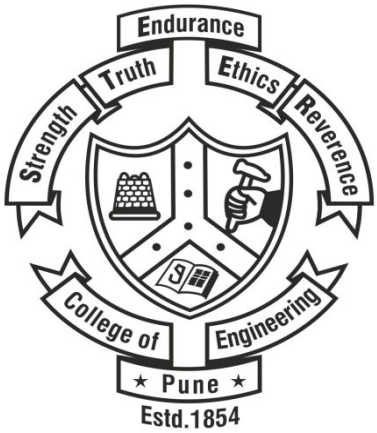
COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Govt. of Maharashtra)

DEPARTMENT OF MANUFACTURING ENGINEERING AND INDUSTRIAL MANAGEMENT



CURRICULUM STRUCTURE

Third Year B.Tech. (Manufacturing Science and Engineering)
(Revision: A.Y. 2020-21, Effective from: A.Y. 2022-23)

UG Program Structure of B. Tech. (Manufacturing Science and Engineering)

List of Abbreviations:

Abbreviation	Title	No of courses	Credits	% of Credits
BSC	Basic Science Course	9	27	16.26
ESC	Engineering Science Course	5	18	10.89
MLC	Mandatory Learning Course	4	0	0
SLC	Self Learning Course	2	5	3.02
HSMC	Humanities/Social Sciences/Management Course	7	9	5.4
LLC	Liberal Learning Course	1	1	0.6
SBC	Skill Based Course	7	17	10.24
IFC	Interdisciplinary Foundation Course	2	4	2.40
IOC	Interdisciplinary Open Course	3	6	3.61
DEC	Department Elective Course	2	6	3.61
PCC	Program Core Course	19	56	33.73
LC	Laboratory Course	17	17	10.24
		78	166	100

UG Program Structure (B.Tech.]
Manufacturing Science and Engineering

Semester I [M-Group]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC		Linear Algebra	2	1	0	3
2	BSC		Optics and Modern Physics	3	0	0	3
3	ESC		Basic Electrical Engineering	3	0	0	3
4	ESC		Engineering Graphics and Design	2	0	4	4
5	ESC		Engineering Mechanics	3	1	0	4
6	SBC		Mechanical Fab Shop	0	0	2	1
7	LC		Optics and Modern Physics Laboratory	0	0	2	1
8	LC		Basic Electrical Engineering Laboratory	0	0	2	1
9	LC		Engineering Mechanics Laboratory	0	0	2	1
			Total Academic Engagement and Credits	**13**	**2**	**12**	**21**

Semester II [M-Group]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC		Uni-variate Calculus	2	1	0	3
2	BSC		Solid State Physics and Statistical Thermodynamics	3	0	0	3
3	BSC		Applied Chemistry	3	0	0	3
4	ESC		Basic Electronics Engineering	3	0	0	3
5	ESC		Programming for Problem Solving	3	0	2	4
6	HSMC		Design Thinking	0	1	0	1
7	HSMC		Effective Communication Skills	0	0	2	1
8	SBC		Electronics and Computer Workshop	0	0	2	1
9	LC		Solid State Physics and Statistical Thermodynamics Laboratory	0	0	2	1
10	LC		Applied Chemistry Laboratory	0	0	2	1
			Total Academic Engagement and Credits	**14**	**2**	**10**	**21**

Semester III [M-Group]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC		Ordinary Differential Equations and Multivariate Calculus	2	1	0	3
2	BSC		Biology for Engineers	3	0	0	3
3	IFC		Strength of Material	2	0	0	2
4	SBC		Product and System Graphics Lab	0	1	2	2
5	PCC		Theory of Machines	2	1	0	3
6	PCC		Manufacturing Processes	3	0	0	3
7	PCC		Material Science and Technology	3	0	0	3
8	LC		Manufacturing Processes Lab	0	0	2	1
9	LC		Material Science and Technology Lab	0	0	2	1
10	LC		Theory of Machines Lab	0	0	2	1
			Total Academic Engagement and Credits	**15**	**03**	**8**	**22**

For other department

			Interdisciplinary Foundation Course-I				
1	IFC		Machining Systems Technology	2	0	0	2

Semester III [For Direct Second Year Admitted Diploma Students]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC		Linear Algebra and Univariate Calculus	4	1	0	5
2	BSC		Foundation of Physics	3	0	0	3
2	BSC		Biology for Engineers	3	0	0	3
3	IFC		Strength of Material	2	0	0	2
4	SBC		Product and System Graphics Lab	0	1	2	2
5	PCC		Theory of Machines	2	1	0	3
6	PCC		Manufacturing Processes	3	0	0	3
7	PCC		Material Science and Technology	3	0	0	3
8	LC		Manufacturing Processes Lab	0	0	2	1
9	LC		Material Science and Technology Lab	0	0	2	1
10	LC		Theory of Machines Lab	0	0	2	1
			Total Academic Engagement and Credits	**20**	**03**	**08**	**27**

Semester IV [M-Group]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC		Vector Calculus and Partial Differential Equations	2	1	0	3
2	MLC		Professional Laws, Ethics and Values	1	0	0	0
3	HSMC		Innovation and Creativity	1	0	0	1
4	IFC		Industrial Electronics and Electrical Drives	1	0	2	2
5	SBC		Rapid Prototyping Practice (an "I-D-P: Ideate-Develop- Prototype" team Micro-project)	0	0	2	1
6	PCC		Engineering Thermodynamics and Heat Transfer	3	0	0	3
7	PCC		Fluid Power	2	1	0	3
8	PCC		Design of Machine Elements	3	0	0	3
9	PCC		Machining Science and Technology	3	0	0	3
10	LC		Engineering Thermodynamics and Heat Transfer Lab	0	0	2	1
11	LC		Fluid Power Lab	0	0	2	1
12	LC		Machining Science and Technology Lab	0	0	2	1
			Total Academic Engagement and Credits	**16**	**02**	**10**	**22**

For Other department

			Interdisciplinary Foundation Course-II	**L**	**T**	**P**	**Credits**
1	IFC		Industrial Engineering	2	0	0	2

Semester IV [For Direct Second Year Admitted Diploma Students]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC		Multi Variate Calculus and Differential Equations	4	1	0	5
2	MLC		Professional Laws, Ethics and Values	1	0	0	0
3	HSMC		Innovation and Creativity	1	0	0	1
4	IFC		Industrial Electronics and Electrical Drives	1	0	2	2
5	SBC		Rapid Prototyping Practice (an "I-D-P: Ideate-Develop- Prototype" team Micro-project)	0	0	2	1
6	PCC		Engineering Thermodynamics and Heat Transfer	3	0	0	3
7	PCC		Fluid Power	2	1	0	3
8	PCC		Design of Machine Elements	3	0	0	3
9	PCC		Machining Science and Technology	3	0	0	3
10	LC		Engineering Thermodynamics and Heat Transfer Lab	0	0	2	1
11	LC		Fluid Power Lab	0	0	2	1
12	LC		Machining Science and Technology Lab	0	0	2	1
			Total Academic Engagement and Credits				**24**

Semester V [M-Group]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC		Probability and Statistics for Engineers	2	1	0	3
2	MLC		Environmental Studies	1	0	0	0
3	IFC		Interdisciplinary Foundation Course Data Analytics	1	0	2	2
4	HSMC		Humanities Open Course – I • English Language Proficiency-I • Finance for Engineers-I • Engineering Economics-I • Industrial Psychology-I • Japanese Language-I • German Language-I	2	0	0	2
5	SBC		Advance Manufacturing & Simulation Lab	0	0	2	1
6	PCC		Metrology and Quality Control	3	0	0	3
7	PCC		Tool and Die Design	2	1	0	3
8	PCC		Industrial Engineering and Management	2	0	0	2
9	PCC		Product Design and Manufacturing	3	0	0	3
10	PCC		Material Forming	3	0	0	3
11	LC		Process Planning and Tool Selection Lab	0	1	2	2
12	LC		Metrology and Quality Control Lab	0	0	2	1
			Total Academic Engagement and Credits	**19**	**3**	**8**	**25**

Semester VI [M-Group]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	MLC		Constitution of India	1	0	0	0
2	HSMC		Humanities Open Course – II • English Language Proficiency-II • Finance for Engineers-II • Engineering Economics-II • Industrial Psychology-II • Japanese Language-II • German Language-II	2	0	0	2
3	HSMC		Entrepreneurship Principles and Process	1	0	0	1
4	SBC		Mini project [“D-S-P-T: Design-Simulate-Prototype-Test ”]	0	0	4	2
5	IOC		Interdisciplinary Open Course-II	2	0	0	2
6	DEC		Department Elective -I/Industry floated Course/Co-Taught Course	3	0	0	3
7	PCC		Robotics and Intelligent Manufacturing	2	1	0	3
8	PCC		Operations Research	3	0	0	3
9	PCC		Kinematics and Dynamics of Machines	2	1	0	3
10	PCC		Manufacturing Automation	3	0	0	3
11	LC		Manufacturing Automation Lab	0	0	2	1
			Total Academic Engagement and Credits	**19**	**2**	**6**	**23**

Department Elective-I

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	DEC		Supply chain and Logistics Management	3	0	0	3
2	DEC		Reliability and Maintenance	3	0	0	3
3	DEC		Facility Planning and Design	3	0	0	3
4	DEC		Micro and Nano Manufacturing	3	0	0	3
5	DEC		Advanced Joining Technology	3	0	0	3
6	DEC		Design of Experiments and Optimization	3	0	0	3

Interdisciplinary Open Course-II

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	IOC		Operations Research	2	0	0	2
2	IOC		Enterprise Resource Planning	2	0	0	2
3	IOC		Supply chain and Logistics Management	2	0	0	2
4	IOC		Project Planning and Control	2	0	0	2

Semester VII [M-Group]: Scheme B

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	MLC		Intellectual Property Rights	1	0	0	0
2	LLC		Liberal Learning Course	1	0	0	1
3	IOC		Interdisciplinary Open Course-III	2	0	0	2
4	DEC		Department Elective-II	3	0	0	3
5	SLC		Massive Open Online Course –I	3	0	0	3
6	PCC		CAD/CAM/CAE/CIM	2	1	0	3
7	PCC		Additive Manufacturing	2	1	0	3
8	PCC		Machine tool and Manufacturing systems	3	0	0	3
9	LC		CAD/CAM/CAE/CIM Lab	0	0	2	1
10	LC		Additive Manufacturing Lab	0	0	2	1
			Total Academic Engagement and Credits	**17**	**2**	**4**	**20**

Department Elective-II [Option among minimum 3 courses]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	DEC		Precision Engineering	3	0	0	3
2	DEC		Total Quality Management and Six Sigma	3	0	0	3
3	DEC		Material Handling Equipment Design	3	0	0	3
4	DEC		Tribology in Design and Manufacturing	3	0	0	3
5	DEC		Mechatronics	3	0	0	3
6	DEC		Manufacturing Control Systems	3	0	0	3

Semester VIII [M-Group]: B Scheme

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	SBC		Major Project with Industry/Corporate/Academia	0	0	18	9
2	SLC		Massive Open Online Course -II	3	0	0	3
			Total Academic Engagement and Credits	**3**	**0**	**18**	**12**

Semester Wise Credit Distribution	Teaching Scheme			Credits
	L	T	P	
I	13	2	12	21
II	14	2	10	21
III	16	2	8	22(27)*
IV	17	2	8	22(24)*
V	19	2	8	25
VI	18	2	10	23
VII	17	2	4	20
VIII	2	0	20	12
Total Academic Engagement and Credits	**116**	**14**	**80**	**166 (131)***

()* DSY entry students

() Probability and Statistics for Engineers

Teaching Scheme
Lectures: 2 hrs / week
Tutorial: 1 hr / week

Examination Scheme
T1, T2 – 20 marks each,
End-Sem Exam – 60

Course Outcomes:

Students will be able to

- Use methods of summarizing and visualizing data sets, compute probabilities of events.
- Use the concepts of random variables and associated probability distributions, understand the meaning of central limit theorem.
- Do basic statistical inference (t-test, z-test, F-test, χ^2 –test, confidence interval).
- Do basic regression analysis.
- Demonstrate use of R software for all the above.
- Identify and apply the basic knowledge of statistics for solving real world problems.

