VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination – 2018-19
M.Tech in Production Technology (MPY)
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

I SEMESTER

Sl. No	Course	Course Code	CourseTitle	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	18MPY11	MATHEMATICAL METHODS IN ENGINEERING	04	--	03	40	60	100	4
2	PCC	18 MPY12	Theory of Metal Cutting	04	--	03	40	60	100	4
3	PCC	18 MPY13	Advance Materials and Processing	04	--	03	40	60	100	4
4	PCC	18 MPY14	Advanced Foundry Technology	04	--	03	40	60	100	4
5	PCC	18 MPY15	Computer Integrated Manufacturing & Automation	04	--	03	40	60	100	4
6	PCC	18 MPYL16	Laboratory	-	04	03	40	60	100	2
7	PCC	18RMI17	Research Methodology and IPR	02	--	03	40	60	100	2
			TOTAL	**22**	**04**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted forthe same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as failed and have to complete during the subsequent University examination after satisfying the internship requirements.

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II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	18MPY21	Industrial Robotics	04	--	03	40	60	100	4
2	PCC	18 MPY22	Advance Joining Processes	04	--	03	40	60	100	4
3	PCC	18 MPY23	Simulation Modelling of Manufacturing Systems	04	--	03	40	60	100	4
4	PEC	18 MPY24X	Professional elective 1	04	--	03	40	60	100	4
5	PEC	18MPY25X	Professional elective 2	04	--	03	40	60	100	4
6	PCC	18MPYL26	Laboratory	--	04	03	40	60	100	2
7	PCC	18MPY27	Technical Seminar	--	02	--	100	--	100	2
TOTAL				**20**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective 1		Professional Elective 2	
Course Code under 18XXX24X	**Course title**	**Course Code under 18XXX25X**	**Course title**
18MPY241	Agile Manufacturing	18MPY251	Product Data Management
18MPY242	Non Destructive Testing	18MPY252	Industrial Design & Ergonomics
18MPY243	Surface Treatment & Finishing	18MPY253	Advanced Fluid Power Systems

Note:

1. Technical Seminar:CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the same and other semesters of the programme shall be mandatory.

The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as failed and have to complete during the subsequent University examination after satisfying the internship requirements.

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III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	18MPY31	Tool Design	04	--	03	40	60	100	4
2	PEC	18MPY32X	Professional elective3	04	--	03	40	60	100	4
3	PEC	18MPY33X	Professional elective 4	04	--	03	40	60	100	4
4	Project	18MPY34	Evaluation of Project phase -1	--	02	--	100	--	100	2
5	Intenship	18MPYI35	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)		03	40	60	100	6
TOTAL				12	02	12	**260**	**240**	**500**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional elective 3		Professional elective 4	
Course Code under 18XXX32X	**Course title**	**Course Code under 18XXX33X**	**Course title**
18MPY321	Applied Probability & Statistics	18MPY331	Maintenance Engineering & Management
18MPY322	Composite Materials	18MPY332	Operations Research
18MPY323	Quality & Reliability Engineering	18MPY333	Project Management

Note:

1. Project Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document, and present a seminar.
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.
SEE (University examination) shall be as per the University norms.

2. Internship: Those, who have not pursued /completed the internship shall be declared as failed and have to complete during subsequent University examinations after satisfying the internship requirements.
Internship SEE (University examination) shall be as per the University norms.

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IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
1	Project	18MPY41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. Project Phase-2:

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

I SEMESTER SYLLABUS

THEORY OF METAL CUTTING

Subject Code: 18 MPY 12 CIE Marks: 40
No. of Lecture Hours/Week: 04 Exam Hours: 03
Total No. of Lecture Hours: 50 SEE Marks: 60

MODULE 1

Mechanics of Metal Cutting: Mechanism of chip formation, Orthogonal & Oblique cutting, types of chips, built-up edge, Determination of shear plane angle, forces on the chips, forces in orthogonal cutting, Merchant circle diagram and analysis, Theory of Lee & Shaffer, co-efficient of friction, power & energy relationship, velocity relationship, shear-strain, factors affecting forces and power, problems.

Geometry of Cutting Tools: Single point and multi point cutting tools, tools nomenclature, tool point reference systems, tool angle specifications –ISO and ASA systems, conversion from one system to another. Recommended tool angles, Effect of cutting parameters on tool geometry. **10 Hrs**

MODULE 2

Tool Materials and Their Properties: Characteristics of tool materials, types of tool materials – carbon tool steels, high speed steels, cast alloys, cemented carbides, ceramics, diamonds, SIALON, CBN, UCON, recommended cutting speeds for the above tools, discussion on steels, air, water, oil hardening of tools and their applications. **10 Hrs**

MODULE 3

Measurement of Cutting Forces: Reasons for measuring cutting forces, Classification of cutting force dynamometers – mechanical, hydraulic, pneumatic, optical, inductance, piezoelectric, and strain gage type dynamometers, Dynamometers for lathe, drilling, and milling, Calibration of dynamometers. **10 Hrs**

MODULE 4

Tool Wear, Tool Life: Mechanisms of tool wear, Sudden & gradual wear, crater wear, flank wear, tool failure criteria, tool life equations, effect of process parameters on tool life, tool life tests, conventional & accelerated tool wear measurement, machinability index

Thermal Aspects in Metal Cutting: Heat sources in metal cutting, temperature in chip formation, temperature distribution, experimental determination of tool temperatures. **10 Hrs**

MODULE 5

Cutting fluids: Basic actions of cutting fluids, properties of cutting fluids, selection of cutting fluids, application of cutting fluids, filtration of fluids, recommended cutting fluids.

Economics of Machining: Introduction, elements of total production cost, optimum cutting speed and tool life for minimum cost, optimum cutting speed and tool life for maximum production, problems. **10 Hrs**

REFRENCE BOOKS

1. Metal Cutting Principles - M.C. Shaw - Oxford Publication – 1985.
2. Fundamentals of metal cutting & Machine Tools - by B.L.Juneja & G.S – Sekhar - Wiley Eastern.

