Introduction to robotics: Mechanics & Control", AddisonWesley
2	Niku Saeed B., Introduction to Robotics: Analysis, Systems, Applications, PHI, New Delhi
3	Schilling R. J., "Fundamentals of Robotics Analysis and Control", Prentice Hall Inc
4	Mittal R. K. and Nagrath I. J., "Robotics and Control", Tata McGraw Hill, New Delhi
5	Ghosal Ashitava, "Robotics: Fundamental Concepts and Analysis", Oxford University Press

Program Elective IV

1. Course Title: **Processing of Non-Metals(PTM2104)**

Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Classification of engineering materials and processing techniques, structure and properties of non-metals.	02
2	Glass structure and properties, glass melting and forming, glass annealing.	03
3	Classification of ceramics: crystal structures and properties, ceramic powder preparation, Synthesis of ceramic powders, fabrication of ceramic products from powders: pressing, casting, vapour phase techniques, sintering, finishing, machining. ceramic coatings..	07
4	Structure and mechanical properties of plastics, thermoplastics and thermosets, Processing of Plastics: Extrusion. Injection moulding. Thermoforming. Compression moulding. Transfer moulding. General behavior of polymer melts, Machining of plastics.	07
5	Classification of composite materials, properties of composites, processing methods of polymeric matrix composites: hand lay-up, autoclaving, filament winding, pultrusion, compression molding, pre-pegging, sheet molding compounds etc., process capability and application areas of various techniques.	10
6	Ceramic matrix composites, mechanical properties of ceramic matrix composites, different processing techniques for ceramic matrix composites, process capability and applications of various techniques.	06
7	Secondary processing of composite materials, Need of secondary operations, different type of secondary operations, machining and drilling of non-metals, machining induced damage, different methods of reducing the damage on account of secondary processing.	05
Total		40

3. **Suggested Books:**

S. No.	Name of Authors / Books / Publisher
1	Manufacturing Processes for Engineering Materials : S. Kalpakjian, 3rd edition Addison - Wesley
2	Plastic Materials and Processing : A. Brent Strong, Prentice Hall, ISBN 0-13-021626-7

Program Elective IV

1. Course Title: **Computer Aided Process Planning (PTM2105)**

Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: traditional process planning, product design evaluation, various steps in process planning.	5
2.	Group Technology: Introduction, advantages, part families, classification and coding systems, production flow analysis, design of machine cells.	10
3.	Concepts Related to Process Planning: Machinability data system, cutting condition optimization.	5
4.	Automated Process Planning: Advantages of automated process planning, various approaches to process planning; Variant process planning, its features and different stages, different variant systems; Generative and semi-generative process planning, its features, design strategies, planning, modeling and coding scheme, decision mechanisms; Process capability analysis, intelligent process planning system; Artificial intelligence -- overview and application in process planning; Various recent process planning systems; Case studies.	12
5.	Interfaces of Process Planning: Integrating with loading, scheduling, MRP II, and capacity planning and other shop floor functions.	10
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books / Publisher
1.	Chang, T. C. and Wysk, R. A, "An Introduction to Automated Process Planning", Prentice-Hall.
2.	Gallagher, C. C and Knight, W. A., "Group Technology: Production Method in Manufacturing", Ellis Horewood.
3.	Nilsson, N. J., "Principles of Artificial Intelligence", Springer Verlag.
4.	Cornelius, L.T, "Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes", World Scientific Publishing Company.

Program Elective IV

1. Course Title: **Condition Monitoring (PTM2106)** Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Failures – System, component and services failures – classification and its causes, Maintenance Schemes – objectives – types and economic benefits, break down, preventive and predictive monitoring.	8
2.	Vibration Monitoring – causes and effects of vibration, review of mechanical vibration concepts – free and forced vibrations, vibration signature of active systems – measurement of amplitude, frequency and phase.	5
3.	Vibration monitoring equipment– vibration sensors (contact and non-contact type) – factors affecting the choice of sensors, signal conditioners, recording and display elements, vibration meter and analyzers, measurement of overall vibration levels.	6
4.	Contaminant analysis: Contaminants in used lubricating oils – monitoring techniques (wear debris) – SOAP technique, Ferrography, X-ray spectrometry, Particle classification. Temperature Monitoring – Various techniques – thermograph, pyrometers, indicating paint and NDT methods.	11
5.	Special Techniques: Ultrasonic measurement method, shock pulse measurement, Kurtosis, Acoustic Emission mentoring, critical speed analysis, shaft orbit analysis, Cepstrum analysis. Nondestructive techniques, Structural health monitoring weldments for surface and subsurface cracks.	10
Total		40