Syllabus Contents:

Unit I **(5 Hrs)**

Descriptive statistics: Measures of location and variation. Visualization of data: Frequency tables, bar diagrams, histograms, heat maps, other visualization tools. Review on introduction to combinatorics and probability theory

Unit II **(5 Hrs)**

Some of the basic probability distributions: Binomial, Poisson, Exponential, and Normal. Central limit theorem.

Unit III **(4 Hrs)**

Introduction to 'R': Introductory R language fundamentals and basic syntax, major Rdata structures, Using R to perform data analysis, creating visualizations using R.

Unit IV **(6 Hrs)**

Basic statistical inference and hypothesis testing: Estimation, basic tests such as t-test, z-test, F-test, χ^2 -test.

Unit V **(4 Hrs)**

Regression methods: Simple linear regression and multiple regression.

Unit VI **(4 Hrs)**

Engineering applications of statistics: Discussion on reliability and quality control. Introduction to random processes, stochastic processes, Markov chains.

Text Books:

- Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probability and Statistics for Engineers and Scientists (8^{th} Edition), Pearson Prentice Hall, 2007.
- Ross S.M., Introduction to probability and statistics for Engineers and Scientists (8^{th} Edition), Elsevier Academic press, 2014.

References Books:

- S. P. Gupta, Statistical Methods, S. Chand & Sons, 37^{th} revised edition, 2008.

- Morrison S.J., Statistics for Engineers - An introduction, Latest edition, 2009.
- William W. Hines, Douglas C. Montgomery, David M. Goldsman, Probability and Statistics for Engineering, (4th Edition), Wiley Student edition, 2006.
- Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications (2nd Edition), Wiley Student edition, 2008.
- Stephens L.J., Schaum's outline of statistics for Engineers, Latest edition, 2019.
- The practice of Business Statistics by Manish Sharma and Amit Gupta, Khanna Publishing Company Private Limited, New Delhi, 2014.

() ENVIRONMENTAL STUDIES

Teaching Scheme
Lectures : 1 hrs / week

Examination Scheme
T1, T2 – 20 marks each,
End-Sem Exam – 60

Course Outcomes:

Students will be able to

- Know importance of environment and conversant with environmental science,
- Able to understand about Renewable and non-renewable natural resources and become aware about environmental issues related to the exploration of natural resources and development of the mankind.
- Aware about means of Pollution
- Learn role of professional in protecting the environment from degradation
- Knowing techniques of Solid waste management and Disaster management
- Aware about Social issues and the environment
- Aware about the solutions for environmental problems created by local, national and global developmental activities.

Syllabus Contents:

Unit I **(4 Hrs)**

Multidisciplinary nature of environmental studies: Definition, scope and importance, need for public awareness.

Unit II **(6 Hrs)**

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems.

Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of

alternate energy sources. Case studies.
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit III **(4 Hrs)**

Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity, Bio-geographically classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

Unit IV **(4 Hrs)**

Biodiversity and its conservation: Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit V **(8 Hrs)**

Environmental Pollution: Definition, Cause, effects and control measures of :-a. Air pollution, b. Water pollution, c. Soil pollution, d. Marine pollution, e. Noise pollution, f. Thermal pollution, g. Nuclear hazards, Solid waste Management : Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster-management: floods, earthquake, cyclone and landslides.

Unit VI **(7 Hrs)**

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rainwater harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies: Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act Wildlife Protection Act Forest Conservation Act Issues involved in enforcement of environmental legislation. Public awareness.

Text Books:

- Environmental studies from crisis to cue R Rajgopalan, III edn. OUP ISBN no. 0-19-537393-X 2.
- Environmental Science, S C Santra, New Central Book Agency PVT LTD London ISBN no. 81-7381-404-X 3.
- Environmental Chemistry by De A.K., Wiley Eastern Ltd.

References Books:

- The Biodiversity of India by Bharucha Erach, Mapin Publishing Pvt. Ltd., Ahmedabad –380 013, India, Email: mapin@icenet.net
- Handbook of Environmental Laws by Trivedi R.K., Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media.

(SBC) () Advance Manufacturing & Simulation Lab

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Total 100 Marks
Term-work: 50 Marks
Oral: 50 Marks

Course Outcomes:

- To understand the design methodology of various press tools, Jigs, Fixtures, press tools and dies.
- To acquire proficiency in the design and development of required toolings and dies.
- To understand use of simulation tool for analysis of press tools and dies.
- To enable the students to Design & drawing of dies for shearing, forming operation.
- To enable the students to effectively use CAD/Simulation software for die design, Casting and forging.

Syllabus Contents:

Assignments:

1. Detail design, drawing and simulation of die for Blanking/Punching/Drawing operation. (Use of CAD/simulation software desirable)
2. Simulation of casting and Molding Process (Use of CAD/simulation software desirable)
3. Prototype fabrication using Digital Fabrications facilities.
4. Hands on Laser cutter and engraver for complex profile fabrication
5. Hands on CNC Router
6. Hands on hybrid micro-machining system
7. Hands on Non-Conventional Machining Processes
8. Demonstration of prototype fabrication using FAB LAB facilities
9. 14. Hands on Laser cutter and engraver for complex profile fabrication at FAB LAB
10. 15. Hands on CNC wood router at FAB LAB

Note: For the above assignments analysis of design can be carried out by using simulation software.

The oral will be based on above term work.

Metrology and Quality Control

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:
Students will be able to

- Interpret the manufacturing drawings and perform inspection.
- Able to use different types of measuring instruments.

- Select appropriate measurement techniques for geometric features.
- Carryout data collection and use statistical tools for analysis.
- Identify and analyse the cause for variation and recommend suitable corrective actions.
- Design an acceptance sampling plan for inspection and carry out process capability studies.

Syllabus Contents:

Unit I **(8 hrs)**

Introduction: Meaning of Metrology, Precision, Accuracy, Methods and Errors in Measurement, Calibration.

Linear Measurement: Standards, Line Standards, End Standard, Wavelength Standard, Classification of Standards, Precision and Non-Precision Measuring instruments and their characteristics, Slip Gauges.

Interferometry: Introduction, Flatness testing by interferometry, NPL Flatness Interferometer.

Study of Measuring Machines, Recent Trends in Engineering Metrology, use of interferometry for length angle and surface roughness measurement.

Angle Measurement: Sine bars, Sine centres, Uses of sine bars, angle gauges, Auto Collimator angle dekkor, Constant deviation prism.

Measurement System Analysis: -Introduction, Influence of temperature, operator skills and the instrument errors etc. on the MSA, Gauge R and R study.

Metrology for Additive manufacturing, laser metrology and measurement

Unit II **(8 hrs)**

Limits, Fits and Tolerances: Meaning of Limit, Fits and Tolerance, Cost – Tolerance relationship, concept of Interchangeability, Indian Standard System.

Design of limits Gauges: Types, Uses, Taylor's Principle, Design of Limit Gauges, Three surface Generation.

Inspection of Geometric parameters: Straightness, Flatness, Parallelism, Concentricity, Squareness, and Circularity.

Comparators: Uses, Types, Advantages and Disadvantages of various types of Comparators.

Measuring Machines: -Theory of Co-ordinate Metrology, Universal Measuring Machines, Co-ordinate Measuring Machines (CMM), different configurations of CMM, Principle, Error involved, calibration, Probing system, automated inspection system**.**

Unit III **(6 hrs)**

Surface Finish Measurement: Surface Texture, Meaning of RMS and CLA values, Roughness Measuring Instruments, Tactile and Non-tactile measuring instruments, difference between waviness and roughness, Grades of Roughness, Specifications, Assessment of surface roughness as per IS, Relationship between surface roughness and Manufacturing Processes.

Screw Thread Metrology: External Screw Thread terminology, Floating Carriage Instruments, Pitch and flank Measurement of External Screw Thread, Application of Tool Maker's Microscope, Use of Profile Projector.

Gear Metrology: Spur Gear Parameters, Gear tooth thickness measurement: Gear tooth vernier calliper, Constant chord method, Span Micrometer.

Unit IV **(8 hrs)**

Quality Control: Meaning of Quality, Approaches- Deming's Approach, Juran's Approach, Quality of Product, Quality of Service, Cost of Quality, Value of Quality, and Difference between Inspection, Quality Control and Quality Assurance, Role of Quality in Present day environment. Meaning of

quality Control, 100% Inspection and Selective Inspection, Statistics in Selective inspection.

Unit V **(5 hrs)**

Statistical Quality Control: Interpretation of SPC Charts, benefits for use on shop floor, Control charts- Attribute (P, nP, C, U) and Variable (X bar, R chart and X & R chart), Sampling inspection, OC Curves and Sampling Plan, Process Capability Index (C_p, C_{pk}), Concept, Methods of determining Cp and Cpk.

Unit VI **(5 hrs)**

Quality Assurance Systems:

Total quality management (T.Q.M): 7 tools of Problem Solving, Like Cause & Effect Diagram, Pareto Analysis etc., Q.F.D., Quality Circles, Kaizen, six sigma, 5S System.

ISO 9001-2000 Series of Standards: History and Evolution of ISO 9000 Series, importance and overview of ISO 9000- 1998 Series standards, structure of ISO 9000-2000 Series standards, clauses of ISO 9000 series standards and their interpretation and implementation, quality system documentation and audit.

ISO 14000: Environmental management concepts, and requirement of ISO 14001, benefits of environmental management Systems.

Text Books:

- R. K. Jain, A Textbook of Engineering Metrology, Khanna PublicationsPvt. Ltd.18th Edition, 2002.
- S.P. Gupta, Statistical Methods, Danpat Rai and Sons, New Delhi, 2007.

References Books:

- John S. Oahland, Total Quality Management, Elsevier Publications, 3rd Edition 2006.
- P. N. Mukerjee, Total Quality Management, Prentice Hall of India Publications, 2nd Edition 2005.
- AmitavaMitra, Fundamental of Quality Control and improvement, Prentice Hall of India Publications, 2nd Edition 2006.
- G.M.S. De Silva, Basic Metrology for ISO 9000 Certification Elsevier Publications, 3rd Edition 2002.
- I.C.Gupta, A Text book of Engineering Metrology, Dhanpat Rai PublicationsPvt. Ltd.6th Edition, 2004.
- A.S.T.M.E., “Handbook of Industrial Metrology”, Prentice Hall, ISBN 10: 0070015368, 1968.

Tool and Die Design

Teaching Scheme

Lecture: 2 hrs/week

Tutorial: 1 hrs/week

Examination Scheme

100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

Students will be able to

- Understand the basic concepts, importance and functions of Jigs, Fixtures, press tools and moulding dies.

- Understand the design aspects of Jigs, Fixtures, press tools and moulding dies.
- Gain proficiency in the development of required tooling.
- Understand the analytical/theoretical analysis of Jigs, Fixtures.
- Understand the analytical/theoretical analysis of press tools and moulding dies.
- Understand the theory of Plastic Moulding process.

Syllabus Contents:

Unit I **(5 hrs)**

Jigs and Fixtures: Significance and purpose of jigs and fixtures and their functions in the manufacturing processes. Classification of jigs and fixtures such as machining, assembly and inspection fixtures; universal jigs and fixtures; modular jigs and fixtures. Design features of main elements of jigs and fixtures such as locating, clamping and guiding elements and their integration. Indexing, locking and auxiliary elements. Bodies, bases or frames of jigs and fixtures.

Unit II **(8 hrs)**

Basic Types of Press Working Operations and Equipment: General classification and components of Press Tools.

Dies and Punches: Elements of Dies and Punch set. Types of dies – simple, compound, combination and progressive dies and punches of various press working operations such as punching, blanking, drawing, bending, forming, coining, Fine Blanking Burr free blanking etc. Design of Blanking die, Progressive die, Calculations of clearances, centre of pressure, different forces, press tonnage, strip layout, sheet utilization ratio, methods of reducing forces.