3. Metal Cutting - V.C.Venkatesh & S.Chandrasekhanan - Pantice Hall – 1991. Metal Cutting - Dr. B.J.Ranganath -Vikas Publications

ADVANCED MATERIALS AND PROCESSING

Subject Code: 18MPY13	CIE Marks: 40
No. of Lecture Hours/Week: 04	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

MODULE 1

Classification and characteristics: Metals, Ceramics, Polymers and composites.
General properties and structure: Atoms, molecules bonds in solids, Crystalline - Defects in Metallic structure, Dislocations and plastic deformation - Strengthening mechanism - grain size, dislocation - Cold work, precipitation hardening, dispersion hardening - phase reactions, fatigue and Creep behavior. **10 Hrs**

MODULE 2

Ferrous Alloys: iron carbon equilibrium diagrams - Steels and cast irons - properties, structure, composition and applications transformation hardening in steels - Heat treatment processes - Effect of alloying elements - High alloy steels, Stainless steel types, tool Steels, Manganese steels, heat resistant steels, HSLA, Maraging steels. **10 Hrs**

MODULE 3

Non Ferrous alloys: AlIoys of copper, Aluminum, nickel, magnesium, titanium, lead, tin, Zinc - composition, heat treatment, structure, properties and application. **10 Hrs**

MODULE 4

Ceramics: Nature and structure of Ceramics - Refractory Abrasives glasses - glass ceramics - Advanced ceramics processing methods.
Composites : Definition - classification and characteristics of composite materials - Volume fraction - laminated composites particulate composites, fibrous composites - Types of reinforcements, their shape and size – production and properties of fiber reinforced plastics, Metal Matrix composites and ceramic matrix composites - Applications. **10 Hrs**

MODULE 5

Processing of Polymers: composites, ceramics - thermal spraying - Ion beam machining diamond coating techniques - tribological Applications. **10 Hrs**

REFERENCE BOOKS:

1. Engineering Metallurgy - Raymond and Higgens - ELBS/EA
2. Introduction to Material Science and Engineering - James.F.Shackleford - McMillan, NY - 7th edition.
3. Powder Metallurgy-Metals Hand Book -ASM, USA - Vol.7, 1974.
4. Composite Materials - Science and Engineering - Chawla K.K., Springer - Verlag, Newyork - 2ndedition, 1998.
5. Cast Metal Matrix Composites ASM Metals Hand Book - P.K. Rohagti - VI5.
6. Elements of Material science and Engineering - Van Vlack L.H. - Addison Wesley, NY - 1989.

ADVANCED FOUNDRY TECHNOLOGY

Subject Code: 18MPY14	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

MODULE 1

Solidification of Casting: Concept of solidification of metals, Homogenous and heterogeneous nucleation, Growth mechanism, Solidification of pure metals and alloys, Mechanism of columnar and dendritic growth, Coring or Segregation, Solidification time and Chvorinov's rule, Concept of progressive and directional solidifications.

Principles of Casting and Risering: Purpose of the gating system, Components of the gating System and its functions, Design of the gating System, types of gates, Gating ratio and its functions, Definition and functions of the riser, Types of risers and their application, Design of the riser - its shape, Size and location. Use of insulating material and exothermic compounds in risers. **10 Hrs**

MODULE 2

Design of Casting: Factors to be considered in casting design, Design consideration in pattern making, moulding techniques and core making and assembly, Cooling stresses and hot spots in casting and modification in casting geometry to overcome them.

Casting Quality Control: Casting defects and factors responsible for them, Different inspection and testing methods to evaluate the casting, Quality control activities in a foundry, Salvaging methods of defective casting. **10 Hrs**

MODULE 3

Furnace Technology: Study of various furnaces used in foundry, construction and operation of crucible and hearth furnace, Resistance, Arc and Induction furnaces - their construction, Operation and application. Heat treatment furnaces and drying ovens used in foundry.

Gray Cast - Iron Foundry Practice: Chemical Composition and structure of gray cast iron, Moulding, gating and risering techniques, melting of gray cast iron in Cupola and induction furnace, Inoculation of gray cast iron, Application of gray cast iron castings.

Ductile Cast Iron: Chemical composition and structure of ductile cast iron, Melting and spherodization treatment, Inoculation of ductile iron, Properties and application of ductile iron casting. **10 Hrs**

MODULE 4

Steel Casting Practice: Common steel casting, their composition, structure and properties. Melting and refining of steel, Gating and risering system of steel castings cleaning of steel castings.

Aluminium Foundry Practice: Composition, properties and application of common aluminium alloy casting, Melting and casting of AI-alloys, Gating and risering system of AI-alloy casting. **10 Hrs**

MODULE 5

Copper alloy Foundry Practice: General characteristics of common cast copper alloys, Melting and casting of copper alloys, Gating and risering of cu-alloy castings.

Foundry Mechanization and Modernization: Introduction to modernization, Mechanization of foundry and its advantages, Mechanization of sand plant, moulding and core making mechanization in melting, pouring and shake out units, Material handling equipments and conveyor systems, Brief sketches and description of layouts of job, Captive and mechanized foundries. **10 Hrs**

REFERENCE BOOKS:

1. Principle of metal casting - Heine, et. al - Tata-McGraw-HiII Publication - 2003.
2. A test book of FoundryTechnology - Lal, M. Khanna, P.O - DhanpatRai& Sons Publication.
3. Foundry Technology - Beelely, P.R. – Butterworth.

COMPUTER INTEGRATED MANUFACTURING AND AUTOMATION

Subject Code: 18MPY15	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

MODULE 1

Production Development Through CIM: Computers in Industrial manufacturing, Product cycle & Production development cycle, Introduction of CAD/CAM & CIM, sequential and concurrent engineering, soft and hard prototyping. **10 Hrs**

MODULE 2

Computer Process Monitoring: Process control methods, direct digital control, supervisory computer control, steady state optimal control, on line search strategies, adaptive control.

Computer Aided Quality Control: The computer in Q.C, automated inspection principles and methods, Contact inspection methods, non-contact inspection methods, machine vision system, optical inspection method, sensors, coordinate, measuring machine, Computer-Aided testing, Integration of CAQL with CAD/CAM. **10 Hrs**

MODULE 3

Computer Integrated Manufacturing: Fundamentals of CAD/CAM, Computerized Manufacturing planning systems, shop floor control & automatic identification techniques.

Computer Network for manufacturing and the future automated factor. **10 Hrs**

MODULE 4

Detroit type of Automation: Flow lines, Transfer Mechanisms, work pattern transfer, Different methods, & Problems.

Analysis of Automated flow lines: Analysis of transfer lines without storage with storage buffer single stage, Double stage, Multistage with problems, Automated assembly systems, Design for automated assembly, parts feeding devices, analysis of Multi station assembly machine, Analysis of Single stage assembly machine **10 Hrs**

MODULE 5

Automated Material Handling Storage: Material functions, types of material handling equipment, analysis of material handling systems, design of system, conveyor system, automated guided vehicle systems, automated storage / retrieval systems, caroused storage systems work in process storage, interfacing handling & storage with manufacturing.