3. Suggested Books:

S. No.	Name of Authors / Books / Publisher
1.	Rao J. S., Vibration Condition Monitoring, Narosa Publishing House.
2.	Isermann R., Fault Diagnosis Application, Springer-Verlag Berlin
3.	Allan Davis, Hand book of Condition Monitoring, Chapman and Hall
4.	Choudary K K., Instrumentation, Measurement and Analysis, Tata McGraw Hill
5.	Collacott, R. A., Mechanical Faults Diagnosis, Chapman and Hall, London

Program Elective V

1. Course Title: **Supply Chain Management(PTM2107)**

Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1	Advanced topics in Linear programming - Dual simplex Method. Revised simplex method and parametric programming.	05
2	Processing n jobs through two machines and three machines, two jobs through m machines, n jobs through m machines, travelling salesman problem	04
3	Fractional programming – Introduction, Linear, Fractional programming, Fractional algorithm	07
4	Decision Theory: Decision without data decision with data (Bay's decision) Maximin, Minimax and other decision models.	07
5	Stochastic process: Markov process, Markov chain - transient and steady state probabilities of a Markov process.	10
6	Multiple criteria decision making -Introduction, Special features, compromise solution, goal programming and modified simplex method	07
Total		40

3. **Suggested Books:**

S. No.	Name of Authors / Books / Publisher
1	Taha, H. A., "An Introduction to Operations Research", 6th Ed., Prentice Hall. 2006
2	Hillier, F. J. and Lieberman, G. J., "Introduction to Operations Research", 7th Ed., Holden Day. 2001
3	Phillips, D. T, Ravindran, A. and Solberg, A. A., "Operations Research: Principles and Practice", 2nd Ed., John Wiley and Sons. 1986
4	Wagner, H. M., "Principles of OR with Applications to Managerial Decisions", 2nd Ed., Prentice Hall. 1975
5	Jensen, P. A, and Bard, J. F., "Operations Research Models and Methods", John Wiley and Sons. 2008

Program Elective V

1. Course Title: **Project Management (PTM2108)**

Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1	Project Management Forms of project organization, project planning, project control, human aspects of project management, pre-requisite for successful project implementation	04
2	Social cost benefit analysis Rationale for SCBA, net benefit in terms of economic prices, study of few scba project- bridge project, river valley project, power generation plant etc	06
3	Technical Analysis Manufacturing process/technology, technical arrangements, materialinput and utilities, product mix, plant capacity, location and site, machineries and equipment, structures and civil work, environmental aspects, project charts and layouts, schedule of project implementation	06
4	Financial estimates and projections Cost of project, land and site development, buildings and civil works, plant and machinery, technical know- how and engineering fees, projected cash- flow statement	07
5	Network Techniques for Project management Development of bar chart, elements of network, development of network, time estimates, deterministic & probabilistic activity networks, probability distribution, time computations, network analysis	07
6.	Project scheduling Techniques PERT & CPM models, cost model & resource allocation	04
7.	Project Documentation Computer application is project engineering, exploring the project window and toolbars, starting a new Project and working with tasks, turning the task list into a schedule, linking tasks, exploring the PERT chart, using the GANTT chart wizard, defining resources and costs. Assigning resources and costs to tasks, optimizing the project plan, printing views and reports with resources, tracking work on the project, analyzing progress and revising the schedule, publishing projects on the web	08
Total		42

3. Suggested Books:

S.No.	Name of Authors/Books/Publisher
1.	K. Nagarajan, Elements of Project Management, New Age International
2.	Prasanna and Chandra, Project Management, Tata McGraw Hill
3.	Panneerselvam R, Project Management Paperback – 2009, PHI Learning Pvt. Ltd.
4.	Pete Spinner, Elements of Project Management, Prentice Hall
5.	Terry Schmidt, Strategic Project Management Made Simple: Practical Tools for Leaders and Teams
6.	Robert K. Wysocki, Effective Project Management
7.	Frederick Plummer, Project Engineering: The Essential Toolbox for Young Engineers