Unit III **(6 hrs)**

Drawing and Bending dies: Design of Shallow & Deep drawing die, Calculation of blank size, number of draws, drawing force, press capacity, ironing & ironing force, Types of Bending dies, various methods used to overcome spring back, Calculation of total bend length and calculation of various forces.

Unit IV **(8 hrs)**

Design of simple dies for forging: Types of Forging, Guidelines for selection of various design factors, parting line, draft, rib-web, Corner & fillet radius, shrinkage & die wear etc., Detailed calculations of stock size, Design of Fullering, edging, types of die inserts.

Unit V **(6 hrs)**

Design of Die casting dies: Die Casting processes Hot & Cold Chamber, Metals for die casting, Design considerations in die casting. Types of cores, feeders, inserts, die lubrications & rules, heat transfer consideration, directional solidification, cooling system, feed and flow system and ejection system, interlocks & safety devices, die casting defects and remedies.

Unit VI **(8 hrs)**

Plastic and Plastic Moulding: Introduction of compression and transfer moulding process, Study of Injection, and blow moulding process and machine specifications, moulding cycle.

Mould Design: Design of simple two plate injection moulds. Design of simple blow moulds for articles like bottles, cans, etc. Study of types of ejectors, gates, runner's, Study of cooling systems and heat transfer consideration. Calculation of no. of cavities, Mould opening force, ejection force etc.

Textbooks:

- Cyril Donaldson, George H. Le Cain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2000, 3rdEdition.
- Vukota Boljanovic, “Sheet Metal Forming Processes and Die Design”, Industrial Press, New York, 2004.

References Books:

- Wilson, Fundamentals of Tool Design, A.S.T.M.E., Prentice Hall of India.
- S. K. Basu, S.N. Mukherjee, R. Mishra, Fundamental of Tool Engineering Design, Oxford & IBH Publishing Co. Pvt. Ltd., 1979.
- J. R. Paquin, R. E. Crowley, Die Design Fundamentals, Industrial Press Inc., 2nd Edition,1987.
- Handbook of Die design Handbook, McGraw Hill, 2006.
- P.C. Sharma; A Text Book of Production Engineering, S. Chand and Company Ltd., New Delhi.
- P.N. Rao, Manufacturing Technology, Tata Mcgraw Hill Publishing Co Ltd, 2000.
- M.H.A. Kempster, Introduction to Jigs and Fixture Design, ELBS Edition, 1990.
- R.G.W. Pye, Injection Mould Design, Longmans Publications, 4th Edition,1989.
- A.S. Athalye, Injection Moulding, MultiTech Publishers Co. Mumbai
- Metal Handbook, Vol-II and III, ASME.
- Forging Handbook, ASM, Vol. 5, 9th edition.
- P.H. Joshi, Press Tools Design & Construction, S. Chand & Company Ltd. Delhi, 2nd Edition (Revised), 2008.

Industrial Engineering and Management

Teaching Scheme
Lectures : 2 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments/Quiz/T1/T2 - 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Learn basics of Industrial Engineering and Management.
- Learn about the concepts of work study.
- Basic principles of industrial management

Syllabus Contents:

Unit I **(5 hrs)**

Introduction: Definition and Role of Industrial Engineering, Contribution of Taylor and Gilbreth, Organization: Concept of organization, characteristics of organization, elements of organization, organizational structure, organization charts; Introduction to types of organization- formal line, military organization, functional organization, line & staff organization; authority and responsibility, span of control, delegation of authority.

Productivity: Definition of productivity, Productivity of materials, land, building, machine and power. Measurement of productivity: factors affecting the productivity.

Unit II **(7 hrs)**

Method Study: Method Study Definition, objective and scope of work-study. Human factors in work-study. Method Study : Definition, objective and scope of method study, activity recording and exam aids, Charts to record moments in shop - operation process charts, flow process charts, travel chart, two handed chart and multiple activity charts. Charts to record movement at work place - principles of motion economy, classification of moments, SIMO chart, and micro motion study. Definition and installation of the improved method, brief concept about synthetic motion studies Numerical), Introduction to Value Engineering and Value Analysis.

Unit III **(6 hrs)**

Work Measurements: Definition, objectives and uses; Work measurement techniques. Work sampling - need, confidence levels, sample size determinations, random observation, conducting study with the simple problems. Time study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination; Introduction to PMTS and MTM. (Numerical), Introduction to MOST.

Unit IV **(4 hrs)**

Principles of Management: Functions related to Planning, organizing, staffing, leading and controlling. Henri Fayol's Principles of Management, Division of Work, Authority and Responsibility, Discipline, Unity of Command, Unity of Direction, Subordination of Individual Interest, Remuneration, The Degree of Centralization, Scalar Chain, Order, Equity, employee stability, and Initiative.

Unit V **(6 hrs)**

Methods of job evaluations and merit rating: Job evaluation (Job analysis, job description, job specification, job classification, wage determination) Wages, salary, and incentives, Time wage system, Piece wage system, motivation, wage incentive plans Straight piece rate, Straight piece rate with guaranteed min. wage, Taylor's differential piece rate system, Halsey plan, Rowan plan, and Gantt plan. Personnel management, Performance appraisal and merit rating, methods of performance appraisal.

Text Books:

- Work Study, ILO
- Basu S.K., Sahu K.C and Rajiv B, Industrial Organization and Management –. PHI New Delhi, 2012, ISBN No. 9788120344211.

Reference Books:

- M.S. Sanders and E.J. McCormick, "Human Factors in Engineering Design", VI Edition, McGraw Hill.
- R.M. Barnes, "Motion and Time Study", Wiley International, 1980.
- S. Dalela and Sourabh, "Work Study and Ergonomics". Standard Publishers, Latest Edition

Product Design and Manufacturing

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2 - 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

At the end of the course, students will be able to:

- Learn basics of product design process and morphology of design.
- Understand Design for manufacturing and Assembly (DFMA) concepts.
- Understand optimization tools and ergonomic principles applied on typical product
- Understand design as well as concept of value engineering in new product design.
- Learn about Design for safety, Environment, and Product cost
- Aware of different stages of product design

Syllabus Contents:

Unit I **(5 hrs)**

Introduction To Product Design: Asimow's Model: Definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-consumption Cycle, The Morphology of Design (The sever phases), Primary Design Phases and flowcharting, Role of Allowance Process Capability, and Tolerance in Detailed Design and Assembly, Introduction to creative design, and the cultural design.

Unit II **(8 hrs)**

Product Design Practices in Industry: Introduction, Product Strategies Time to Market, Analysis of the Product, The Three S's, Standardization Renard Series (Preferred Numbers), Simplification, The Designer and it's Role, The Designer: Myth and Reality, The Industrial Design Organization Basic Design Considerations, Problems faced by Industrial Designer. Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers, What the Designer contributes, Role of Aesthetics in Product Design, Functional Design Practice.

Unit III **(10 hrs)**

Engineering Materials: Properties & Selection of Materials – I, Selection of Materials – II, Applications of Engineering Material.
Robust Design, Design for X, Product Design for Manual Assembly, DFMA Guidelines, Ergonomics in Product Design
Selection of Processes-I, Selection of Processes-II, Process Capabilities, Design Guidelines for Sand Casting, Design Guidelines for Die Casting Process.
Product Design Guidelines: Compression Molding and Extrusion, Design Guidelines for Extrusion and Injection Molding, Design Guidelines for Sheet Metal Working, Design Guidelines for Machining, Design Guidelines for Powder Metal Processing.
Assembly Processes: Introduction, Adhesive Joining: Guidelines, Design Guidelines for Mechanical Fasteners, Design Guidelines for Welding, Design Guidelines: Brazing and Soldering

Unit IV **(6 hrs)**

Optimization in Design: Introduction, Siddal's Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multipliers, Simplex search Method, Geometric Programming, Johnson's Method of Optimum Design.

Unit V **(8 hrs)**

Introduction to Safety Engineering, Design for safety, Environment, and Product cost Design for

Environment, Design for Environment: Steps, Product Architecture Design for Safety and Reliability. Elements of visual needs, translating customer needs. Cost and Price Structure, Information Need Sources, Estimating Direct and Indirect Costs, Design and Manufacturing Costs, Ways to Model Manufacturing Costs Human Engineering Considerations in Product Design. Introduction, Human being as Applicator of Forces, Anthropometry: Man as Occupant of Space, The Design of Controls, The Design of Displays, Man/Machine Information Exchange.

Unit VI **(8 hrs)**

Value Engineering and Product Design: Introduction, Historical& Perspective, What is Value? Nature and Measurement of Value, Maximum Value, Normal Degree of Value, Importance of Value, The Value Analysis, Job Plan, Creativity, Steps to Problem-solving and Value Analysis, Value Analysis Tests, Value Engineering Idea Generation Cheek-list, Cost Reduction through Value Engineering Case Study on Tap Switch Control Assembly, Material and Process Selection in Value Engineering.

Modern Approaches to Product Design: Concurrent Design, Quality Function Deployment (QFD) for design.

Textbooks:

- A.C. Chitale and R.C. Gupta, Product Design and Manufacturing by PHI.
- Karl T. Ulrich & Steven D., Product Design & Development Eppinger Tata McGraw Hill, 3rdEdition, 2003

Reference Books:

- Tim Jones, Butterworth Heinmann, New Product Development by Oxford, *TAC*- 1997.
- Roland Engene Y., Inetoviez, New Product Development: Design & Analysis, John Wiley and Sons Inc., N.Y. 1990.
- Geofferry Boothroyd, Peter Dewhurst and Winston Knight. Product Design for Manufacture and Assembly, Amherst, 1983.
- Bill Hollins, Stwout Pugh, Butterworth, Successful Product Design by London 1990.
- Boothroyod & Dewburst P., Design for Assembly, a Designer's Hand book, University of Massachusets, Amherst, 1983.
- Keyinotto & Kristini Wood, Product Design Pearson Education 2004.

Material Forming

Teaching Scheme
Lecture: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

Students will be able to

- Learn basic concept of different metal forming process and the application of concept to analyse the processes.
- Learn application of theoretical approach to solve practical problems associated with different material forming processes such as rolling, drawing, forging, and extrusion.
- Gain an understanding and appreciation of the breadth and depth of the field of material

forming.

- Understand the various basics of formability, working on metals.
- Learn how to apply different theory criterions to metal forming.

Syllabus Contents:

Unit I **(8 hrs)**

Introduction of forming processes: Strain hardening Concept of flow stress determination, Theory of plasticity, Yield criteria for ductile materials- Von-mises criteria, Tresca Criteria, flow stress concept. Effect of temperature, strain rate, metallurgical microstructure, chemical composition, and mechanical properties, for Classification of material forming process. Concept of Formability, formability limits and formability diagram.

Unit II **(6 hrs)**

Forging: Introduction, classification of forging processes. Forging equipment- Hammers, presses, furnaces etc. construction working capacities and selection of equipment. Basic forging operations such as drawing, fullering edging, blocking etc. wing Forgeability tests, design of forging as a product, Slab Method of Analysis friction in forging. Forging defects and the remedies. New technologies: Liquid metal forging, isothermal forging, No draft forging, P/M forging, Rotary swaging, roll forging, Lubrications in forging.

Unit III **(6 hrs)**

Wire and Tube Drawing: Introduction rod and wire drawing machines - construction and working. Preparation of stock for wire drawing. Wire drawing dies, material and design. Patenting heat treatment. Variables in wire drawing, Maximum reduction in wire in one pass, forces required in drawing. Multiple drawing, work hardening, lubrication in wire drawing. Tube drawing: Methods, force calculation, stock penetration. lubrication in tube drawing

Unit IV **(8 hrs)**

Rolling of Metals: Scope and importance of rolling. Types of Rolling Mills- Construction and working. Roll bite, reduction, elongation and spread. Deformation in rolling and determination forces required. Process variables, redundant deformation. Roll flattening, Roll camber - its effect on rolling process, mill spring. Defects in rolling. Automatic gauge control- Roll pass classification & design. Lubrication in rolling. Sheet Metal Forming, blanking, bending, drawing and deep drawing.