10 Hrs

REFERENCE BOOKS:

1. CAD/CAM - Zimmers & Grover – PHI.
2. CAD/CAM/CIM - P.Radhakrishna - New Age International - 2nd edition.
3. Automation, Production systems & Computer Aided Manufacturing - M.P. Grover - Prentice Hall - 1984.
4. CAD/CAM -Zeid – Mc-Graw Hill - 2005.
5. CAD/CAM - P.N.Rao - TMH. - 2nd edition, 2004.
6. Robotics for Engineering - Koren.Y - Mc-Graw Hill - 1985.
7. Robert vision & Sensory Controls - Rooks B. - North Holland. - (ed) vol-3

Laboratory Exercises

18 MPYL16

Perform any Eight / Ten experiments:

1. Determination of Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning.
2. Forces measurements during orthogonal turning.
3. Estimation of Power required during orthogonal turning.
4. Torque and Thrust measurement during drilling.
5. Determination of cutting forces during milling using Milling tool dynamometer
6. Measurement of Chip tool Interface temperature during turning using thermocouple technique.
7. Study the variation of surface roughness with different speed and feed during plain milling operation on flat surface.
8. Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.
9. To prepare metallic samples for metallographic examination and to study the principle & construction of the Metallurgical Microscope.
10. Study of Microstructure and Hardening of steel in different medium and cooling rates.
11. Effect of Carbon percentage on the hardness of Steel.
12. CNC milling- Writing and execution of part program for contour milling.

REFRENCE BOOKS

1. **Metal Cutting Principles** - M.C. Shaw - Oxford Publication – 1985.
2. **Fundamentals of metal cutting & Machine Tools** - by B.L.Juneja & G.S – Sekhar - Wiley Eastern.

3. **Metal Cutting** - V.C.Venkatesh & S.Chandrasekhanan - Pantice Hall – 1991.
4. **Metal Cutting** - Dr. B.J.Ranganath -Vikas Publications.

RESEARCH METHODOLOGY AND IPR

Subject Code: 18RMI17 CIE Marks: 40
No. of Lecture Hours/Week: 02 Exam Hours: 03
Total No. of Lecture Hours: 20 SEE Marks: 60

RESEARCH METHODOLOGY

Introduction: Meaning, Objectives and Characteristics of research - Research methods Vs Methodology - Types of research - Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical - Research process - Criteria of good research - Developing a research plan.

Defining the research problem - Selecting the problem - Necessity of defining the problem - Techniques involved in defining the problem - Importance of literature review in defining a problem - Survey of literature - Primary and secondary sources - Reviews, treatise, monographs patents - web as a source - searching the web - Identifying gap areas from literature review - Development of working hypothesis. **10 Hrs**

BASIC PRINCIPLES OF IP LAWS

Introduction: History, Concept of property, Constitutional aspects of IP, Basis for protection, Invention, Criteria for patentability, Non – patentable inventions.

Patents: Introduction, Origin and meaning of the term patent, Objective of a patent law, principles underlying the patent law in India, patentable invention, Overview of Procedure for obtaining patent and patent rights

Transfer of patent: Forms of transfer of Patent rights, Assignment, kinds of assignment, License, kinds of license, Rights conferred on a licensee, Transmission of patent by operation of law.
Trade Marks: Introduction, Statutory authorities, procedure of registration of trademarks, rights conferred by registration of trademarks, licensing in trade mark. **10 Hrs**

TEXT BOOKS:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
3. T. M Murray and M.J. Mehlman, Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons 2000

REFERENCE BOOKS:

1. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
2. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications

4. Intellectual Property Rights in the Global Economy: Keith Eugene Maskus, Institute for International Economics, Washington, DC, 2000

II SEMESTER SYLLABUS

INDUSTRIAL ROBOTICS

Subject Code: 18MPY21	CIE Marks: 40
No. of Lecture Hours/Week: 04	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

MODULE 1

FUNDAMENTAL CONCEPTS OF ROBOTICS: History, present status and future trends, Robotics, Robot, Definition, Robotics Systems and Robot Anatomy, Specification of Robotics, Resolution, Repeatability and Accuracy of a Manipulator.

ROBOT DRIVES: Power transmission systems and control Robot drive mechanisms, hydraulic-electric-pneumatic drives, and Mechanical transmission method – Rotary-to-Rotary motion conversion. Rotary-to-linear motion conversion end effectors – types-griping problem Remote-Centered compliance Devices, Control of Actuators in Robotic Mechanisms.

10 Hrs

MODULE 2

SENSORS AND INTELLIGENT ROBOTS: Sensory devices – Non-optical-Position sensors – Optical position sensors – velocity sensors – proximity sensors: Contact and non-contact type Touch and slip sensors – Force and Torque Sensors – AI and Robotics.

COMPUTER VISION FOR ROBOTICS SYSTEMS: Robot vision systems – Imaging components – Image representation – Hardware aspects-Picture coding – Object Recognition and Categorization-Visual inspection – software considerations – applications – commercial – Robotics vision systems. **10 Hrs**

MODULE 3

COMPUTER CONSIDERATIONS FOR ROBOTIC SYSTEMS: Computer architecture for robots, hardware, Computational elements in robotic applications – Robot programming – sample programs path planning – Robot's computer system. **10 Hrs**

MODULE 4

TRANSFORMATIONS AND KINEMATICS: Homogeneous Co-ordinates – Co-ordinate Reference Frames – Homogeneous Transformations for the manipulator – the forward and inverse problems of manipulator kinematics – Motion generation – Manipulator dynamics – Jacobian in terms of D.H.Matrices controller architecture.. **10 Hrs**

MODULE 5

ROBOT CELL DESIGN AND CONTROL: Specifications of Commercial Robots – Robot Design and Process specifications – motor selection in the design of a robotic joint – Robot Cell layouts – Economic and Social aspects of robotics.

APPLICATIONS OF ROBOTS: Capabilities of Robots – Robotics Applications – Obstacle avoidance – Robotics in India – The future of Robotics **10 Hrs**

TEXT BOOKS:

1. Robotics engineering an integrated approach - Richard D Klafter, Thomas A Chmielewski, Michael Negin – Prentice Hall of India Pvt. Ltd. - Eastern Economy Edition, 1989.