Program Elective V1. Course Title: **Maintenance Management (PTM2109) Semester - II**

2. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Importance of maintenance, Objectives, duties, functions and responsibilities of maintenance engineering department, Organization and structure of maintenance systems.	04
2	Maintenance Policies and Planning: Maintenance strategies, advantages and disadvantages of each strategy, Planned maintenance procedure, advantage of planned maintenance, Scientific maintenance, Safety in maintenance.	06
3	System Reliability: Quantitative estimation of reliability economics of introducing a standby unit into the production system, Optimum design configuration of a series/parallel system, Breakdown time distribution.	06
4	Maintenance Activities: Optimal overhaul/repair or replacement policies for equipment subject to breakdown, Budgeting and control, Production maintenance integration.	04
5	Replacement Decisions: Economic models, block replacement policy, age replacement policy, replacement policies to minimize downtime, Economics of preventive maintenance.	08
6	Maintainability and Availability: Economics of maintainability and reliability, Maintainability increment, Equipment and mission availability.	08
7	Maintenance Organization: Computer applications in maintenance management, automatic chalk out equipment kits capabilities and limitations, Management information system for maintenance.	06
Total		42

3. **Suggested Books:**

S. No.	Name of Books / Authors / Publisher
1	Dhillon B.S., "Engineering Maintenance: a Modern Approach". 1 edition, CRC.
2	Kelly A., "Maintenance Planning and Control", Butterworth-Heinemann.Ltd, London.
3	Niebel B.W., "Engineering Maintenance Management", Marcel Dekker, New York.
4	Cliffon R. H., "Principle of Planned Maintenance", McGraw Hill Inc. New York.
5	Heintzelman J. E., "Handbook of Maintenance Management", Prentice-Hall Inc., Englewood Cliffs, New Jersey.

Program Elective V

1. Course Title: **Six Sigma (PTM2110)**

Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1	Six Sigma Basics: Overview & Implementation, the DMAIC process. Simple graphical tools: 7 QC Tools, Box Plot, Dot Plot, Stem & Leaf Plot.	04
2	Basic Statistics: Histograms to Distributions, Normal Distribution, Central Limit Theorem, Law of large numbers, t, chi-squared and F distributions. Normal Probability Plotting on ordinary graph paper, Interpretation	04
3	Testing a new process for improvement - Variability known from past, Variability estimated from the experiment, Comparing two processes - Randomised samples, Paired samples, Comparing more than two methods simultaneously- ANOVA Six Sigma Analyse: Experimental strategies - Deficiencies of one factor at a time experiments, Problems in analysis of past data, Necessity for randomization	08
4	Basics of Experimental Design - Terminology, Two level factorials, Estimation of effects and interactions, Yates algorithm, Unreplicated experiments - judging significance, Testing for significance in replicated experiments Developing mathematical model equations, calculating residuals, Handling non-normal response - Transformations. Choosing the number of experiments, Handling uncontrollable factors – Blocking, Dealing with difficult to randomise factors – split plot experiments Dealing with large number of factors, Fractional Factorial experiments.	12
5	Six Sigma Metrics: DPU, DPO, DPMO, Sigma levels, Yield, First Time Yield, Overall Yield, Throughput Yield, Rolled Throughput Yield, Normalized Yield Process Capability Indices: Cp, Cpk, Cpm, Cpkm. Dealing with non-normality through transformations, Importance of stability for capability, Effect of sample size - Confidence Intervals Measurement System Analysis: Repeatability and Reproducibility	12
Total		40

4. **Suggested Books:**

S. No.	Name of Books / Authors / Publisher
1	F. Breyfogle, Implementing Six Sigma: Smarter Solutions Using Statistical Methods, John Wiley & Sons, New York
2	M. Harry and R. Schroeder, Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Corporations, Doubleday, New York
3	J. Lawson, and J. Erjavec, Modern Statistics for Engineering and Quality Improvement, Thomson Duxbury.
4	D. C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, Inc., New York

Open Elective-I

1. Course Title: **Industrial Safety (PTM2111)**

Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1.	Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	8
2.	Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	8
3.	Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	8
4.	Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	8
5.	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance	10
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books /Publisher
1.	Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2.	Maintenance Engineering, H. P. Garg, S. Chand and Company.
3.	Pump-hydraulic Compressors, Audels, McGrew Hill Publication
4.	Dervitsiotis, K. N., "Operations Management", 2 nd Ed., McGraw Hill.
5.	Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Open Elective-I