Unit V **(6 hrs)**

Extrusion: Types - Direct, reverse, impact, hydrostatic extrusion. Dies for extrusion, stock penetration. Extrusion ratio Force equipment (with and without friction), metal flow in extrusion, defects. Role of friction and lubricants. Manufacture of seam-less tubes.

Unit VI **(9 hrs)**

Advanced metal forming processes: High velocity forming- principles, comparison of high velocity and conventional Forming processes. Explosive forming, Magnetic pulse forming, Electrohydraulic Forming, Incremental Sheet Forming Micro-forming, Micro-coining, micro-extrusion, Micro-bending Stretch forming, Micro-Incremental Sheet Forming coining embossing, curling spinning, flow forming advantages, limitations, and application of the process, Joint “extrusion-rolling” process, slitting rolling, surface flexible rolling, flow forming, forming of composite materials.

Text Books:

- Dieter, Mechanical Metallurgy, ISBN0071004068
- P.N. Rao, “Manufacturing Technology”, Tata Mc-GrawHill ISBN0070087695
- S.K. Hajra Choudhary and S.K. Bose, “Elements of workshop Technology” Volume I, II, Asia Publishing House, 10th Edition 2000.

References Books:

- Chapman W.A.J, “Workshop Technology”, Volume I, II, III, CBS Publishers and k distributors, 5th Edition,2002.
- Degarmo, Black and Kohser, “Materials and processes in Manufacturing”, Prentice Hall of India. 2nd Edition, 1998.
- O.P. Khanna and M. Lal, “Production Technology”, Vol. I,II, Dhanpat Rai Publication, 5th Edition, 1999.
- B.S. Raghuwanshi, “Workshop Technology”, Dhanpatrai Publication, 9th Edition, 1999.
- G.W. Rowe, “Principles of industrial metal working process”, Edward Arnold ISBN8123904282.
- Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co. ISBN8176190020
- ASM Metal handbook Vol: 14 Forming and Forging.

Process Planning and Tool Selection Lab

Teaching Scheme
Practical: 2 hrs/week
Tutorial: 1 hrs/week

Examination Scheme
Total 100 marks
Term work: 50Marks
Oral: 50marks

Course Outcomes:

Students will be able to

- Analyse the dimensions, tolerances, and control of various features of parts.
- Select and assign sequence of machining processes from basic to principal processes.
- Identify and select the appropriate tools and toolings for major machining operations to be performed on workpiece.
- Prepare process plan and flow diagram for given component.

Syllabus Contents:

The term work shall consist of record of any Six assignments on following topics:

1. Preliminary part print analysis for given components which includes study of part, its dimensions and tolerances and control of its features of parts.
2. Preparation of tolerance chart for any two components also students must describe handling, basic processes for manufacturing, sequence of operations. Study of Special processes, if necessary, related surfaces to be machined, Assembly Process if any for the given parts.
3. Analysis of Part Dimensions of given component: Shape of part as flatness, straightness, roundness, geometrical shapes, symmetry, job requirement of finish on part.
4. Drawing of arrangement of locators, for standard shaped components like rectangular prism, pyramids, cylinder, tube, cones and any one nonstandard component for good geometric control Manufacturing Processes.
5. Identification and list our sequence of various manufacturing processes to be performed on a

given component/works-piece, from a drawing such as Basic Processes, Principal Processes, Major Operations and Auxiliary Processes, Supporting Operations.
6. Study and Selection of Tooling: Standard and Special Tooling. Use of Jigs and Fixtures, Selection of Equipment, Tooling. Economics of Tooling.
7. Study of conventional tooling methods for commonly Machined Surfaces, Tooling ideas for Typical features on a job. Multi tooling setups, new tools and tooling methods
8. Study of the machined parts and initial data required for process design from the point of manufacture:

a. Planning the sequence of machining operations along with selection of machining operations along with selection of machine tools, cutting tools, jigs and fixtures, cutting variables as well as fixing in process dimensions and gauging.
b. Datum features/surfaces and their selection.
c. Stock preparations and blank selection with material estimate.
d. Time estimate and time standards.
e. Process sheet design for the complete manufacture of the machined parts

Metrology and Quality Control Lab

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

Course Outcomes:
Students will be able to

- Understand principle, construction and working of various measuring instruments,
- Selection of proper instruments for measurement
- Calculation of least count of instrument, take reading using the instrument
- Interpret the observations & results.
- Collection and recording of data and analysis of data

Syllabus Contents:

Term Work / Experiments: The term work shall consist of the record of the following experiments and assignments.
1. Determination of Linear/Angular dimensions of a part using Precision and Non-Precision measuring Instruments.
2. Precision angular measurement using a) Sine Bar, b) Auto Collimator, c) Angle Dekkor.
3. Machine Tool alignment tests on any machine tool like Lathe, Drilling Machine or Milling machine (minimum three tests)
4. Measurement of screw thread parameters using Floating Carriage Micrometer.
5. Measurement of Gear parameters: a) Gear Tooth thickness and depth, b) constant Chord, c) Span Measurement, d) Pitch Circle Diameter.
6. Surface Finish measurement using suitable instrument.
7. Interferometry: Measurement of surface flatness using optical flat.
8. Study and Measurement of parameters using Profile Projector.
9. Exercise on Design of Limit Gauges using Taylor's Principles.
10.Study and Measurement of parameters using Tool Makers Microscope.

Semester VI

Constitution of India

Teaching Scheme
Lectures :1 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:
Students will be able to

- Comprehend how India has come up with a constitution which is the combination of the positive aspects of other Constitutions.
- Interpret the Preamble and know the basics of governance of our nation.
- Identify the different aspects covered under the different important Articles.
- Apprehend the basic law, its interpretation, and the important amendments.
- Understand our Union and State Executive better.
- Recognize the basic that along with enjoying the rights one needs to fulfil one's duties.

Syllabus Contents:

Unit I **(2 hrs)**
Understanding the concept 'Rule of Law' Meaning and history of Constitution. Understanding the concept of Human Rights and Fundamental Rights.

Unit II **(3 hrs)**
Introduction to The Constitution of India, understanding its objects. Preamble to the constitution of India.

Unit III **(2 hrs)**
Fundamental rights under Part – III, exercise of the Rights, limitations, and important cases.

Unit IV **(2 hrs)**
Fundamental duties & their significance. Relevance of Directive principles of State Policy

Unit V **(2 hrs)**
Legislative, Executive & Judiciary (Union and State) Prerogative Writs.

Unit VI **(2 hrs)**
Constitutional Provisions for Scheduled Castes, Scheduled Tribes, & Backward classes. Constitutional Provisions for Women & Children

Unit VII **(2 hrs)**
Emergency Provisions. Electoral procedure in India, Amendment procedure and few important Constitutional Amendments

Text Books:

- Introduction to the Constitution of India by Durga Das Basu (Students Ed.) Prentice – Hall EEE, 19th/20th Ed.
- Engineering Ethics by Charles E. Haries, Michael. S. Pritchard and Michael J.

Robins Thompson Asia.

References Books:

- An Introduction to Constitution of India by M.V. Pylee, Vikas Publishing

Entrepreneurship Principles and Process

Teaching Scheme
Lectures :1 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

Students will be able to

- Discover, develop, and assess different types of Entrepreneurial ventures and opportunities.
- Learn about opportunity and risk analysis.
- Use the strategies for valuing your own company, and how venture capitalist and angel investors use valuations in negotiating milestones, influence, and control.
- Pick correct marketing mix and how to position the company in the market by using analytical tools.
- Learn how to sale themselves and the product/service and to handle objections.
- Know how organizations operates, their process matrices, start new ventures, write winning business plans.

Syllabus Contents:

Unit I **(2 hrs)**
Market Research: Introduction to Entrepreneurship, Profile of the Entrepreneur, Market Gap /Opportunity Analysis, Market Research Methods, Defining the Focal Market: Market Segmentation, Industry analysing– Research /Competitive Analysis.

Unit II **(2 hrs)**
Types of Companies and Organizations: Company/ Organization Types, Legal Aspects, Taxation, Government Liaison, Building the Team, Mergers and Acquisitions.

Unit III **(2 hrs)**
Business Finance: Shares and Stakes, Valuation, Finance Creation (Investors/Financers), Revenue Plans and Projections, Financial Ratios, Business Lifecycle, Break Even.

Unit IV **(2 hrs)**
Marketing & Digital Marketing: Marketing Basics, Marketing Strategy and Brand Positioning, Plans and Execution Techniques, Marketing Analytics, Online Marketing.

Unit V **(2 hrs)**
Sales: Understanding Sales, Pitching Techniques, Sales strategies, Inside Sales v/s Outside Sales, RFP.

Unit VI **(1hrs)**
Operations Management: Operational Basics, Process Analysis, Productivity, Quality.

Unit VII **(3hrs)**

Start-ups: Start-up Basics, Terms, Start-up Financing, Start-up Incubation, Start-up Incubation, Getting Listed.

Text Books:

- The Startup Playbook: Secrets of the Fastest-Growing Startups From Their Founding Entrepreneurs by David Kidder.
- Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration by Ed Catmull.
- True North by Bill George and Peter Sims.
- Bhargava, S.(2003).Transformational leadership: Value based management for Indian Organizations(Ed.). New Delhi: Response-Sage.
- Cardullo, M.W.P.E. (1999). Technological entrepreneurism: Enterprise formation, financing, and growyh. England: Research Studies Press Ltd.
- Hisrich, R.D. & Peters, M.P. (2001). Entrepreneurship: Starting, developing, and managing an ewenterprise (5thEd.). New York: McGraw-Hill.

References Books:

- Kanungo, R.N. (1998). Entrepreneurship and innovation: Models for development (Ed.,Vol.2). New Delhi: Sage.
- Mc Cleland, D.C. (1961). Achieving society. Princeton.
- Van Nostrand. Verma, J.C., & Singh G.(2002).Small business and industry: A hand book for entrepreneurs. New Delhi: Response-Sage.
- Richard A Brealy & Steward C Myres, Principles of Corporate Finance, McGraw-Hill's, 7thEdn,2004.
- Prasanna Chandra, Financial Management: Theory and Practice, Tata McGraw-Hill's, 6thEd, 2004.
- I.M. Pandey, Financial Management, Vikas Publishing.

Mini Project

Teaching Scheme
Practical: 4 hrs/week

Examination Scheme
100 marks: Continuous evaluation

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Learn theoretical concept applications to solve practical problems.
- Students will learn about concepts of feasibility study, economic worthwhileness, etc. with practical approach.

Guidelines for Mini Project:

The mini project will consist of design, simulation and prototype fabrication of any device which can attempt to address technological solution to the existing problems based on the societal and/or research needs, identified in consultation with faculty mentor/supervisor. Students are expected to carry out feasibility study on the concept finalized. The expected prototype must consist of design of the system using any one of CAD tools, simulation/analysis of predicted behavior / expected outcome and fabrication of functional prototype utilizing various prototype fabrication techniques, such as 3D printing, digital fabrication processes and conventional metal

fabrication. It is desirable that the prototype should consists of three systems, mechanical structure, embedded electronics (control system for motors, sensors etc. or as per application) and programming of control systems.

- Students shall form a group of 3 to 5 students, while forming a group shall not be allowed less than three or more than five students.
- Students should do survey and identify needs, which shall be converted into problem statement in consultation with faculty supervisor.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty may give inputs during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert best solution into functional prototype which includes design, simulation and prototype fabrication using 3D printing, digital fabrication processes and conventional metal fabrication.
- The solution to be validated with proper justification and report to be compiled in standard format decided by the department.
- The progress of Mini-Project to be evaluated on continuous basis, minimum two reviews in each semester. Final viva-voce examination based on project should carried out by external examiner along with faculty supervisor/guide.