2. Robotics: Control Sensing, Vision, intelligence - Fu KS Gomaler R C, Lee C S G – McGraw Hill Book Co. - 1987.

REFERENCE BOOKS:

1. Handbook of Industrial Robotics - Shuman Y. Nof - John Wiley & Sons, New York - 1985.
2. Robotics Technology and Flexible Automation - Deb SR - McGraw Hill Book Co. - 1994

ADVANCE JOINING PROCESSES

Subject Code: 18MPY22	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

Module – 1

Distortion- methods to avoid distortion, Stresses in Joint Design.

Electro Slag, Welding Electron Beam Welding, Plasma arc Welding, Laser Beam Welding, Explosion Welding, Diffusion Welding, Ultrasonic Welding, Friction welding and Thermit welding. **10 Hrs**

Module – 2

Welding and cladding of dissimilar materials, overlaying and surfacing.

Advanced soldering and brazing processes -different types. Welding of plastics. **10 Hrs**

Module – 3

Inspection of Welds: Destructive techniques like Tensile, Bend, and Nick break, Impact & Hardness. Non-Destructive techniques like 'X' rays, Ultrasonic, Magnetic particle, Dye Penetrant, Gamma ray inspection.

Welding Symbols- Need for, Representing the welds, Basic weld symbols, Location of Weld, Supplementary symbols, Dimensions of welds, Examples **10 Hrs**

Module – 4

Welding Design - Introduction, Principles of sound welding design, Welding joint design. Welding positions, Allowable strengths of welds, under steady loads.

Quality Control in Welding - Introduction, Quality assurance v/s Quality control, Weld quality, Discontinuities in welds, their causes and remedies and Quality conflicts.

10 Hrs

Module – 5

Computer-Aided Welding Design – Introduction, Principles of sound welding design, Wilding joint design, Welding positions, Allowable strengths of welds. Idler steady loads, Weld throat thickness, Solved and um solved examples. **10 Hrs**

REFERENCE BOOKS:

1. **Welding Engineering Handbook** - A.W.S.
2. **Welding Engineering** - Rossi - McGraw Hill.
3. **Advanced Welding processes** – Nikodaco & Shansky - MIR Publications.
4. **Welding Technology** - O.P. Khanna
5. **Welding for Engineers** - Udin, Funk &Wulf

SIMULATION MODELLING OF MANUFACTURING SYSTEMS

Subject Code: 18MPY23	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

Module – 1

Principle of Computer Modelling and Simulation: Monte Carlo simulation. Nature of computer- modeling and simulation. Limitations of simulation, areas of applications.

System and Environment: Components of a system -discrete and continuous systems, Models of a system -a variety of modeling approaches. **10 Hrs**

Module – 2

Discrete Event Simulation: Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, too server queue, simulation of inventory problem.

Statistical Models in Simulation: Discrete distributions, continuous distributions. **10 Hrs**

Module – 3

Random Number Generation: Techniques for generating random numbers- Mid square method - the mod product method -Constant multiplier technique -Additive congruential method - Linear congruential method -Tests for random numbers -The Kolmogorov-Smirnov test -the Chi-square test, Ivica Cmkovic, Ulfaskluna and Annitaborsen Dohlgvist Publisher Artech house. **10 Hrs**

Module – 4

Random Variable Generation: Inversion transforms technique-exponential distribution. Uniform distribution, weibul distribution, continuous distribution, generating approximate normal variates-Erlang distribution.

Empirical Discrete Distribution: Discrete uniform -distribution Poisson distribution - geometric distribution - acceptance - rejection technique for Poisson distribution gamma distribution. **10 Hrs**

Module – 5

Design and Evaluation of Simulation Experiments: variance reduction techniques - antithetic variables, variables-verification and validation of simulation models.

Simulation Software: Selection of simulation software, simulation packages. **10 Hrs**

TEXT BOOKS:

1. Discrete Event System Simulation - Jerry Banks & .John S Carson II - Prentice Hall Inc.- 1984.

2. Systems Simulation - Gordan. G. - Prentice Hall India Ltd - 1991.

REFERENCE BOOKS:

1. System Simulation with Digital Computer – Nusing Deo - Prentice Hall of India - 1979.

2. Computer Simulation and Modeling - Francis Neelamkovil - John Wilely& Sons - 1987.

3. Simulation Modeling with Pascal - RathM.Davis& Robert M O Keefe - Prentice Hall Inc. - 1989.

AGILE MANUFACTURING

Subject Code: 18MPY241 CIE Marks: 40
No. of Lecture Hours/Week: 03 Exam Hours: 03
Total No. of Lecture Hours: 50 SEE Marks: 60

Module-1

Introduction - What is agile Manufacturing? - Competitive environment of the future the business case for agile manufacturing conceptual frame work for agile manufacturing.

10 Hrs

Module-2

Four Core Concepts: Strategy driven approach - integrating organization, people technology Interdisciplinary design methodology. **10 Hrs**

Module-3

Agile Manufacturing and Change Management: The change implications. Post failures in advanced manufacturing, changes on the way, traditional management accounting, paradigm, investment appraisal, product costing - performance, measurement and control systems, Traditional, control technological and design paradigms traditional problems in workplace-organizational issues - role of technology. **10 Hrs**

Module-4

Agile Manufacturing Enterprise Design: Agile manufacturing - enterprise design. system concepts as the basic manufacturing theory - joint technical & organizational design and a model for the design of agile manufacturing enterprise, enterprise design process insights into

design processes, what is interdisciplinary design, Main issues - simple design example.
10 Hrs

Module-5
Skill & Knowledge Enhancing Technologies for Agile Manufacturing: Skill and Knowledge enhancing Technologies - scheduling - technology design strategic-Design Concepts. Design and Skill of Knowledge enhancing Technologies for machine tool systems - Historical overview, Lessons, problems and Future development. **10 Hrs**

REFERENCE BOOKS:
1. Agile manufacturing - Forging new Frontiers - Paul T. Kidd - Addison Wesley Publication 1994.
2. Agile Manufacturing – Proceedings of International Conference - Dr. M.P Chowdiah (Editor)–TataMcGraw Hill Publications - 1996.
3. on agile manufacturing - Tata McGraw Hill Publications -1996
4. Agile manufacturing - Forging Neat Furniture's - Paul T Kidd – Addition Wesley Pub – 1994.
5. World Class Manufacturing - Paul T Kidd - Washington: National - 1994

NON DESTRUCTIVE TESTING

Subject Code: 18MPY242	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

Module-1
Introduction to ND testing: selection of ND methods, visual inspection, leak testing, Liquid penetration inspection, its advantages and limitation, Magnetic particle inspection: Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection –application and limitations **10 Hrs**