1. Course Title: **Composite Materials (PTM2112)**

Semester - II

2. Details of Course:

S. No.	Contents	Contact Hours
1.	INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	8
2.	REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions	8
3.	Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications	10
4.	Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	6
5.	Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	10
Total		42

3. Suggested Books:

S. No.	Name of Authors / Books /Publisher	Year ofPublication / Reprint
1.	Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.	1993
2.	Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.	2007
3.	Composite Materials – K.K.Chawla.	2010

Open Elective-I

1. Course Title: **Mechatronics (PTM2113)**

Semester - II

2. Details of Course:

Sr. No.	Contents	Contact Hours
1.	Introduction: Definition of mechatronics, measurement system, control systems, microprocessor based controllers, mechatronics approach.	2
2.	Sensors and Transducers: Sensors and transducers, performance terminology, photoelectric transducers, flow transducers, optical sensors and transducers, semiconductor lasers, selection of sensors, mechanical / electrical switches, inputting data by switches.	7
3.	Actuators: Actuation systems, pneumatic and hydraulic systems, process control valves, rotary actuators, mechanical actuation systems, electrical actuation systems.	5
4.	Signal Conditioning: Signal conditioning, filtering digital signal, multiplexers, data acquisition, digital signal processing, pulse modulation, data presentation systems.	5
5.	Microprocessors and Microcontrollers: Microcomputer structure, microcontrollers, applications, programmable logic controllers.	8
6.	Modeling and System Response: Mathematical models, bond graph models, mechanical, electrical, hydraulic and thermal systems, dynamic response of systems, transfer function and frequency response, closed loop controllers.	9
7.	Design and Mechatronics: Input/output systems, computer based modular design, system validation, remote monitoring and control, designing, possible design solutions, detailed case studies of mechatronic systems used in photocopier, automobile, robots.	7
Total		43

3. Suggested Books

S. No.	Name of Authors / Books /Publisher	Year of Publication/ Reprint
1.	Bolton, W., "Mechatronics", Longman.	1999
2.	Alciatore, D. G. and Histrand, M. B., "Introduction to Mechatronics", Tata McGraw Hill	2003
3.	Shetty, D. and Richard, A.K., "Mechatronics System Design", PWS Pub. Boston	1997
4.	Mahalik, N., "Principles, Concept and Applications: Mechatronics", Tata McGraw.	2003
5.	Bishop, R.H. "Mechatronics Handbook", CRC Press.	2002
6.	Bolton, W., "Mechatronics: A Multidisciplinary Approach", 4th Ed., Prentice Hal	2009
7.	Merzouki R., Samantaray A. K., Pathak P.M., Bouamama B. Ould, Intelligent Mechatronic Systems: Modeling, Control and Diagnosis, Springer.	2013

Open Elective-I

1. Course Title: Smart Materials, Structures and Devices (PTM2114) Semester – II

2. Details of Course:

Sr. No.	Contents	Contact Hours
1	Intelligent Materials: Primitive functions of intelligent materials; Intelligence inherent in materials; Materials intelligently harmonizing with humanity; Intelligent biological materials.	2
2	Smart Materials and Structural Systems: Actuator materials; Sensing technologies; Microsensors; Intelligent systems; Hybrid smart materials; Passive sensory smart structures; Reactive actuator-based smart structures; Active sensing and reactive smart structures; Smart skins.	4
3	Electro–Rheological Fluids: Suspensions and electro, rheological fluids; The electro-rheological phenomenon; Charge migration mechanism for the dispersed phase; Electro rheological fluid actuators.	4
4	Piezoelectric Materials: Background; Piezoelectricity; Industrial piezoelectric materials; Smart materials featuring piezoelectric elements	3
5	Shape Memory Materials: Background on shape memory alloys; Applications of shape memory alloys; Continuum applications: structures and machine systems; Discrete applications; Impediments to applications of shape memory alloys; Shape memory plastics.	4
6	Fiber Optics: Overview; Light propagation in an optical fiber; Embedding optical fibers in fibrous polymeric thermosets; Fiberoptic strain sensors.	3
7	The Piezoelectric Vibrations Absorber Systems: Introduction; The single mode absorber, theory, design solution, extension including viscous modal damping, the electromechanical coupling coefficient, inductance, experimental results; The multimode absorber, derivation of transfer function, design solution, self-tuning absorber, performance function, control scheme	7
8	Modeling of Shells: Derivation of the basic shell equations, equation of motion, equations for specific geometries and cylindrical shell.	10
9	Modeling of plates and beams: Plate equations and beam equations.	5
Total		42