Robotics and Intelligent Manufacturing

Teaching Scheme
Lectures: 2 hrs/week
Tutorial: 1 hrs/week

Examination Scheme
T1 and T2 – 20 marks each,
End-Sem Exam - 60

Course Outcomes:

Students will be able to

- Define basic terms, classify and analyze the robot structure & gripper designs.
- Select the drive system with feedback control and sensors.
- Apply the knowledge of kinematics for link transformation.
- Write a program for robotic application.
- Analyze the trajectory planning of joints of robot manipulator.
- Select the robots on the basis of application areas and perform economic analysis.

Syllabus Contents:

Unit I **(8 Hrs)**

Basic Concepts in Robotics: Automation and robotics, robot anatomy, basic structure of robots,

resolution, accuracy and repeatability. Classification and Structure of Robotics System: Point to point and continuous path systems. Control loops of robotic system, manipulators, wrist motions and grippers.
Robot End Effectors / Grippers: Grippers and tools, Types of end effectors-mechanical, magnetic and vacuum, gripper force analysis and gripper design considerations.

Unit II **(8 Hrs)**

Drives and Control Systems: Basic control systems, concepts and models, types of drive system-Hydraulic systems, pneumatic and electrical, DC servo motors, control system analysis, robot activation and feedback components, types of controllers- P, PI, PID controllers.
Sensors in Robotics.
Sensors, internal-external sensors, contact and non-contact sensors, position and velocity sensors, Touch and slip sensors, Force and torque sensors, tactile sensors, Proximity, and range sensors. Vision Systems: Vision equipment, line scan and area scan sensor, Charge Coupled Device, image processing, and analysis, preprocessing, segmentation, and feature recognition, smoothening of binary image.

Unit III **(8 Hrs)**

Robot Arm Kinematics and Dynamics: Homogenous coordinates and homogenous transformations, Forward and Inverse kinematics in robot, Denavit Hartenberg convention and its applications Lagrange-Euler formation, Robot dynamics control.

Unit IV **(6 Hrs)**

Interfacing: Interfacing robot with PC: Robot Programming: Methods of robot programming, lead through programming methods, a robot program for generating a path in space, motion interpolation, WAIT, SIGNAL and DELAY commands, branching capabilities and limitations of lead through methods. Robot Language: The textual robot languages, generations of robot programming languages, variables, motion commands, end effectors and sensor commands, computations and operations, Introduction to artificial intelligence.

Unit V **(6 Hrs)**

Trajectory Planning: Introduction, Joint Space Scheme, Cubic Polynomials with via points, Blending scheme.

Unit VI **(6 Hrs)**

Robot Applications in Manufacturing: Material transfer and machine loading/unloading, processing operations assembly and inspection. Concepts of safety in robotics, social factors in use of robots, economics of robots.
Introduction to Telechirs & Futuristic Topics in Robotics: Telechiric machines and its application - handling radioactive materials, work in space mining& under sea operations, Telechiric surgery, collaborative robotics, calibration.

Text Books:

- S. R. Deb.: Robotics Technology and Flexible Automation, Tata Mc Graw Hill Publishing Co. Ltd.
- P.A. Janakiraman, Robotics and Image Processing, Tata Mcgraw Hill, 1995

References Books:

- Yoren Koren: Robotics for Engineers, McGraw Hill Book Co., ISBN 0-07-035341-7.
- M. P. Grover, M. Weiss, R. N. Nagel, N. G. Odrey, : Industrial Robotics Technology, ISBN 0- 07-100442-4.
- K. S. Fu, C. G. S. Lee, R. C. Gonzaler, Robotics Control, Sensing, Vision and Intelligence,

Tata McGraw Hill. 2008, ISBN 13: 9780070226258Forging Handbook, ASM, Vol. 5, 9th edition.
- P.H. Joshi, Press Tools Design & Construction, S. Chand & Company Ltd. Delhi, 2nd Edition

Operations Research

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2 - 40 Marks, End Sem Exam- 60 marks

Course Outcomes:
Students will be able to
- Develop a general understanding of the Operational Research (OR) approach to decision making
- Develop network planning procedures for solving logistic and scheduling problems.
- Formulate inventory and queuing problems and generate optimal solutions.
- Identify best techniques to solve a specific problem.

Syllabus Contents:

Unit I **(6 hrs)**
Introduction: Operations Research: Development, history, definitions, objectives, characteristics, limitations, phases, and applications. Optimization models and their classifications.
Linear Programming: Formulation of LP problem, Simplex method (minimization / maximization cases). Degeneracy in LP, Duality in LP, Sensitivity analysis.

Unit II **(6 hrs)**
Transportation: Introduction. Methods for finding initial solution. Test of optimality Maximization Transportation problem. Tran-shipment problem. Degeneracy.
Assignment Problem: Introduction. Solution methods. Variations of the assignment problem. Traveling Salesman Problem.

Unit III **(7 hrs)**
Sequencing Models: Scheduling and sequencing. Assumptions in sequencing models. Processing "n" jobs on "m" machines. Graphical Method.
Scheduling: Multiple jobs single machine sequencing methods- FCFS, EDD, LFT, etc.
Inventory Control System (Quantitative Approach): Introduction. Meaning of Inventory Control. Functional classifications of Inventories. Advantages of Inventory Control. Deterministic Inventory Models: economic lot size with instantaneous replenishment with and without shortage costs, economic lot size models with quantity discount.

Unit IV **(7 hrs)**
Queuing Theory: Queuing Systems: Introduction, cost associated with, Classification of queuing models. Kendall's notations. Models: {(M/M/1): (α / FSFS)}. Single server models.
Simulation: Introduction to discrete event Simulation. Monte -Carlo Simulation. Problems related to Monte-Carlo Simulation.
Dynamic Programming: Distinguishing characteristics of D.P. Deterministic DP problems.

Unit V **(7 hrs)**

Replacement Models: Replacement of capital equipment that deteriorates with time, Replacement of items that fail without deteriorating.

Theory of Games: Introduction, two–person zero-sum game. Minimax and Maximin principle. Saddle point. Methods for solving game problems with mixed strategies. Introduction to graphical, and iterative methods for solving game problems.

Unit VI **(7hrs)**

Network Models: Introduction to PERT / CPM. Concepts and construction of network diagrams. Critical path and project duration, floats, network crashing, optimum project duration and cost, PERT activity, time estimate, probability of completion of a project on before specified time, resource allocation and load smoothening, minimal Spanning tree, shortest route and maximal Flow problems.

Text Books:

- Gupta P. K. and Hira D. S.: Operations Research, S Chand & Company Ltd.
- Sharma S. D., Kedar Nath: Operations Research, Ram Nath& Co.

References Books:

- Sharma J. K.: Mathematical Models in Operations Research, Tata McGraw – Hill Publishing Company Limited.
- Taha H. A.: Operations Research - An Introduction, Prentice Hall of India Pvt. Ltd.
- Wagner H. N.: Principles of Operations Research with applications to Managerial Decisions, Prentice Hall of India Pvt. Ltd.
- R. Panneerselvam: Operations Research, Prentice Hall of India Pvt. Ltd.
- Wiest J. D. & Levy F. K.: Managerial Guide to PERT/CPM, Prentice Hall of India Pvt. Ltd.
- Srinath L.S “PERT & CPM principles & Applications” Affiliate East West Press (P) Ltd., New Delhi, 1975.

Kinematics and Dynamics of Machines

Teaching Scheme	Examination Scheme
Lectures: 2hrs/week Tutorial: 1 hr/week	100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Analyse the load-carrying members to be safe under their particular expected loading patterns commonly encountered by machine parts.
- To select the type of follower motion for particular application.
- Analyse the stresses on the on different types of gear teeth considering various factors and design the gear pair to be safe under bending and pitting conditions.
- Select the appropriate type of bearing for a given application, considering static and dynamic loading conditions.
- Describe journal bearing system and complete the basic design of such bearings.
- Perform the design and analysis of at least five types of clutches and brakes to specify the required capacity to drive the given system reliably.

Syllabus Contents:

Unit I **(6 hrs)**

Cams and Follower: Introduction, Types of cam and Follower, Types and Analysis of motion, Uniform velocity, Simple harmonic motion, Uniform acceleration and retardation (Equal and unequal), and Cycloidal motion. Constructions of displacement, velocity and acceleration diagrams and cam profile for given follower motion.

Unit II **(6 hrs)**

Design for fluctuating loads: Types of loads Elementary equations for stresses, stress concentration causes and remedies, Fluctuating stresses, S-N Diagram, Endurance limit, Factors affecting Endurance Strength, Design for Finite and Infinite life under reverse stresses, Cumulative damage, Soderberg's and Goodman's Diagram, Modified Goodman's Diagram, Design under combined stresses. Design of components like shaft, bolted joints, springs etc. subjected to variable loading.

Unit III **(10 hrs)**

Spur Gears: Classification, Terminology, Law of Gearing, Velocity of sliding, Interference, Minimum number of teeth to avoid interference, Standard system of Gear tooth, Design of Spur Gears, Selection of Type of Gears, Force Analysis, Gear tooth Failures, Selection of Materials, Beam Strength, Wear Strength, Effective Load Calculation, Dynamic Load, Gear Design for Maximum Power Transmitting Capacity.

Helical Gears: Virtual Number of Teeth, Force Analysis, Beam Strength, Wear Strength, Effective Load, Helical Gear Design.

Unit IV **(7 hrs)**

Bevel Gears: Force Analysis, Design Calculations of Bevel Gears, Beam Strength, Wear Strength, Effective Load.

Worm Gears: Force Analysis, Friction in Worm Gears, Strength Rating of Worm Gears, Wear Rating of Worm Gears, Heat Dissipation.

Flywheel: Introduction, Design Parameters, Energy Storage Capacity of the Flywheel, Weight of the Flywheel, Engine Flywheels, Flywheels for Punches, Stresses in Flywheel Rims, Design of Rimed Flywheel, Stresses in Arms, Design of Arms, Construction of Flywheel.

Unit V **(6 hrs)**

Friction Clutches, Brakes and Dynamometer: Pivot collar friction, design consideration for plate, cone & centrifugal clutches. Design of various brakes, like band brake, shoe brake, band & block brake, Disc Brakes, thermal considerations.

Unit VI **(7 hrs)**

Rolling Contact Bearings: Selection of bearing from Manufacturer's Catalogue, Design for variable loads and Speeds, Bearings with Probability of Survival other than 90%.

Sliding Contact Bearings: Hydrostatic Step Bearing, Energy Losses in Hydrostatic Step Bearing, Reynold's Equation, Raimondi and Boyd Method, Bearing Design – Selection of Parameters, Sommerfeld Number, Constructional Details of Bearings, Temperature Rise.

Text Books:

- V.B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publishing Company Ltd., 2nd Edition, 2007.
- S. S. Rattan, "Theory of Machines", Tata McGraw Hill Publishing Company Ltd., 2nd Edition, 2007.

References:

- R.S. Khurmi J. K. Gupta, “Theory of Machines”ǁ, Eurasia Publishing House (Pvt.) Ltd, 2nd Edition .
- R.S. Khurmi J. K. Gupta, “A Text book of Machine Design”, S. Chand Publication, 25th Edition , 2020.
- Joseph E. Shigley, John J. Uicker, “Theory of Machines and Mechanisms”ǁ, Oxford University Press, 3rd Edition.
- Thomas Bevan, “Theory of Machines”ǁ, CBS Publishers and Distributors, 3rd Edition.
- Robert L. Norton, “Design of Machinery”ǁ, McGraw Hill Higher Education, 3rd Edition.
- Robert L. Mott, P.E, “Machine elements in mechanical design”, Pearson Prentice Hall Publication 4th Edition.
- M. F. Spotts, “Design of Machine Elements”ǁ, Dorling Kindersley (India) Pvt. Ltd., 8th Edition.
- S. S. Rao, “Mechanical Vibrations”ǁ, Dorling Kindersley (India) Pvt. Ltd., 4th Edition.

Manufacturing Automation

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-Assignments/Quiz/T1,T2 – 40,
ESE- 60 marks

Course Outcomes:

- To have an overview of manufacturing, manufacturing operations and automation technologies
- To study the definition and elements of Mechatronics and automation system
- To learn how to apply the principles of Mechatronics and automation for the development of productive and efficient manufacturing systems.
- To study the hydraulic and pneumatic systems employed in manufacturing industry.
- To study material handling technologies for their identification in automated material control purposes.
- To learn the integration of automation technologies and material handling technologies into manufacturing systems.