Module-2
Eddy current inspection: principles, operation variables, procedure, inspection coils, and detectable discounts by the method. Microwave inspection: Microwave holography, applications and limitations. **10 Hrs**

Module-3
Ultrasonic inspection: Basic equipment characteristics of ultrasonic waves, variables inspection, inspection methods pulse echo A,B,C scans transmission, resonance techniques, transducer elements couplets, search units, contact types and immersion types inspection standards-standard reference blocks **10 Hrs**

Module-4

Radiography inspection: principles, radiation source X-rays and gamma rays, X-ray-tube, radio graphic films, neutron radiography, Thermal inspection principles, equipment inspection methods applications. **10 Hrs**

Module-5

Optical Holography: Basics of Holography, recording and reconstruction - Acoustical Holography: systems and techniques applications. Indian standards for NDT. **10 Hrs**

REFERENCE BOOKS:

1. Non Destructive Testing – Mc Gonnagle JJ – Garden and reach New York.
2. Non Destructive Evolution and Quality Control - volume 17 of metals hand book 9 edition Asia internal 1989.
3. The Testing instruction of engineering materials - Davis H.E Troxel G.E wiskovil C.T - McGraw hill.

SURFACE TREATMENT & FINISHING

Subject Code: 18MPY243 CIE Marks: 40
No. of Lecture Hours/Week: 03 Exam Hours: 03
Total No. of Lecture Hours: 50 SEE Marks: 60

Module-1

Fundamentals of Electro plating, galvanizing, hot dip metal coating, thin coating, thin coating, chromium plating, Nickel plating. Vacuum coating, FVD & CVD metal spraying - Methods, surface preparation, mechanical **10 Hrs**

Module-2

Properties of sprayed metals, plasma coating. Plastic coating of metal - PVC coating Spherodising process details, phosphate coating - mechanism of formation. **10 Hrs**

Module-3

Testing of surface coating-methods. Heat treatment methods, Annealing, Normalizing, Tempering, Case hardening methods, flame hardening subzero treatment. **10 Hrs**

Module-4

Heat treatment methods for gears, spindles, cutting tools. **10 Hrs**

Module-5

Advanced coating technologies: Hard facing, electro deposition technique, Nano-coatings, coating characterization **10 Hrs**

REFERENCE BOOKS:

1. Surface preparations & finishes for Metals - James A Murphy - McGraw Hill.

2. Principles of metal surface treatment and protection - Pergamon Press Gabe, David Russell Description, Oxford; New York - 2d ed., 1978.
3. Handbook of metal treatment and testing - John wiley& sons.
4. Heat Treatment of Metals – Zakrov - MlR Publications.
5. Metals Hand Book – ASM

PRODUCT DATA MANAGEMENT

Subject Code: 18MPY251	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

Module – 1

Introduction: Introduction to PDM-present market constraints need for collaboration-Internet and developments in server-client computing. **10 Hrs**

Module – 2

Components of PDM: Components of a typical PDM set-up hardware and software-document management creation and viewing of documents -creating parts-version control of parts and documents –case studies. **10 Hrs**

Module – 3

Projects and Roles: Creation of projects and roles -life cycle of a product- life cycle management -automating information flow -work flows-Creation of work flow templates -life cycle -work flow integration -case studies. **10 Hrs**

Module – 4

Configuration Management: Base lines-product structure configuration management -case studies.

Change Management: Change issue -change request-change investigation- change proposal-change activity-case studies. **10Hrs**

Module – 5

Generic Products and Variants: Products configuration comparison between sales configuration mild products generic-generic product modeling in configuration mode1er-use of order generator for variant creation -registering of variants in product register-case studies. **10 Hrs**

REFERENCE BOOKS:

1. **Computer Integrated Design and Manufacturing** - David Bed worth. Mark Henderson &. Philips Wolfe - McGraw Hill Inc. - 1991.
2. **Visual Modeling with Rational Rose and UML** - Terry Quatrain - Addison Wesley - 1998.
3. **Wind-chill** - RS.O Reference manuals - 2000.

INDUSTRIAL DESIGN & ERGONOMICS

Subject Code: 18MPY252	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

Module 1

Introduction: An approach to industrial design - elements of design structure for industrial design in engineering application in modem manufacturing systems.

Ergonomics and Industrial Design: Introduction - general approach to the man-machine relationship-workstation design-working position. **10 Hrs**

Module 2

Control and Displays: shapes and sizes of various controls and displays-multiple displays and control situations - design of major controls in automobiles, machine tools etc., - design of furniture design of instruments. **10 Hrs**

Module 3

Ergonomics and Production: Ergonomics and product design ergonomics in automated systems-expert systems for ergonomic design, anthropomorphic data and its applications in ergonomic design limitations of anthropomorphic data - use of computerized database.

10 Hrs

Module 4

Visual Effects of Line and Form: The mechanics of seeing psychology of seeing, general influences of lined and form.

Colour: colour and light - colour and objects - colour and the eye colour consistency - colour terms - reactions to colour and colour continuation - colour on engineering equipment's.

10 Hrs

Module 5

Aesthetic Concepts: Concept of unity - concept of order with variety - concept of purpose style and environment - Aesthetic expressions. Style-components of style - house style, observations style in capital goods.

Industrial Design in Practice: General design - specifying design equipments - rating the importance of industrial design – industrial design in the design process. **10 Hrs**

TEXT BOOKS:

1. **Industrial design for Engineers** - Mayall W.H. - LondonCliffee Books Ltd. - 1988.

2. **Applied Ergonomics Hand Book** - Brien Shakel (Edited) - Butterworth Scientific, London – 1988.

ADVANCED FLUID POWER SYSTEMS

Subject Code: 18MPY253	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

Module 1

Introduction: Pascal Law, Advantages of Fluid Power, Applications of Fluid Power, Components of a Fluid Power.

Hydraulic Power Unit: Introduction, Pumping Theory, Pump Classification, Gear Pumps, (Vane Pumps- simple, balanced & pressure compensated vane pump, Vane design) Piston Pumps- Radial, Axial (Bent axis & Swash plate), Pump Performance, Pump Noise, Ripple in pumps.