3. Suggested Books

S. No.	Name of Authors / Books /Publisher	Year of Publication/ Reprint
1.	Gandhi, M. V. and Thompson, B. S., “Smart Materials and structures”, Chapman & Hall.	1992
2.	Banks, H. T., Smith, R. C. and Qang, Y. W., “Smart Material structures:Modeling, Estimation and Control”, John Wiley & Sons.	1996
3.	Gabbert, U. and Tzou, H. S., “Smart Structures and Structronic System”, Kluwer Academic Publishers	2001
4.	Preumont, A., “Vibration Control of Active Structures”, Kluwer Academic Publishers.	2002
5.	Cheng, F. Y., Jiang, H. and Lou, K., “Smart Structures: Innovative Systems for Seismic Response Control”, CRC Press.	2008

Open Elective-I

1. Course Title: **Industrial IoT and Industry 4.0 (PTM2115)**

Semester – II

Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Sensing & actuation, Sensor fundamentals and characteristics, Optical Sources and Detectors, Intensity Polarization and Interferometric Sensors, Strain, Force, Torque and Pressure sensors, Position, Direction, Displacement and Level Sensors, Velocity and Acceleration sensors, Flow, Temperature and Acoustic sensors	09
2	IoT Fundamentals and Architecture: Evolution of IoT, Introduction to IoT components, IoT protocols and softwares, IoT point to point communication technologies.	07
3	Introduction to Cloud computation, Big data analytics, and AI: Evolution of Cloud Computation, Commercial clouds and their features, Databases in the Cloud, Automatic Storage Management in the Cloud. Smart Connected System Design Case Study open source IoT platforms, cloud dashboards, Introduction to big data analytics and Hadoop. Machine Learning and Data Science	05
4	Iot Based Design and Fabrication: Digital Tools, Product Representation and Exchange Technologies and Standards, Agile (Additive) Manufacturing Systems and Standards. Mass Customization, Smart Machine Tools, Smart Perception – Sensor networks and Devices.	05
5	Industrial IoT- Application Domains: Online Predictive modelling, Monitoring and Intelligent Control of Machining/Manufacturing; Logistics/Supply Chain Processes; Smart Energy Management of Manufacturing Processes and Facilities	08
6	IIoT applications in Manufacturing systems: Inventory Management & Quality Control, Plant Safety and Security, Facility Management etc.	06
7	IoT case studies: Based on Industrial automation, Transportation, Maintenance issues	02
Total		42

3. Suggested Books

Text Books:

1. Alasdair Gilchrist, Industry4.0: The Industrial Internet of Things, Apress
2. Sudip Mishra, Anandarup Mukherjee, Arijit Roy: Introduction to IOT, Cambridge University Press
3. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, CISCO Press
2. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things
3. John Wiley & Sons, 3. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi

Lab III

1. Course Title: **Advanced Manufacturing Lab II (PTM2201)**

Semester – II

Teaching Scheme

Practical : 3 hrs/week

Examination Scheme

Term work : 100

Sl. No.	Topic
1.	Electro-discharge Drilling
2.	Wire-cut Electro-discharge Machining
3.	Chemical Machining
4.	Electro-chemical Machining
5.	Ultrasonic Machining
6.	Abrasive Jet Machining
7.	Laser Beam Drilling
8.	Rapid Prototyping (3 practicals)

Lab IV

1. Course Title: Strategic Management Lab (PTM2202)

Semester – II

Teaching Scheme

Practicals : 3 hrs/week

Examination Scheme

Term work : 100

Sl No.	Topic
1.	Social cost benefit analysis
2.	Risk management of a construction/manufacturing project
3.	Cost benefit and sensitivity analysis of an industrial project
4.	Pre-feasibility and feasibility analysis of an industrial project
5.	Information processing through decision support system
6.	Decision making through an expert system
7.	Data mining and its application
8.	Expert system in machinery/equipment maintenance
9.	Condition monitoring of machines and equipment
10.	IoT Based Manufacturing Applications