Syllabus Contents:

Unit I **(8 hrs)**

Overview of Manufacturing: Introduction to Production Systems, Automation in Production Systems, Overview of Manufacturing, Manufacturing Operations, Manufacturing Models and Metrics.

Automation, Mechatronics and Control Technologies: Introduction to Automation, Definition of Mechatronics, Mechatronics in Manufacturing, Industrial Control Systems, Hardware Components for Automation, Mechatronics and Process Control (Data Conversion Devices, Sensors, Microsensors, Transducers, Signal Processing Devices, Relays, Contactors and Timers), Data Acquisition, Actuators and Mechanisms.

Unit II **(8 hrs)**

Material Handling and Identification Technologies: Introduction to Material Handling, Principles of Material Handling, Material Transport Systems, Automated Guided Vehicle System (AGVS), Conventional and Automated Storage Systems, Engineering Analysis of Storage Systems, Automatic Identification and Data Capture.

Manufacturing Systems: Introduction to Manufacturing Systems, Single Station Manufacturing Cells, Manual Assembly Lines: Single Model and Mixed Assembly Line Balancing, Automated Production Lines, Mechanical Automation, Automated Assembly Systems, Performance and Economics of Assembly system.

Unit III **(6 hrs)**

Automation and Principle of Hydraulic and Pneumatic Circuit Design and Analysis: Hydraulic and Pneumatic Controls, Application in Machine Tools and other Mechanical Fields, Hydraulic and Pneumatic Circuit Design Considerations, Functional Diagram in Circuit Design, Pneumatic Circuit Analysis, Electrical Controls for Fluid Power Circuits, Fluid Logic Control Systems, Fluid Power Maintenance and Safety, Synthesis of circuits, circuit optimization techniques.

Unit IV **(6 hrs)**

Programmable Automation (Processor): Overview of Microcomputer systems, Microcontroller, 8051 Microcontroller Architecture, 8051 Instruction set and interfacing, applications and assembly language programming of microcontroller.

Unit V **(8 hrs)**

Control System and Controllers: Transfer function and block diagram, Block Diagram Reduction, Controller Principles, Process Characteristics, Control System Parameters, Controller Modes, Control Actions.

Discrete Control: Programmable Logic Controllers, Basic Structure, Ladder Logic Programming, Types and Selection of PLC.

Unit VI **(6 hrs)**

Mechatronic Systems: Control Architectures, Design Strategy and Case Studies Introduction, Control Architecture, Traditional and Mechatronics Designs, Possible Mechatronic Design Solutions, Case Studies of Mechatronic Systems.

Text Books:

- Mikell P. Groover, Automation, Production Systems, and Computer Integrated Manufacturing, Third Edition, Prentice-Hall of India Private Limited.
- W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education Limited
- S. R. Majumdar, Pneumatic Systems: Principles and Maintenance, Tata McGraw Hill

Reference Books:

- Geoffrey Boothroyd, “Assembly Automation and Product Design”, CRC, Taylor & Francis Publishers.
- N. P. Mahalik, Mechatronics: Principles, Concepts and Applications, Tata McGraw Hill.

- S. R. Majumdar, Oil Hydraulic Systems: Principles and Maintenance, Tata McGraw Hill.
- HMT Ltd. Mechatronics, Tata McGraw-Hill.
- Joji P. Pneumatic Controls, Wiley India.

Manufacturing Automation Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

Course Outcomes:

Student will be able to

- Have an overview of manufacturing, manufacturing operations and automation technologies.
- Study the definition and elements of mechatronics and automation system.
- Learn how to apply the principles of mechatronics and automation for the development of productive and efficient manufacturing systems.
- Study the hydraulic and pneumatic systems employed in manufacturing industry.
- Study material handling technologies for their identification in automated material control purposes.
- Learn the integration of automation technologies and material handling technologies into manufacturing systems.

Syllabus Contents:

The term work shall consist of record of any eight assignments on following topics:

- Study & Design of basic hydraulic and pneumatic circuits: such as Standard ON-OFF and Pneumatic Latch.
- Study & Design of Pneumatic or Hydraulic circuit for Two Push Button Control and Clamping of Work piece.
- Study & Design of Pneumatic or Hydraulic circuit for material handling.
- Study & Experiments in 8051 Microcontroller & its applications in Production Engineering.
- Study & experiments in Programmable Logic Controllers (PLC).
- Study of Displacement, Level, Pressure controls.
- Measurements & Design of circuit for Speed & Temperature measurements.
- Study & Design of Simple Hydraulic or Pneumatic and Electro-Hydraulic or Electro Pneumatic Automatic Control Circuit Problem.
- Study & Design of Electro-hydraulic or Electro-pneumatic Control Circuit Problem.
- Study of Maintenance and Troubleshooting of Fluid Power Systems.

Note: Oral shall be based on above assignments.

Department Elective - I

(DEC) Supply Chain and Logistics Management

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:
Students will be able to

- Understand, analyse the designing, planning and operational decisions of SCM.
- Identify, clarify managerial action to improve supply chain performance for the desired goals.
- Understanding of techniques used in the management of critical components of logistics and supply chains e.g., transportation, warehousing, inventory.
- Explain the likely future development of logistics and supply chain management.

Syllabus Contents:

Unit 1 **(6 hrs)**

Introduction to Supply chain management

Definition of Supply chain and supply chain management, Supply chain stages and decision phases, process view of a supply chain. Supply chain flows. Internal supply chains and External supply chains. Information systems and SCM, Inventory management across the SC. Drivers of supply chain performance. Competitive and supply chain strategies. Achieving strategic fit**.** Expanding strategic scope, Challenges facing SC managers

Unit 2 **(8 hrs)**

Supply Chain Network

Supply Chain Network (SCN) - Role, Factors, design options for distribution network. Models for Facility Location and Capacity Allocation and problem solving, Impact of uncertainty on SCN - Discounted Cash Flow Analysis.

Unit 3 **(8 hrs)**

Planning & Managing Inventories in a Supply Chain

Role of forecasting in the SC, Time series forecasting methods, Review of inventory concepts. Trade promotions, Managing Cycle Inventory, Cycle time overview, causes of long cycle times, Methods of reducing cycle time, Safety inventory determination.

Unit 4 **(8 hrs)**

Sourcing and Transportation in the supply chain

Role of Sourcing, Supplier - Scoring & Assessment, Selection & Contracts. Design Collaboration. Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network, Tailored transportation, Routing and scheduling in transportation. International transportation.

Unit 5 **(6 hrs)**

Coordination and Technology in the Supply Chain
Coordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. The role of IT in Supply Chain, The Supply Chain IT Framework, CRM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in Practice. Case discussions.

Unit 6 **(4 hrs)**
Performance measurement and Cases in SCM: Performance metrics in SCM, Balanced scorecard approach.

Textbooks:

- Sunil Chopra & Peter Meindl; Supply Chain Management -Strategy, Planning & Operation; 11 Edition - 2003. Pearson Education Inc.
- Douglas Lanibert & James Stock: Strategic Logistics Management: Irwin McGraw Hill.
- Robert B. Handfield, Ernest L. Nichols, Jr, Introduction to Supply chain management, Prentice Hall.

References Books:

- Robert B. Handfield, Ernest L. Nichols, Jr.; Supply Chain Redesign-Transforming Supply Chains into Integrated Value Systems 2002, Pearson Education Inc., ISBN:8129701138.
- Jeremy F. Shapiro, Duxbury; Modelling the Supply chain: 2002, Thomson Learning, ISBN: 0-534-37363-
- David Simchi Levi, Philip Kaniinsky& Edith Simchi Levi: Designing and Managing the Supply Chain: McGraw Hill.
- B.S. Sahay, Supply Chain Management: Mc. Millen.

(DEC) () Reliability and Maintenance

Teaching Scheme	Examination Scheme
Lectures : 3 hrs/week	100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:
Students will be able to

- Get acquainted with concept of reliability and maintainability.
- To analyze a system for reliability assessment and life cycle costing.
- To understand and get familiarized with condition monitoring in maintainability.
- To understand the importance and application of reliability.
- To use the concepts of reliability in designing and maintenance of products.
- To simulate techno economic life which is very important for industry application.

Syllabus Contents:

Unit I **(5 hrs)**

Reliability: Definition-methods of improving reliability, derivation of Reliability function, configurations of reliability, series parallel & mixed configuration, simple problems.

Unit II **(8 hrs)**

Reliability Calculations: Methods of improving reliability, redundancy element, unit stand-by redundancy, reliability models, constant hazard, simple problems, hazard models.

Unit III **(8 hrs)**

Maintenance Systems: Objective, of maintenance, maintainability and availability concepts, types of availability - mean time to failure-mean time between failures-mean time to repair-mean down time- Reliability allocation.

Unit IV **(8 hrs)**

Life Cycle Costing: Techno economic Life; Reliability effort function, simple cost models for Life cycle.

Unit V **(8 hrs)**

Maintenance Management: Principle types of maintenance breakdown, periodic, preventive and total productive maintenance, maintenance planning and control strategies, maintenance planning, maintenance policies, maintenance organization, maintenance standards-quality service standards-maintenance Strategy, influence of Terotechnology on maintenance management maintenance performance indices, maintenance system documentation. Failure Analysis: using causes & effects using Ishikawa diagram FMEA, FMECA.

Unit VI **(8 hrs)**

Condition Monitoring: Definitions, advantages, limitations, through ferrography and particle analyser, spectroscopic oil analysis programme (SOAP), contaminant analysis, vibration monitoring, use of monitoring, instruments and applications-magnetic chip detector. Role of computers in condition monitoring. Monitoring, systems- layers & monitors.

Text Books:

- L. S. Srinath Reliability Engineering, -Affiliated East -West press, 2002.
- S.K. Basu & B. Bhadury, Terotechnology: Reliability Eng. & maintenance Management, Asian book Private Ltd., Delhi, 1st Edition, 2003.

Reference Books:

- K. K. Ahuja, Industrial management and Organizational Behaviour, Khanna Publications. 1999.
- H. P. Garg, Industrial Maintenance, S. Chand & company. Ltd, Third Edition 1990.
- Dr. Shankar, Industrial engineering Management Golgotia Publications Pvt. Ltd. 1997.
- A.K. Gupta, Reliability Engineering & Terotechnology.

(DEC) Facility Planning and Design

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

Students will be able to

- Learn formulations, models, and analytical procedures for the study of facilities layout planning.
- Learn fundamental principles of material handling.
- Be able to design a factory layout incorporating product, process, and personnel requirement

Syllabus Contents:

Unit I **(6 hrs)**

Plant Location and Layout: Introduction to FPD, objective and scope, Factors influencing plant location, Theories of plantlocation and location economies, categories of plant and their characteristics, advantages, and limitations, different plant layout approaches like Immer, Nadler, Muther, etc.

Unit II **(8 hrs)**

Material Handling: Definition, principles, system design and selection of equipment, unit load concepts, basic material handling equipment in industries, material handling system design methodology, equipments mechanization level, automated guided vehicles.

Unit III **(6 hrs)**

Computer Aided Layout: CRAFT, COFAD, PLANET, CORELAP, ALDEP, Muther's Classification, line balancing for machinelayout, machine cell layout procedures.

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Unit IV **(8 hrs)**

Space Determination and Area Allocation: Factors for consideration in space planning, receiving, storage, production, shipping, otherauxiliary) service actions, establishing total space requirement, area allocation factor to be considered, expansion, flexibility, aisles column and area allocation procedure. Design of layout using Travel chart, plot plan, block plan, activity relationship score, TCR estimation.

Unit V **(8 hrs)**

Quantitative Approaches to Facilities Planning: Facility requirement involving deterministic models, single and multi-facility location models, Location allocation problems, Warehouse layout models, in process inventory requirement, delivery vehicle estimation, warehouse layout model involving numerical, assignment problem for personal deployment.