Hydraulic Actuators: Linear actuator- cylinders, Mechanics of Hydraulic cylinder loading, limited rotation hydraulic actuator, cylinder cushioning, Gear, Vane & Piston motor, Motor performance, Hydrostatic transmission **10 Hrs**

Module 2

Power Controlling Elements – Valves: i) Directional Control Valves – Classification, 2/2, 3/2,4/2 & 4/3 ways Dcv's, Different Centre configurations in 4/3 way valves, actuation of DCV's, Indirect actuation, Valve Lap – Lap during Stationary and during switching.

ii) Pressure Control Valves: Classification, opening & Closing Pressure difference, Cracking Pressure, Pressure Relief Valve – Simple & Compound type, Pressure reducing valve, sequence, unloading & counter balance valve, Pressure switches.

iii) Flow Control valves – Fixed throttle, Variable throttle, Pressure Compensation principles, pressure compensated Flow control valve – Reducing & Relief type **10 Hrs**

Module 3

Hydraulic Circuit Design & Analysis: Control of Single & double acting cylinder, Regeneration circuit, cylinder sequencing & Synchronizing circuit. Speed control of cylinder & Motors, Analysis of Hydraulic system with frictional losses, Accumulators &accumulator circuits.

Pneumatic System: Introduction, – Generation of compressed air, air receiver, servicing FRL unit, Air filter, pressure regulation, lubricator, Pneumatic cylinder & air motor – different types of cylinder, cushion assembly, Cylinder performance.

Pneumatic Valve: Directional control valves, impulse valve, Quick exhaust valve, shuttle valve, Twin pressure valve, Time delay valve **10 Hrs**

Module 4

Pneumatic Circuit & Logic Circuits:- Control of single and double acting cylinder, impulse operation, speed control, sequencing, Pneumatic Vacuum system AND,OR, NOT, NAND, NOR, YES Function, Logic circuits design using shuttle valve & twin pressure valve, Binary Arithmetic, logic & Boolean Algebra, use of kannaughveitch map for pneumatic circuit design. **10 Hrs**

Module 5

Electrical Control in Fluid Power: Contactors, & Switches, Relays, Limit switch, Electro hydraulic & Electro Pneumatic Circuits, Simple Cylinder reciprocation, interlocking using relays, Proximity switches, application of proximity switches, Time dependent will dependent and travel dependent circuits. **10 Hrs**

REFERENCE BOOKS:

1. **Fluid Power with Application** - Anthony Esposito - Pearson Education - 5th edition.
2. **Oil hydraulics -Principles & maintenance** - S.R. Majumdar - Tata M C Graw Hill
3. **Components & Application** - Bosch Rexroth didactic - Hydraulics Trainer - vol 1. Publication
4. **Pneumatic System, Principles and Maintenance** - S.R. Majumdar - Tata McGraw Hill Publication.
5. **Pneumatics: Theory and Applications** - Bosch Rexroth didactic - Publication
6. **Electro Pneumatics** - Bosch Rexroth didactic -Vol. 2, Publication.

Laboratory Exercises
18MPYL26

01. To become familiar with the use of a kinematics graphics simulator in order to perform robot motion and programming.

02. To use trajectory planning concepts on the model of a single-link robotic manipulator.

03. To familiarize students with the use of a vision system.

04. Simulation of Cutting/Milling operations on a computer using CAM packages.

05. To simulate a manufacturing system using discrete-event simulation techniques. To enable students to have a Systems-Wide View of manufacturing systems. A 3-D graphics manufacturing-oriented simulation software on a PC-type computer should be used. A simple manufacturing system is modelled first and the effects of local changes examined.. Then, students make changes to the manufacturing system in order to increase throughput, reduce in-process inventories, and so on. The effects of resource failure and repair times are also examined.

Reference Books:

1. CAD/CAM - Zimmers & Grover – PHI.
2. CAD/CAM/CIM - P.Radhakrishna - New Age International - 2nd edition.
3. Automation, Production systems & Computer Aided Manufacturing - M.P. Grover - Prentice Hall - 1984.
4. CAD/CAM - Zeid – Mc-Graw Hill - 2005.
5. CAD/CAM - P.N.Rao - TMH.- 2 nd edition, 2004.
6. Robotics for Engineering - Koren.Y - Mc-Graw Hill - 1985.
7. Robert vision & Sensory Controls - Rooks B. - North Holland. - (ed) vol-3

III SEMESTER SYLLABUS
TOOL DESIGN

Subject Code: 18MPY31	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

Module 1

Tool-design Methods: Introduction, the design procedure, drafting and design techniques in tooling drawing

Tool-making Practices: Introduction, tools of the tool maker, hand finishing and polishing, screws and dowels, hole location, jig-boring practice, installation of drilling bushings, punch and die bushings, punch and die manufacture, EDM, EDM for cavity applications, tracer and duplicating mills for cavity applications, low-melting tool materials.

Tooling Materials and Heat Treatment: Introduction, properties of materials, ferrous tooling materials, non-ferrous tooling materials, non-metallic tooling materials, heat treatment and tool design. **10 Hrs**

Module 2

Design of Cutting Tools: Introduction, the metal cutting process, revision of metal cutting tools-single point cutting tools, milling cutters, drills and drilling, reamers, taps. Selection of carbide tools, determining the insert thickness for carbide tools.

Design of Tools for Inspection and Gauging: Introduction, work piece quality criteria, principles of gauging, types of gages and their applications, amplification and magnification of error, gage tolerances, selection of material for gages, indicating gages, automatic gages, gauging positionally tolerance parts, problems. **10 Hrs**

Module 3

Design of Drill Jigs: Introduction, types of drill jigs, general considerations in the design of drill jigs, drill bushings, methods of construction, drill jigs and modem manufacturing.

Design of Fixtures: Introduction, types of fixtures, fixtures and economics.

Design of Press-working Tools: Power presses, cutting operations, types of die-cutting operations - and their design, evolution of blanking and progressive blanking **10 Hrs**

Module 4

Design of Sheet Metal Bending, Forming and Drawing Dies: Introduction, bending dies, forming dies, drawing dies. Evolution of a draw die, progressive dies and selection of progressive dies. Strip development for progressive dies, evolution of progressive dies, examples of progressive dies. Extrusion dies, drop forging dies and auxiliary tools, problems.

Tool Design for Joining Processes: Introduction, tooling for physical joining processes, tooling for soldering and brazing, tooling for mechanical joining processes, problems.

10 Hrs

Module 5

Tooling for Casting: Introduction, tooling for sand casting, shell moulding, metal moulding and die-casting, problems.

Tool Design for NC Machine Tools: Revision of NC control, fixture design for NC machine tools, cutting tools and tool-holding methods, automatic tool changers and tool positioners.