Unit VI **(8 hrs)**

Analytical Approaches in FPD: Facility requirement through waiting line models, simulation, repair limit model, spare parts inventory models, software manpower requirement model, optimum

inspection policy, corrective maintenance schedule, optimum overhaul frequency, evaluation and selection of facility planning models.

Text Books:

- Tompkins, J A and White, J. A. Facilities Planning, John Wiley & Sons.
- Francis, R.L. and White, J. A. Facility Layout and Location, John Wiley & Sons.

Reference Books:

- James M. Apple, Plant Layout and Material handling 2nd Edition., The Ronald Press Company John, Wiely and Sail .
- Muther Richard, Practical Plant Layout, McGraw hill.
- SundereshHeragu, Facilities Design, PWS Publishing Company, ISBN- 0-534- 95183.
- James M Moore, Plant Layout Design, MacMillon Co. 1962 LCCCN: 61 - 5204.

(DEC) Micro and Nano Manufacturing

Teaching Scheme

Lectures: 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

- The course will enable the students to know the basic concepts of and principles of Micro and nano systems.
- The course will impart fundamental knowledge of micro and nano fabrication processes to the students.
- To impart fundamentals of hybrid micro machining processes
- To learn about nano finishing processes and its applications
- This course will help students to know about working principles and applications of micro sensors/micro actuators.
- This course will help students to know the advance applications of micro-nano systems to various critical applications such as biomedical, microfluidics etcetc

Syllabus Contents:

Unit I **(6 hrs)**

Fundamental of micro and nano technology, Micro and Nanofabrication, concepts of micro and Nano-systems and Microsystems Products, Microsystems and Microelectronics, Application of Microsystems, Standardisation and Commercialization Issues of Micro-Nano Systems.

Unit II **(8 hrs)**

Micro machining – Ultra Sonic Micro Machining, Abrasive Water Jet Micro Machining – Tool based Micro-machining, Chemical and Electro Chemical Micro Machining – Electric Discharge Micro machining. Electron and Laser Beam Micro Machining, Hybrid Micro machining, Electro Chemical Discharge micro machining, Machining of Micro gear, micro nozzle, micro pins and its applications. Tool based micromachining (TBMM).

Unit III **(8 hrs)**

Nano machining and Finishing: Focused Ion Beam Machining –Plasma Beam Machining – electrochemical nanomachining, Abrasive Flow finishing –- Magnetic Float polishing – Elastic Emission Machining – Chemo-Mechanical Polishing, Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing.

Unit IV **(7 hrs)**

Concepts of micro forming and welding, Micro extrusion – Micro and Nano structured surface development by Nano plastic forming, Roller Imprinting, Electrochemical and Electro-discharge machining etc, Micro bending and micro welding with LASER, Electron beam for micro welding, Metrology for micro machined components.

Unit V **(6 hrs)**

Micro sensors, Micro actuation, MEMS with Micro actuators, Micro actuators with mechanical Inertia – Micro fluidics, micro/nano biosensors: Classification of physical sensors, Integrated, Intelligent or Smart sensors, Bio sensing Principles and sensing methods, Biosensors arrays and Implantable devices, Innovative Applications on Present Devices: Nano chips, Nanotubes and Nanowires, Integration of chips and microprocessors.

Unit VI **(7 hrs)**

Introduction to different Biomedical Applications of Microsystems: Delivery of Diagnostic and Therapeutic Agents to Vascular Targets, Real-Time Biological Imaging and Detection,
Diagnostic and Therapeutic Applications of Metal Nano shells, Micro devices for Oral Drug Delivery etc. Technology Support, Meeting Social Needs, future scope of micro-nano system.

Textbooks:

- Foundations of MEMS, Chang Liu 2006, Prentice Hall.
- Jain V.K., Introduction to Micro machining Narosa Publishing House, 2011.

Reference Books:

- Bhattacharyya B., “Electrochemical Micromachining for Nanofabrication, MEMS and Nanotechnology”, William Andrew publications (Imprint of Elsevier) 2015.
- Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN: 8122422578.
- Tai-Ran Hsu, “MEMS and MICROSYSTEMS”, John Wiley & Sons, New Jersey, 2008.
- Micro fabrication & Nano manufacturing by Mark J. Jackson.
- Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
- Nanotechnology and Nano electronics – WR Fahrner, Springer International Z. Cui, Nanofabrication, Springer, 2008.
- Stephen.D. Senturia, “Micro-systems design”, Springer, 2000.
- Nanotechnology and Nano electronics – WR Fahrner, Springer International Z. Cui, Nanofabrication, Springer, 2008.
- Janocha H., Actuators – Basics and applications, Springer publishers – 2012.
- Company Ltd., 2000, 3rd Edition.

(DEC) Advanced Joining Technology

Teaching Scheme

Lectures: 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

- Explain the working of various conventional & advanced Welding Processes.
- Understand advantages & limitations of welding processes and select the appropriate welding process based on application, customer requirement and specifications.
- Demonstrate an ability of inspection and testing of welded components and apply remedial measures to minimize defects in welding.

Syllabus Contents:

Unit I **(7 hrs)**

Gas and Arc welding processes: Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations, and applications.

Unit II **(7 hrs)**

Resistance Welding Processes: Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

UNIT III **(7 hrs)**

Solid State Welding Processes: Cold pressure welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications, Advances in adhesive bonding, Brazing and soldering, cladding.

UNIT IV **(9 hrs)**

Advanced Welding Processes: Thermit welding, atomic hydrogen welding, Electron beam welding, Laser Beam welding - principle, working and applications, Friction stir welding, Cold Metal Transfer - concepts, processes and applications, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles, Automated Welding, Remote Welding, Robotic Welding, Intelligent Systems for Welding Process Automation.

UNIT V **(6 hrs)**

Testing and Design of Weldments: Design and quality control of welds. Edge preparation types of joints, weld symbols. Stresses in butt and fillet welds - weld size calculations. Design for fatigue. Destructive and non-destructive testing of weldments. Weldability Testing - tensile, bend hardness. Impact, notch and fatigue tests. Visual examination - liquid penetration test, magnetic particle examination. Radio graphs, ultrasonic testing. Life assessment of weldments. IS codes.

UNIT VI **(6 hrs)**

Weld Metallurgy: Weld thermal cycles and their effects, concept of weldability and its assessment. Heat affected Zone and its characteristics Weldability of steels, cast iron, stainless steel, aluminium, Mg, Cu, Zirconium, and titanium alloys, Carbon Equivalent of Plain and alloy steels, Hydrogen embrittlement, Lamellar tearing, Residual stress, Distortion and its control. Heat transfer and solidification, Analysis of stresses in welded structures, pre and post welding heat treatments, weld joint design, welding defects.

Textbooks:

- Parmer R.S., "Welding Engineering and Technology", Khanna Publishers, New Delhi, 2008.
- Little R.L., "Welding and Welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.
- Kalpakjian S. "Manufacturing Engineering and Technology" Prentice Hall Pearson Education India; 4th edition, 2002.

Reference Books:

- Schwartz M.M. "Metals Joining Manual". McGraw Hill Books, 1979.
- Tylecote R.F. "The Solid Phase Welding of Metals". Edward Arnold Publishers Ltd. London, 1968.
- AWS- Welding Hand Book. 8th Edition. Vol- 2. "Welding Process"
- Nadkarni S.V. "Modern Arc Welding Technology", 1st edition, Oxford IBH Publishers, 2005.
- Christopher Davis. "Laser Welding- Practical Guide". Jaico Publishing House, 1994.
- Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 1993.
- Mishra. R.S and Mahoney. M.W, Friction Stir Welding and Processing, ASM,2007.

(DEC) Design of Experiments and Optimization

Teaching Scheme

Lectures: 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

- The course will enable the students to know the basic concepts of and principles of Design of experiments.
- The course will impart fundamental knowledge of Optimization techniques to the students.
- Understand importance of optimization of industrial process management.
- Apply basic concepts of mathematics to formulate an optimization problem.
- Analyse and appreciate variety of performance measures for various optimization problems.

Syllabus Contents:

Unit I **(11 hrs)**

Introduction: Need for Research, Need for Design of Experiments, Experimental Design Techniques, Applications of Experimental Design in Marketing, Production & Finance. Analysis of Variance: Introduction, Test of Hypothesis & Hypotheses Concerning Mean(s), Two Tailed Test Concerning Difference between Two Means when the Variances of the Populations are Known and are Unknown with Small Sample Sizes, Limitations of Testing of Hypothesis for Difference between the Means of Two Samples, Testing of Hypothesis Using F-Test, F-Distribution, Two Tailed F-Test

Concerning Equality of Two Population Variances.

Unit II **(8 hrs)**

ANOVA: Need for Analysis of Variance (ANOVA). Simple Designs of ANOVA: Introduction, Completely Randomized Design, Randomized Complete Block Design, Latin Square Design, Duncan's Multiple Range Test, Factorial Design of Experiment, Two-Factor Factorial DOE, Factorial DOE with Three Factors, 2^n Factorial DOE, Concept of 2^2& 2^3 Factorial DOE, Yates' Algorithm for 2^n, 3^n Factorial DOE, Concept of 3^2& 3^3 Factorial DOE, Experimental Designs with at least One Random Factor, Distinction between Random Factor and Fixed Factor, Expected Mean Square (EMS) Rule, Rules (Steps) for Formation of Expected Mean Squares.

Unit III **(9 hrs)**

Regression Approach: Introduction, Linear Regression, Simple Regression, Testing of Hypothesis on the Significance of Regression, Multiple Regression, Regression Model with Two Independent Variables Using Normal Equations, Matrix Method for Regression Model (Generalized Method). Response Surface Methodology: Introduction, Types of Design, Response Surface Design with Blocks, CCD, BBD, Mixture Experiments.

Orthogonal Arrays: Introduction, Design of Orthogonal Arrays, Column Effect Method, ANOVA for Orthogonal Array, Determination of Four-level Factor from Two-level Factors, Determination of Three-level Factor from Two-level Factors, Orthogonal Arrays with Three-level Factors Having Some Interactions, Estimation of Predicted Mean and Confidence Interval for Predicted Mean, Confirmation Experiments.

Unit IV **(4 hrs)**

Robust Parameter Design: Introduction, Signal-to-Noise Ratio, ANOVA for S/N Ratio, Steps of S/N Ratio Approach, Robust Parameter Design Using Response Surface Methodology. Grey Relational Analysis: Introduction, Steps of Grey Relational Analysis.

Unit V **(7 hrs)**

Nonlinear programming: Convex sets and convex functions, their properties, Convex programming problem, Generalized convexity, Pseudo and Quasi convex functions, Invex functions and their properties, KKT conditions.

Unit VI **(10 hrs)**

Search Techniques: Direct search and gradient methods, Unimodal functions, Fibonacci method, Golden Section method, Method of steepest descent, Newton-Raphson method, Conjugate gradient methods. Dynamic Programming: Deterministic and Probabilistic Dynamic Programming, Discrete and continuous dynamic programming, simple illustrations. Multi-objective Programming: Efficient solutions, Domination cones. Some famous MADM & MCDM Methods.

Advanced optimization techniques: Introduction to some evolutionary algorithm, GA, PSO, TLBO, ABC, JAYA, Simulated Annealing, case studies of optimization & decision making in manufacturing environment.

Text Books:

- Mokhtar S. Bazaaraa, Hanif D. Shirali and M.C.Shetty, Nonlinear Programming, Theory and Algorithms, John Wiley & Sons, New York (2004).
- Design and analysis of experiments by R. Pannerselvam (PHI Learning)

Reference Books:

- Engineering Optimization: Theory and Practice by S.S. Rao; New Age Publishers.