Plastics as Tooling Materials: Introduction, plastics commonly used as tooling materials, application of epoxy plastic tools, construction methods, metal forming operations with Urethane dies, calculating forces for Urethane pressure pads, problems. **10 Hrs**

TEXT BOOKS:

1. **Tool Design** - Cyril Donaldson, GH Lecain and VC Goold - TMH Publishing Co Ltd., New Delhi, - 3rd editions, 2000.
2. **Fundamentals of Tool Design** – ASTME - PHI (P) Ltd., New Delhi -1983.

REFERENCE BOOKS:

1. **Cutting Tool Design** - Rodin - Mir publications -1968.
2. **Metal cutting & Tool Design** - Arshinov -Mir Publishers, Moscow – 1970.
3. **Press working of metals** – Hinman -McGraw Hill – 1950.

APPLIED PROBABILITY AND STATISTICS

Subject Code: 18MPY321	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

MODULE 1

Introduction to statistics: Statistical Thinking, Collecting data, Statistical Modeling Frame work, measure of central tendency and variance, Importance of Data summary and Display, Tabular and Graphical display. **10 Hrs**

MODULE 2

Discrete Random Variables and Probability distribution: Discrete Random variables, Probability distributions and Probability mass functions, Cumulative distribution functions, Mean and Variance of a discrete random variable, discrete uniform distribution, Binominal distribution, Hyper Geometric distribution, Poisson distribution, Applications. **10 Hrs**

MODULE 3

Continuous Random Variables and Probability Distributions: Continuous random variables, Probability distributions and probability density functions, cumulative distribution functions, Mean and Variance of a continuous random variable, uniform distribution, Normal distribution, Normal approximation to Binominal and Poisson distribution, Exponential distribution. **10 Hrs**

MODULE 4

Testing of Hypothesis: Estimation theory, Hypothesis testing, Inference on the mean of a population (variance known and unknown), Inference on the variance of a normal population, Inference on a population proportion, Testing for Goodness of Fit, Inference for a difference in Means, Variances known, Inference for a difference in means of two normal distributions, Variances unknown, Inference on the Variances of two normal populations, Inference on two population proportions. **10 Hrs**

MODULE 5

Simple Linear Regressions and Correlation: Simple Linear Regression, Properties of Least square Estimators and Estimation of variances, Transformations to a straight line, Correlation.

Multiple linear regressions: Multiple linear regressions model, least square estimation of parameters, Matrix approach to multiple linear regression, properties of least square estimators and estimation of variance. **10 Hrs**

TEXT BOOKS:

1. Applied statistics and Probability for Engineers – Douglas C Montgomery, George C Runger, 2nd Edn, John Wiley and Sons, ISBN-0-471-17027-5, 1999.
2. Statistics for Management, Richard I Levin, David S Rubin, 6thEdn, Prentice Hall India, ISBN-81-203-0893X.

REFERENCES:

1. Probability and Statistics in Engineering - William W Hines, Douglas C Montgomery - John Wiley and Sons – 2ndEdn,
2. Business Statistics for Management and Economics - Daniel, Terrell - Houghton Mifflin Company – 6Edn, ISBN-0-395-62835-0.
3. Probability and Statistics - by Walpole & Mayer - MacMillan Publishing Company - 1989.

COMPOSITE MATERIALS

Subject Code: 18MPY322	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

MODULE 1

INTRODUCTION TO COMPOSITE MATERIALS: Definition, classification and characteristics of composite materials – fibrous composites, laminated composites, particulate composites. Properties and types of reinforcement and matrix materials. **10 Hrs**

MODULE 2

FIBRE REINFORCEMENT PLASTIC PROCESSING: Layup and curing, fabricating process – open and closed mould process – hand layup techniques – structural laminate bag molding, production procedures for bag molding – filament winding, pultrusion, pulforming, thermo–forming, injection, injection molding, liquid molding, blow molding **10 Hrs**

MODULE 3

FABRICATION OF COMPOSITES: Cutting, machining, drilling, mechanical fasteners and adhesive bonding, joining, computer aided design and manufacturing, tooling, fabrication equipment. Ceramic Matrix composites and their fabrication technologies **10 Hrs**

MODULE 4

Application of composites: Characterization of composites, computer aided design and analysis of composites, Application of industrial experimentation for fabrication and testing of composites. **10 Hrs**

MODULE 5

STUDY PROPERTIES OF MMC'S: Physical Mechanical, wear, machinability and other properties. Effect of size, shape and distribution of particulate on properties.
Advanced composites such as Polymer based Sandwich structures of Nano composites.
Introduction to shape memory alloys. **10 Hrs**

TEXT BOOKS:

1. Composite Science and Engineering - K.K.Chawla - Springer Verlag - 1998.
2. Introduction to composite materials - Hull and Clyne - Cambridge University Press – 2nd Edition, 1990.
3. Composite Materials - S.C. Sharma -Narora publishing house - 2000.

REFERENCE BOOKS:

1. Composite Materials hand book - MeingSchwaitz - McGraw Hill Book Company -1984.
2. Forming Metal hand book – 9th edition, ASM handbook, V15, 1988, P327-338.
3. Mechanics of composites - Autar K kaw - CRC Press - 2002.

QUALITY AND RELIABILITY ENGINEERING

Subject Code: 18MPY323	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

MODULE 1

Introduction and Process Control for Variables: Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors - process capability - process capability studies and simple problems -Theory of control chart- uses of control chart-Control chart for variables - X chart, R chart and s chart. **10 Hrs**

MODULE 2

Process Control for Attributes: Control chart for attributes –control chart for proportion or fraction defectives - p chart and np chart - control chart for defects - C and U charts, State of control and process out of control identification in charts. **10 Hrs**

MODULE 3

Acceptance Sampling: Lot by lot sampling - types - probability of acceptance in single, double, multiple sampling techniques-O.C. curves - producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans. **10 Hrs**

MODULE 4

Life Testing - Reliability: Life testing - Objective - failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration - simple problems, Maintainability and availability- simple problems. Acceptance sampling based on reliability test - O.C Curves. **10 Hrs**

MODULE 5

Quality and Reliability: Reliability improvements -techniques- use of Pareto analysis - design for reliability - redundancy unit and standby redundancy - Optimization in reliability - Product design - Product analysis - Product development - Product life cycles. **10 Hrs**

Note: Use of approved statistical table permitted in the examination.