- D. G. Luenberger, Linear and Nonlinear Programming, Second Edition, Addison Wesley (2003).
- Mechanical Design Optimization Using Advanced Optimization Techniques (SpringerSeries in Advanced Manufacturing) Hardcover – 15 January 2012by R. Venkata Rao, V.J. Savsani.
- R. E. Steuer, Multi Criteria Optimization, Theory, Computation and Application, John Wiley and Sons, New York (1986).
- Decision Making in the Manufacturing Environment Using Graph Theory and Fuzzy Multiple Attribute Decision Making Methods, Vol. 1 & Vol. 2by R. Venkata Rao; Springer Pub.
- Jaya: An Advanced Optimization Algorithm and its Engineering Applications by Ravipudi Venkata Rao; Springer Pub.
- Teaching Learning Based Optimization Algorithm and Its Engineering Applications by Ravipudi Venkata Rao; Springer Pub.
- Design and Analysis of Experiments by Douglas C. Montgomery.
- Design of Experiments for 21st Century Engineers by Paul Allen.
- Design of Experiments for Engineers and Scientists (Elsevier Insights) by Jiju Antony.

Interdisciplinary Course II

Operations Research

Teaching Scheme
Lectures: 2 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2 - 40 Marks, End Sem Exam- 60 marks

Course Outcomes:
Students will be able to

- Develop a general understanding of the Operational Research (OR) approach to decision making
- Develop network planning procedures for solving logistic and scheduling problems.
- Formulate inventory and queuing problems and generate optimal solutions.
- Identify best techniques to solve a specific problem.

Syllabus Contents:

Unit I **(6 hrs)**

Introduction: Operations Research: Development, history, definitions, objectives, characteristics, limitations, phases, and applications. Optimization models and their classifications.

Linear Programming: Formulation of LP problem, Simplex method (minimization / maximization cases). Degeneracy in LP, Duality in LP, Sensitivity analysis.

Unit II **(6 hrs)**

Transportation: Introduction. Methods for finding initial solution. Test of optimality Maximization Transportation problem. Tran-shipment problem. Degeneracy.

Assignment Problem: Introduction. Solution methods. Variations of the assignment problem. Traveling Salesman Problem.

Unit III **(7 hrs)**

Sequencing Models: Scheduling and sequencing. Assumptions in sequencing models. Processing "n" jobs on "m" machines. Graphical Method.

Scheduling: Multiple jobs single machine sequencing methods- FCFS, EDD, LFT, etc.

Inventory Control System (Quantitative Approach): Introduction. Meaning of Inventory Control. Functional classifications of Inventories. Advantages of Inventory Control. Deterministic Inventory Models: economic lot size with instantaneous replenishment with and without shortage costs, economic lot size models with quantity discount.

Unit IV **(7 hrs)**

Queuing Theory: Queuing Systems: Introduction, cost associated with, Classification of queuing models. Kendall's notations. Models: {(M/M/1): (α / FSFS)}. Single server models.

Simulation: Introduction to discrete event Simulation. Monte -Carlo Simulation. Problems related to Monte-Carlo Simulation.

Dynamic Programming: Distinguishing characteristics of D.P. Deterministic DP problems.

Unit V **(7 hrs)**

Replacement Models: Replacement of capital equipment that deteriorates with time, Replacement of items that fail without deteriorating.

Theory of Games: Introduction, two–person zero-sum game. Minimax and Maximin principle. Saddle point. Methods for solving game problems with mixed strategies. Introduction to graphical, and iterative methods for solving game problems.

Unit VI **(7hrs)**

Network Models: Introduction to PERT / CPM. Concepts and construction of network diagrams. Critical path and project duration, floats, network crashing, optimum project duration and cost, PERT activity, time estimate, probability of completion of a project on before specified time, resource allocation and load smoothening, minimal Spanning tree, shortest route and maximal Flow problems.

Text Books:

- Gupta P. K. and Hira D. S.: Operations Research, S Chand & Company Ltd.
- Sharma S. D., Kedar Nath: Operations Research, Ram Nath& Co.

References Books:

- Sharma J. K.: Mathematical Models in Operations Research, Tata McGraw – Hill Publishing Company Limited.
- Taha H. A.: Operations Research - An Introduction, Prentice Hall of India Pvt. Ltd.
- Wagner H. N.: Principles of Operations Research with applications to Managerial Decisions, Prentice Hall of India Pvt. Ltd.
- R. Panneerselvam: Operations Research, Prentice Hall of India Pvt. Ltd.
- Wiest J. D. & Levy F. K.: Managerial Guide to PERT/CPM, Prentice Hall of India Pvt. Ltd.
- Srinath L.S "PERT & CPM principles & Applications" Affiliate East West Press (P) Ltd., New Delhi, 1975.

Enterprise Resourse planning

Teaching Scheme
Lectures: 2 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:
At the end of course students will be able to:

- Use the ERP modules
- Generate the reports and analyse it
- Carry out financial accounting and managerial accounting

Syllabus Contents:

Unit I **(8 hrs)**
Basic Concepts of ERP, Evolution of ERP system , Major features of ERP, Benefits of ERP, Seller-Buyer Concept of ERP System, Introduction to Modules of ERP system, different vendors of ERP.

Unit II **(8 hrs)**
Materials Management: Basic Features of MM module, SAP MM Organizational Structure, Master data in SAP MM Module: Material Master, Vendor Master, Purchase Info Record, Types of Business Processes in Procurement: Procure to Pay Process, Generation of reports and its analysis

Unit III **(8 hrs)**
Sales and Distribution: Basic features of SD module, Organizational structure of SD module, Master Data in SD Module: Material Master, Customer Master, Conditions Master, Types of Business Processes in Sales and Distribution: Order-to-Cash Process, Generation of reports and its analysis

Unit IV **(8 hrs)**
Production Planning: Types of Manufacturing in PP, Organizational Structure of PP Module, Master Data in PP Module : Material Master Data, Work Center, Bill of Material, Routing, Capacity Planning, Sales & Operation planning, Demand management, Material Resource Planning, Business Processes in PP Module: Production Processing Cycle, Generation of reports and its analysi

Unit V **(8 hrs)**
Financial Accounting and Management Accounting: Basic Accounting Terms :Account, Business Transaction, Capital Expenditure, Revenues Expenditure, Capital Receipt, Revenue Receipt, Deferred Capital, Expenditure, Income, Debtor, Creditor, Sales Assets, Fixed Assets, Current Assets, Long Term Liabilities, Current Liabilities etc. FI Organizational Structure, FI Master Data, FI Processes

Textbooks:

- Gopal Krishnan .P, Materials Management: An Integrated approach, Phi Learning

References Books:

- Simha R. Magal, Jeffrey Word, Integrated Business Processes with ERP Systems, Wiley
- Gopal Krishnan .P, Materials Mgmt: An Integrated approach, Phi Learning
- Glynn C.Williams, Implementing SAP ERP Sales and Distribution, Tata McGraw Hill
- R.Panneerselvam, Production and Operation Management, PHI Learning
- Barry Gerhart , Raymond Noe, John Hollenbeck,Patrick Wright, Human Resource
- Mnagement, Tata Mcgraw Hill
- Khan & Jain, Basic Financial Management, Tata McGraw Hil

(DEC) Supply Chain and Logistics Management

Teaching Scheme
Lectures: 2 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

Students will be able to

- Understand, analyse the designing, planning and operational decisions of SCM.
- Identify, clarify managerial action to improve supply chain performance for the desired goals.
- Understanding of techniques used in the management of critical components of logistics and supply chains e.g., transportation, warehousing, inventory.
- Explain the likely future development of logistics and supply chain management.

Syllabus Contents:

Unit 1 **(6 hrs)**

Introduction to Supply chain management

Definition of Supply chain and supply chain management, Supply chain stages and decision phases, process view of a supply chain. Supply chain flows. Internal supply chains and External supply chains. Information systems and SCM, Inventory management across the SC. Drivers of supply chain performance. Competitive and supply chain strategies. Achieving strategic fit**.** Expanding strategic scope, Challenges facing SC managers

Unit 2 **(8 hrs)**

Supply Chain Network

Supply Chain Network (SCN) - Role, Factors, design options for distribution network. Models for Facility Location and Capacity Allocation and problem solving, Impact of uncertainty on SCN - Discounted Cash Flow Analysis.

Unit 3 **(8 hrs)**

Planning & Managing Inventories in a Supply Chain

Role of forecasting in the SC, Time series forecasting methods, Review of inventory concepts.

Trade promotions, Managing Cycle Inventory, Cycle time overview, causes of long cycle times, Methods of reducing cycle time, Safety inventory determination.

Unit 4 **(8 hrs)**

Sourcing and Transportation in the supply chain

Role of Sourcing, Supplier - Scoring & Assessment, Selection & Contracts. Design Collaboration. Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network, Tailored transportation, Routing and scheduling in transportation. International transportation.

Unit 5 **(6 hrs)**

Coordination and Technology in the Supply Chain

Coordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. The role of IT in Supply Chain, The Supply Chain IT Framework, CRM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in Practice. Case discussions.

Unit 6 **(4 hrs)**

Performance measurement and Cases in SCM: Performance metrics in SCM, Balanced scorecard approach.

Textbooks:

- Sunil Chopra & Peter Meindl; Supply Chain Management -Strategy, Planning & Operation; 11 Edition - 2003. Pearson Education Inc.
- Douglas Lanibert & James Stock: Strategic Logistics Management: Irwin McGraw Hill.
- Robert B. Handfield, Ernest L. Nichols, Jr, Introduction to Supply chain management, Prentice Hall.

References Books:

- Robert B. Handfield, Ernest L. Nichols, Jr.; Supply Chain Redesign-Transforming Supply Chains into Integrated Value Systems 2002, Pearson Education Inc., ISBN:8129701138.
- Jeremy F. Shapiro, Duxbury; Modelling the Supply chain: 2002, Thomson Learning, ISBN: 0-534-37363-
- David Simchi Levi, Philip Kaniinsky& Edith Simchi Levi: Designing and Managing the Supply Chain: McGraw Hill.
- B.S. Sahay, Supply Chain Management: Mc. Millen.

Project Planning and Control

Teaching Scheme

Lectures: 2 hrs/week

Examination Scheme

100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Course Outcomes:

At the end of course students will be able to:

- apply fundamental and technical knowledge of project planning.
- demonstrate leadership and decision-making capabilities

- handle the project through project planning steps.
- analyse the projects through network techniques and handle financial aspects of project

Syllabus Contents:

Unit I **(8 hrs)**

Function of Project Planning –Inter dependency relationship, Generation and screening of project ideas, project rating index, characterization of the market, demand forecasting**,** market planning.

Unit II **(8 hrs)**

Financial Analysis: Estimation of cost of project and means of financing, estimates of sales and production, cost of production, working capital requirement and its financing, estimates of working results, breakeven points – projected cash flow statement, projected balance sheet.

Unit III **(8 hrs)**

Project cash flows: Basic principles of measurement of cash flows, components of the cash flow streams – viewing a project from different points of view, definition of cash flows by financial institutions and planning commission, Forms of project organization, project planning, project control, human aspects of project management, prerequisites for successful project implementation.

Unit IV **(8 hrs)**

Project review and administrative aspects: Initial review, performance evaluation, abandonment analysis, administrative aspects of capital budgeting, evaluating the capital budgeting system of an organization.

Unit V **(8 hrs)**

Network techniques: Network techniques for project management, development of project network, time estimation, determination of critical path, scheduling when resources are limited, PERT and CPM models

Textbooks:

- Prasanna Chandra Project Planning: Analysis, Selection, Implementation and Review, Mc Graw Hill Education, 7th Edition 2009

References Books:

- Narendra Singh, Project Management and Control, HPH, 2003
- John M. Nicholas and Herman Steyn, Project Management for Business and Technology: Principles and Practice, Prentice Hall India, 2012
- Clifford F. Gray & Eric W. Larson, Project Management: The Managerial Process, Tata Mc Graw Hill, 4th edition, 2010
- Chitkara K K, Construction Project Management, Planning, Scheduling and Control, Tata McGraw-Hill, 2nd Edition, 2010.
- Merdith Jack R & Gopalan M.R, Project Management, Wiley India (P) Ltd. 2006
- Harold Kerzner, Project Management A systems approach to Planning, Scheduling and Controlling, Wiley India, 10th Edition, 2009.