REFERENCE BOOKS:

1. Grant, Eugene .V, Statistical Quality Control, McGraw-Hill, 1996
2. L.S.Srmah, Reliabi!ity Engineering, Affiliated East west press, 1991
3. R.C.Gupta, Statistical Quality control, Khanna Publishers, 1997
4. Besterfield D.H., Quality Control, Prentice Hall, 1993.
5. Sharma S.C., Inspection Quality Control and Reliability, Khanna Publishers, 1998.
6. Connor, P.D.T.O., Practical Reliability Engineering, John Wiley, 1993

MAINTENANCE ENGINEERING & MANAGEMENT

Subject Code: 18MPY331	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

Module 1

MAINTENANCE CONCEPT : Need for maintenance-Challenges in maintenance-Objectives of maintenance-Maintenance organization- Scope of maintenance department-Maintenance management-Tero Technology- Five zero concept-Maintenance performance measurement- Maintenance costs-Maintenance audit. **10 Hrs**

Module 2

MAINTENANCE POLICIES: Planned vs unplanned maintenance-Preventive maintenance vs Breakdown maintenance-Predictive maintenance-Corrective maintenance-Opportunistic maintenance-Design out maintenance-Condition Based Maintenance (CBM) - Analysis of downtime-Repair time distribution (exponential, lognormal) - MTTR-System repair time-Maintainability prediction. **10 Hrs**

Module 3

MAINTENANCE LOGISTICS: Proactive and Reactive maintenance-Minimum vs Extensive maintenance-Work order form- Maintenance planning-Maintenance scheduling-Spare parts control & inventory management- Human factors in maintenance-Maintenance crew size-Replacement models. **10 Hrs**

Module 4

FAULT DIAGNOSIS: Nondestructive and destructive testing-Shock pulse monitoring-Condition monitoring-Lubrication practices-Wear Debris Monitoring (WDM)-Vibration monitoring-Corrosion control-Signature analysis- Computerized Maintenance Management System-Use of Fault Trees. **10 Hrs**

Module 5

TOTAL PRODUCTIVE MAINTENANCE: TPM Philosophy-Chronic and sporadic losses- Six big losses- Overall Equipment Effectiveness- Autonomous Maintenance-TPM Pillars-Reliability prediction-MTBF, MTTF-Reliability of series & parallel systems-Reliability Centered Maintenance. **10 Hrs**

TEXT BOOK:

1. Tanmoy Deb, "Maintenance Management and Engineering", Ane Books Pvt.Ltd. 2011.

REFERENCES:

1. Charles E.Ebeling, "An Introduction to Reliability and Maintaibaility Engineering", McGraw Hill Education (India) Pvt.Ltd, 2013.
2. Seiichi Nakajima, "Introduction to Total Productive Maintenance", Productivity Press, 1988.
3. MasajiTajiri and Fumio Gotoh, "Autonomous Maintenance in seven steps", Productivity Inc., Oregon, 1999.
4. M. Ben – Daya, S.O. Duffuaa, A. Raouf, J. Knezevic, "Handbook of Maintenance Management and Engineering", Springer, 2009.
5. Mishra.R.C. Pathak.K,"Maintenance Engineering and Management", Second Edition, PHI Learning, 2012.

OPERATIONS RESEARCH

Subject Code: 18MPY332	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

Module 1

Introduction: OR Methodology, Definition of OR, Application of OR to Engineering and Managerial Problems, Features of OR models, Limitation of OR.

LINEAR PROGRAMMING: Definition, Mathematical formulation, Standard form, solution space, Solution – Feasible, basic feasible, Optimal, Infeasible, Multiple, Optimal, Redundancy, Graphical Method **10 Hrs**

Module 2

Linear programming: Simplex method, variants of simplex algorithm – Artificial basis techniques, Duality, Economic interpretation of Dual, Solution of LPP using duality concept **10 Hrs**

Module 3

Transportation problem: Formulation of transportation model, Basic feasible solution using different methods (North-West corner, Least Cost, Vogel's Approximation Method) Optimality Methods. Unbalanced transportation problem, Variants in Transportation Problems, Applications of Transportation problems**.**

Assignment problem: Formulation of the Assignment problem, unbalanced assignment problem, travelling salesman problem **10 Hrs**

Module 4

Queuing theory: Queuing system and their characteristics, The M/M/1 Queuing system, Steady state performance analyzing of M/M/1 queuing model.

Game theory: Formulations of games, Two person zero sum game, games with and without saddle point, graphical solutions (2xn, mx2 game), and dominance property **10 Hrs**

Module 5

Project management using network analysis: Network construction, determination of critical path and duration, CPM Structured approach, Calculations of schedules and floats, Network crashing. PERT- Estimation of project duration and variance. **10 Hrs**

TEXT BOOKS:

1. Introduction to Operation Research -Taha H A - Prentice Hall of India - 6th edition, 1999.
2. Principles of Operations Research theory and Practice -Philips, Ravindran and Soleberg Wiley India Pvt Ltd.

REFERENCE BOOKS:

1. Introduction to Operation Research - Hamdy A Taha
2. Introduction to Operation Research -Hiller and Libermann – McGraw Hill - 5th edn.
3. Operations Research - S.D. Sharma – Kedarnath, Ramnath& Co - 1996
4. Operations Research Theory and Application - J K Sharma – Pearson Education Pvt Ltd - 2nd Edn, ISBN-0333-92394-4.

PROJECT MANAGEMENT

Subject Code: 18MPY333	CIE Marks: 40
No. of Lecture Hours/Week: 03	Exam Hours: 03
Total No. of Lecture Hours: 50	SEE Marks: 60

MODULE 1

Introduction: Identification of Investment Opportunities, Market and Demand Analysis – Technical Analysis - Investment Outlay **10 Hrs**

MODULE 2

Means of Financing -Profitability and Breakeven Analysis -Cash Flows of Projects -Tax factor in investment Analysis -Interest Compounding and Discounting. **10 Hrs**

MODULE 3

Appraisal Criteria and Selection of Investment -cost of capital analysis of Risk -Financial Projection, social Cost Benefit Analysis **10 Hrs**

MODULE 4

Manpower Management in Projects -Functional Approach to Manpower Management, - the Element of decision Process Project Team Concepts - Field Autonomy- Policies Governing Projects. **10 Hrs**

MODULE 5

Networks Techniques in Project Management -PERT/CPM Analysis - Administrative aspects of Capital Investment. 1**0 Hrs**

Text Books:

1. **Projects - appraisal, preparation, budgeting and implementation** – Prasannachandra - Tata Mc Graw Hill.

Reference Books:

1. **Handbook of Project Management** - Dennis lock.

2. **Project Management** - Dennis lock - Gower Publishing Ltd - 8th revised edition